Examining disparities in public support for, knowledge about, and trust in science

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Declarations

No part of this thesis has been submitted for another degree.

All the work is original, and it is my own (as described below).

Chapter 2 is co-authored with Prof. Nick Allum and is currently under review for publication in *Public Understanding of Science*. Prof. Nick Allum contributed to the research design and discussion section.

Chapter 3 is exclusively my work and will be submitted to the *Environmental Politics*.

Chapter 4 is co-authored with Prof. Nick Allum and Dr. Burak Sonmez and will be submitted to the *Proceedