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RELIGIOSITY, CONSERVATISM, AND VALUE PREFERENCES AS PREDICTORS OF ATTITUDES TOWARDS SCIENCE

Abstract

Anti-science attitudes and movements have been attracting more, and more attention of researchers in the past years, especially during the pandemic. Anti-science attitudes can be defined as a dismissal of established, and empirically confirmed scientific facts for reasons that are not scientifically grounded. Previous research in social psychology has consecutively shown that this phenomenon can be predicted much better by ideological, and worldview variables than by education level. The aim of this research was to examine the role of religiosity, political orientation (conservatism), and individual value preferences in predicting four attitudes towards science, i.e.: climate change denialism, vaccination skepticism, anti-evolutionism, and general positive belief in science.

The study was carried out according to the quantitative research paradigm. Hierarchical regression analysis was applied to test the predictive power of each independent variable. For each dependent variable a 3-step regression analysis was carried out, with age as control variable added in step 1, religiosity, and conservatism added in step 2, and 12 values preferences in step 3. The highest correlation could be observed between religiosity, political conservatism, anti-evolutionism, and Tradition value preference. The strongest negative correlations appeared between Universalism, and Power preference, as well as between belief in science, and anti-evolutionism. Conservatism was a positive predictor of climate change denialism, and Universalism preference predicted it negatively. Vaccine skepticism regression analysis did not bring any significant results. Anti-evolutionism was influenced by religiosity, and conservatism, as well as a lower preference of Security, Conformity, and Universalism values. Belief in science was positively predicted by Security preference, and negatively predicted by religiosity, and Tradition preference.

Keywords: science skepticism, anti-science, value preferences, climate change denialism, vaccine hesitancy, anti-evolutionism

Streszczenie

Religijność, konserwatyzm i preferencje wartości jako predyktory postaw wobec nauki

Postawy i ruchy antynaukowe przyciągają coraz większą uwagę badaczy w ostatnich latach, zwłaszcza w czasie pandemii. Postawy antynaukowe można zdefiniować jako odrzucanie ustalonych i empirycznie potwierdzonych faktów naukowych z powodów, które nie są naukowo uzasadnione.

Wcześniejsze badania w psychologii społecznej wykazały systematycznie, że zjawisko to można znacznie lepiej przewidzieć na podstawie zmiennych ideologicznych i światopoglądowych niż na podstawie poziomu wykształcenia. Celem badań było przeanalizowanie roli religijności, orientacji politycznej (konserwatyzmu) oraz indywidualnych preferencji wartości jako predyktorów czterech różnych postaw wobec nauki, tj. denializmu zmian klimatycznych, sceptycyzmu wobec szczepień, antyewolucjonizmu i ogólnej pozytywnej wiary w naukę.
Badanie przeprowadzono w paradygmacie ilościowym. Zastosowano hierarchiczną analizę regresji do sprawdzenia mocy predykcyjnej każdej zmiennej niezależnej. Dla każdej zmiennej zależnej przeprowadzono trójstopniową analizę regresji, dodając wiek w kroku 1, religijność i konserwatyzm w kroku 2 oraz preferencje wartości w kroku 3. Najsilniej pozytywnie skorelowane ze sobą były religijność, konserwatyzm, antyewolucjonizm i preferencja Tradycji. Najsilniejsze negatywne korelacje zaobserwowano między preferencją Uniwersalizmu i Władzy oraz między wiarą w naukę a antyewolucjonizmem. Konserwatyzm był pozytywnym predyktorem zaprzeczania zmianom klimatycznym, a preferencja Uniwersalizmu jego negatywnym predyktorem. Analiza regresji sceptycyzmu wobec szczepionek nie wykazała znaczących wyników. Na antyewolucjonizm wpływ miały religijność i konserwatyzm, a także niższa preferencja Bezpieczeństwa, Konformizmu i Uniwersalizmu. Wiara w naukę była pozytywnie związana z preferencją Bezpieczeństwa oraz negatywnie z religijnością i preferencją Tradycji.

Słowa kluczowe: sceptycyzm wobec nauki, postawy antynaukowe, preferencje wartości, denializm zmian klimatycznych, sceptycyzm wobec szczepień, antyewolucjonizm.

Introduction

Scientific reasoning has been perhaps the greatest product of human mind, ever since Thales of Miletus made a claim that the Nile flooded for natural reasons, not because of the goddess Hapi. This claim symbolically gave birth to the scientific method which has been guiding science in its efforts to shape our lives, and come up with new ways of solving problems. But is it for the better?

Not everyone agrees that science's influence on our world is mostly positive. The accelerating pace of scientific development in the last decades seems to have polarized attitudes towards science. Some put faith in science, and believe it is the only way of attaining the truth [Farias et al., 2013]. Others mistrust, and reject scientific communication in particular domains, like immunology, genetical engineering, evolutionary biology, or climate science. Such skepticism towards science concerns especially those cases when scientific evidence is rejected a priori, and assumed to be false for reasons that are not scientifically grounded [Diethelm, McKee, 2009; Lewandowsky, Oberauer et al., 2013].

Most scientists would probably agree that it is an important thing to preserve civil rights, and liberties, including freedom of expressing negative attitudes towards science, and freedom of choosing one's own medical treatments. However, to fulfil the goal of improving human life, and preserve standards concerning health, safety or environmental stability, science must sometimes suggest radical policies, for example obligatory vaccinations of infants or prohibition of environmentally harmful products. If these suggestions meet with public resistance, such phenomenon should be thoroughly analysed.

Background

In order to understand the phenomenon of science skepticism, we need to investigate how skeptical attitudes are formed. Nowadays almost all individuals encounter misleading anti-scientific content, either in the form of a social media post, YouTube video, podcast, TV show or a radio interview [Erviti et al., 2020; Goertzel, 2010]. Some anti- and pseudoscientific claims, like the ones about 5G technology causing cancer, become viral. Even when repeated as a joke, they give anti-science a voice, and audience. However, not everyone who comes across this type of content develops a negative attitude towards science.

What are the factors influencing individual response to scientific, and anti--scientific communication? In the first place, it depends on the capacity to understand this communication. Researchers refer to it as scientific literacy, and it relates to knowledge, and education [Rutjens et al., 2017]. Researchers point out that comprehending scientific concepts, and explanations is rather counterintuitive for humans, and requires cognitive training [McCauley, 2011]. We were evolutionary programmed to detect agency, purposefulness, as well as to sort objects into essentialist categories. These features gave our species evolutionary advantage, but they might be an obstacle in acquiring scientific information.

Secondly, the formation of attitudes towards science relates to psychological response to scientific findings. What science discovers, and proclaims may be completely inconsistent with our worldview, beliefs about ourselves and the world, and thus perceived as threatening [Hayes, Tariq, 2000; Kahan et al., 2010; Rutjens et al., 2018]. Previous research has found that personal ideology plays a more important role in explaining negative attitudes towards science than demographic variables, including education [Rutjens et al., 2017; 2018]. In the section below, I will briefly present the crucial ideological antecedents of science skepticism.

Ideological predictors of science skepticism

Religion has been often presented as the main opponent of science, for example in stories about the Catholic Church actively fighting the theories of Galileo, Copernicus, and Darwin [Brooke, 1991]. The thesis about religion, and science being in an inevitable conflict is deeply rooted in the Western culture. Even though some scholars try to oppose it, and show a space for compatibilism [Elsdon-Baker, Lightman, 2020], religiosity appears in the social research as the main determinant of science skepticism. Previous studies have confirmed religiosity to be a predictor of vaccine skepticism, evolution skepticism, as well as general lack of trust in science [Farias et al., 2013; Losh, Nzekwe, 2011; Rutjens et al., 2017]. McPhetres and Zuckerman [2018] carried out a series of large studies on a US population and concluded that religiosity was associated with low scientific literacy and predicted negative attitude towards science.

Personal ideology can also be expressed through political views. They concern the way someone thinks society should be organized, including power relations, and resources allocation. Science often makes discoveries that challenge people's existing beliefs about the world, but also bring social changes. Therefore, those who are oriented towards maintaining the social status quo, might question scientific communication. In fact, it has been confirmed in previous studies that conservatism is a significant predictor of science skepticism, mostly in the form of climate change skepticism [Hornsey et al., 2016; Lewandowsky, Gignac et al., 2013; Lewandowsky, Oberauer et al., 2013; Lewandowsky, Oberauer, 2016].

Another concept useful for characterizing one's worldview are value preferences. Values are the most basic cognitive structures guiding our evaluation of what is wrong, and right, important, or unimportant [Schwartz, Bilsky, 1987]. They relate to beliefs about desirable situations, and goals in a broad sense, transcending specific situations. Values are also ordered by importance, which means that the more important a value is to a group or individual, the bigger will be its impact on attitudes, and behavior. Since late 80's social research on value preferences has been dominated by the theory of Shalom Schwartz, which places values on a circular continuum [Schwartz, 1992]. Values placed next to each other are positively correlated, and share a common motivational goal, whereas values placed opposite each other are antagonistic.

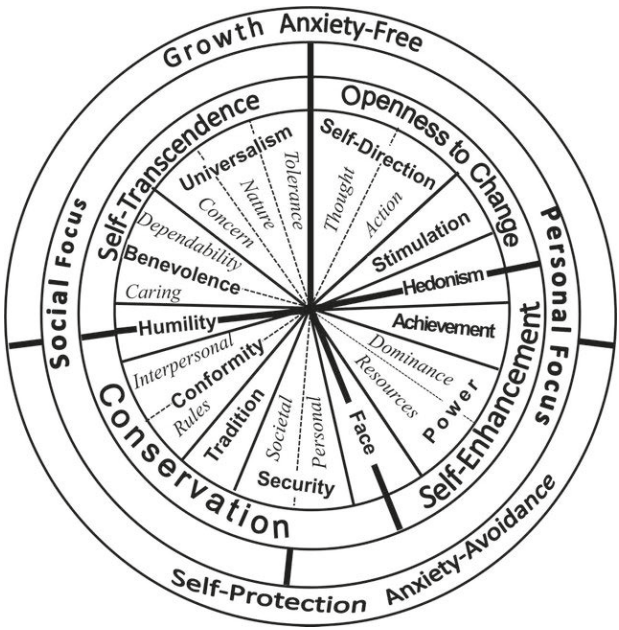

Figure 1. Circular motivational continuum of 19 values with metatypes, according to the refined version of the theory

Source: Schwartz et al., 2012.

To date, little research has been conducted on the relationship between values, and attitudes towards science. Maciuszek, and colleagues [Maciuszek et al., 2020] have compared participants with highly anti-scientific, and highly pro-scientific attitudes. The first group was more likely to prefer Tradition, Conformity, and Power, while the second group was oriented towards Self-direction, Benevolence, and Universalism. Verma, and colleagues investigated values preferences of participants who assessed credibility of different type of information shared on social media [Verma et al., 2017]. It turned out that susceptibility to fake news was positively correlated with Conformity, and Tradition preference, and negatively correlated with Universalism, and Benevolence preference. Meanwhile, high trust in information based on scientific journals was positively correlated with Stimulation, Self-direction, and Universalism preference, as well as negatively correlation with Tradition, and Achievement preference.

There is a considerable amount of literature on associations between religiosity, political orientation, and values. It has been observed by Schwartz, and Huismans [1995] that religiosity was generally positively correlated with promoting Tradition, Conformity, Security, and Benevolence, and negatively correlated with Hedonism, Stimulation, Self-direction, and Universalism. In terms of political values, Tradition, Security, and Conformity was also positively associated with traditional morality, blind patriotism, preference for law & order and acceptance of free enterprise [Schwartz et al., 2010]. Meanwhile, prioritizing Benevolence, Universalism, and Self-direction was connected with promoting equality, civil liberties, and acceptance of immigrants. In a study conducted by Caprara, and colleagues [Caprara et al., 2009], it was shown that participants who supported center-left parties were more likely to prioritize Universalism and those who supported center-right parties were more likely to promote Security.

Outline of the present study

To sum up, the main assumption underlying this study is that attitudes toward science are deeply rooted in personal ideology, and worldview. The present study aimed to examine the influence of individual religiosity, conservatism, and value preferences on attitudes towards science. Moreover, the study was meant to address two research gaps. Firstly, there has been no systematic analysis of the role of religiosity, and conservatism in shaping attitudes towards science in Poland. Secondly, value preferences have not been tested as predictors of science skepticism.

In terms of methodology, the study was largely modelled on the research of Bastiaan Rutjens and colleagues presented in the paper *Not all skepticism is equal. Exploring ideological antecedents of science acceptance and rejection* [Rutjens et al., 2017]. For the purpose of the present study I have adopted measures of religiosity, political orientation, climate change skepticism and vaccine

skepticism, as well as hierarchical stepwise regression as a method of analysing results.

Four different dependent variables were measured: climate change skepticism (dismissal or doubt of the existence of global warming and its anthropogenic nature), vaccination skepticism (dismissal or doubt of vaccination safety), evolution skepticism (complete or partial rejection of the theory of evolution in favour of other explanations for the origin of life on Earth), and belief in science (acceptance of science as the best way to attain the truth, and know the world). It was hypothesized that religiosity, conservatism, Conformity, Security, and Tradition would be generally positively associated with skepticism towards science.

Method

The data was collected in November 2020 on a Polish survey platform SW Research (www.swpanel.pl). The study was carried out online, like the majority of studies in social psychology carried out during the COVID-19 pandemic. Recruiting participants through a survey platform facilitated the collection of a large sample size during lockdown. Double attention-check was applied in the form of two items placed randomly in between questionnaires. After obtaining raw data from the research panel participants who failed to pass both attention checks were manually excluded from the sample. Afterwards 355 participants were left out of 711 who completed the questionnaire. Our sample was between 15, and 72 years old (M = 34.1, SD = 14.6).

Religiosity was measured with one item ("Do you consider yourself to be a religious person?", Likert-type scale from 0 to 7). I also included a two-item measure of conservatism asking about participants' view on social, and economic issues on a liberal-conservative scale (ranged 0 to 7). Higher results indicated higher religiosity, and conservatism levels. Both measures were adopted from the work of Rutjens and colleagues [Rutjens et al., 2017]. It has been largely discussed in social sciences, whether single-item measures are valid and reliable in psychology. It has been, however, suggested several decades ago that when measuring religiosity a single item can be as valid as multiple-item scale in large samples [Gorsuch, McFarland, 1972; Gorsuch, McPherson, 1989].

Then, I included a polish translation of the Belief in Science Scale [Farias et al., 2013]. Ten items were measured on a Likert-type scale from 1 to 5, Cronbach's alpha α = .87. Factor analysis was set to calculate loadings for one factor, which turned out to explain 47% of the variance.

Skepticism towards climate change, and vaccination was measured using 2 five-item scales from Rutjens et al. paper [Rutjens et al., 2017], with answers on a six-point Likert-type scale. Since the authors had not provided any information regarding factor analysis of the scales, I decided to run an exploratory factor analysis without pre-set number of factors. Therefore, the climate change skepticism turned

out to be represented by 2 factors. One of them, represented by only 1 item was excluded from further analysis. The other 4 items (α = .69) explained 54% of the variance. Vaccination skepticism scale factor analysis emerged one factor (α = .82), explaining 60% of the variance.

Next, participants completed a measure of evolution skepticism which consisted of 5 items (Likert-type scale from 1 to 5) chosen from Losh, and Nzekwe paper [Losh, Nzekwe, 2011]. Factor analysis resulted in two factors. As previously, I excluded the single-item factor from further analysis. The remaining factor explained 62% of the variance (α = .78).

Finally, the revised Personal Value Questionnaire (PVQ-R) was included to measure 19 value types preferences. I used Polish translation of the 57 items, which has been widely tested in terms of reliability, and validity [Cieciuch, 2013b, 2013a; Schwartz et al., 2012]. Since all values could be evaluated positively, the score for each value type had to be centered (the average score of all items was deducted from the particular value type score). Following the suggestion of Schwartz that researchers should arbitrarily divide the circle of values [Schwartz, 1992; 2012], I decided to merge subtypes of certain value types into broader types: Power--dominance, and Power-resources were connected into Power, and accordingly for Self-direction, Security, Conformity, Benevolence, and Universalism. Therefore, 12 value types were used for analysis.

Results

In order to present correlations between the variables in a readable way, I included a multidimensional scaling analysis (MDS). The diagram, created in SPSS with PROXSCAL method, is constructed in such way that a distance between any two points on the matrix represents their correlation in a direct proportion. In terms of value types, their placement on the MDS plot almost exactly mirrored theoretical assumptions. Tradition, religiosity, conservatism, and evolutionary skepticism were located very closely on the matrix. Vaccine skepticism was situated more at the centre which indicates it was not strongly correlated with any group of variables. Belief in science was situated opposite anti-science attitudes, close to Self-direction.

Hierarchical regression analyses of 4 dependent variables were performed. Controlling for age in step 1, religiosity, and conservatism were added in step 2, and value types in step 3. According to Schwartz [Schwartz, 2009], all value types cannot be simultaneously added in regression as predictors due to multicolinnearity issue. In the manual he advises to include up to 8 centered values as predictors. Therefore, a correlation matrix was used to exclude from each regression analysis 2 value types showing weakest correlation with a given dependent variable.

Climate change skepticism regression results in Table 1 reveal that political conservatism was a significant predictor of climate change skepticism in

step 2. Its predictive value, however, was reduced after adding value types in step 3, where Universalism was a negative, and the only significant predictor, Beta = –.28, $p < .01$. The final model explained 10% of the variance, $F(13, 334) = 3.96$, $p < .001$.

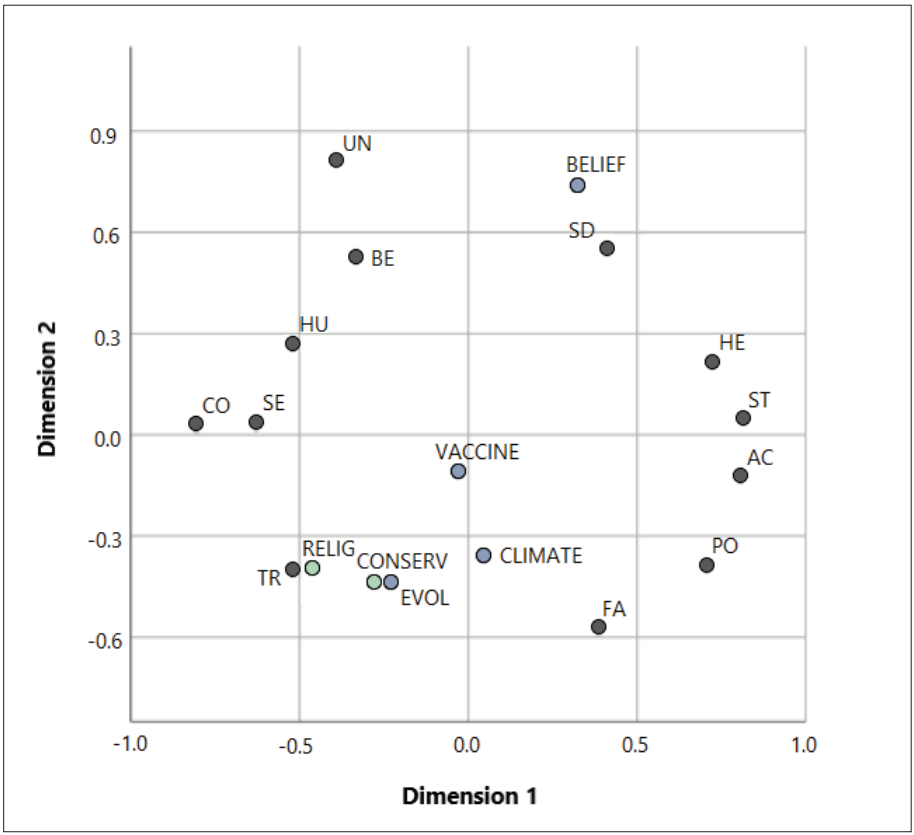

Figure 2. Multidimensional scaling plot
UN = Universalism, SD = Self-direction, HE = Hedonism, ST = Stimulation, AC = Achievement, PO = Power, FA = Face, TR = Tradition, SE = Security, CO = Conformity, HU = Humility, BE = Benevolence, BELIEF = belief in science, VACCINE = vaccination skepticism, CLIMATE = climate change skepticism, EVOL = evolution skepticism, CONSERV = conservatism, RELIG = religiosity

Source: own study.

Table 1. Regression analysis of climate change skepticism

Predictors	Step 1	Step 2	Step 3
1. Age	–.04	–.04	–.03
2. Religiosity		.01	.01
Conservatism		.18**	.09
3. Security			–.02
Power			.10
Self-direction			–.01
Universalism			–.28**
Tradition			.02
Humility			.11
Stimulation			–.10
Hedonism			.04
Achievements			–.10
Face			–.06
Adj. R^2	–.00	.03	.10

**$p < .01$. Excluded: Conformity, Benevolence
Source: own study.

Vaccine skepticism was best predicted by religiosity in step 2. Adding values in step 3 increased the explained variance only to 4%, $F(13, 334) = 2.02$, $p < .05$, and reduced the predictive power of religiosity. No predictors were significant in the final model.

Table 2. Regression analysis of vaccine skepticism

Predictors	Step 1	Step 2	Step 3
1. Age	.00	–.02	–.03
2. Religiosity		.15*	.12
Conservatism		–.02	–.08
3. Security			.08
Power			.09
Self-direction			.06
Universalism			–.09
Tradition			.12
Humility			.03
Stimulation			–.12
Hedonism			.12
Achievements			–.01
Face			–.05
Adj. R^2	.00	.01	.04

*$p < .05$. Excluded: Conformity, Benevolence
Source: own study.

Evolution skepticism was predicted by age, but this effect disappeared when controlling for two ideological variables entered next, both of which significant. Adding value types in step 3 rendered conservatism no longer significant, and revealed three value types significantly predicting the dependent variable: Security (Beta = –.13, $p < .05$), Conformity (Beta = –.15, $p < .05$), and Universalism (Beta = –.17, $p < .05$), $F(13, 334) = 8.85$, $p < .001$.

Table 3. Regression analysis of evolution skepticism

Predictors	Step 1	Step 2	Step 3
1. Age	.15**	.10	.10
2. Religiosity		.34**	.30**
Conservatism		.16**	.10
3. Security			–.13*
Self-direction			–.06
Conformity			–.15*
Universalism			–.17*
Tradition			.09
Humility			.03
Stimulation			–.10
Hedonism			–.04
Achievements			–.11
Face			–.09
Adj. R^2	.02	.20	.23

*$p < .05$, **$p < .01$. Excluded: Power, Benevolence
Source: own study.

Finally, hierarchical regression analysis of belief in science was performed. The proportion of explained variance between ideological variables, and value preferences was like that of evolution skepticism. Adding religiosity, and conservatism to the model increased the explained variance by 16%, while adding value types increased it only by 4%. Age, and religiosity were significantly predicting belief in science even after adding value types in step 3. In the final model, apart from age (Beta = .11, $p < .05$), and religiosity (Beta = –.31, $p < .01$), there were two value types significantly predicting belief in science: Security (Beta = –.22, $p < .01$), and Tradition (Beta = –.19, $p < .01$).

Table 4. Regression analysis of belief in science

Predictors	Step 1	Step 2	Step 3
1. Age	.08	.14**	.11*
2. Religiosity		–.38**	–.31**
Conservatism		–.05	–.02
3. Security			.22**
Self-direction			–.01
Benevolence			–.03
Universalism			–.02
Tradition			–.19**
Humility			–.04
Stimulation			.09
Hedonism			–.05
Achievements			.02
Face			–.07
Adj. R^2	.00	.16	.20

*$p < .05$, **$p < .01$. Excluded: Power, Conformity

Source: own study.

Discussion

The predictive power of Universalism on climate change skepticism was higher than that of political conservatism. It is interesting, given that conservatism has been established as a main antecedent of climate change skepticism in many studies [Hornsey et al., 2016]. A possible explanation for this might be that Universalism includes values directly expressing the need to preserve the natural environment, and protect it from pollution. Such attitude is connected with a concern about climate change. The relatively small predictive power of political orientation might be

willingness to preserve natural environment. Apparently, it was also an important indicator of participants' attitude towards climate change, and theory of evolution.

To sum up, we can conclude that science rejection was rooted in participants religiosity, conservatism, and Tradition preference. On the other hand, science acceptance was rooted in Security, Conformity, and Universalism preference. However, this tendency cannot be applied to vaccine skepticism, which did not render any significant predictors in this study.

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attributed to the way it was measured. Perhaps the liberal-conservative axis is not applicable to Polish society, and a different measure must be applied in future studies.

Vaccine skepticism was not significantly related to any ideological variable or value type in the final model. It was predicted by religiosity, but the effect disappeared after adding values. The overall explained variance in the final model was only 4%, suggesting that a different approach to measure, and test vaccination skepticism must be taken.

Skepticism about the theory of evolution was rooted in participants' religiosity, and in their lower preference of Security, Conformity, and Universalism. Therefore, participants who were skeptical about evolution were less concerned about safety, equality, and justice for all people, care for the environment, as well as obeying the rules and obligations. It is surprising that Security, and Conformity are negative predictors of anti-evolutionism, because they correlate positively with religiosity and negatively with Universalism. However, it is worth noting that adding values to the model increased the explained variance by only 3%, while adding religiosity, and conservatism increased it by 18%. We can therefore conclude that religiosity was a major antecedent of anti-evolutionism in this study.

Belief in science was expressed mostly by older, nonreligious, nontraditional participants who valued safety, and security. According to the theory, Tradition, and Security value types are situated next to each other on the circumplex, and they both emphasize maintaining the current state of one's environment, harmony in relationships, and predictability of the world. It is therefore surprising that they appeared in the model with opposite signs. It may be that our participants see science as a guarantor of maintaining a safe, and predictable environment, but this is completely unrelated to commitment to tradition.

Conclusions

The present study aimed to capture relations between ideological variables, value preferences, and anti-science attitudes. The results confirmed that some values play a role in predicting skepticism towards science, although the relations between studied variables might be more complex than what regression analysis can capture.

Science skepticism was predicted to be generally associated with religiosity, conservatism, and a preference for values from the Conservation metatype. This hypothesis was only partially confirmed. Religiosity, and conservatism were generally associated with skepticism, and lack of faith in science, but the influence of values was more complex. Security preference was found to be, contrary to what was expected, associated with a positive attitude toward science, and evolutionary theory. Similarly, the preference for Conformity appeared to have a positive influence on evolution acceptance. Only Tradition was negatively connected with belief in science, as expected.

Universalism was also found to be positively associated with science acceptance in two analyses. This value type represents equality, tolerance, and most importantly,

willingness to preserve natural environment. Apparently, it was also an important indicator of participants' attitude towards climate change, and theory of evolution.

To sum up, we can conclude that science rejection was rooted in participants religiosity, conservatism, and Tradition preference. On the other hand, science acceptance was rooted in Security, Conformity, and Universalism preference. However, this tendency cannot be applied to vaccine skepticism, which did not render any significant predictors in this study.

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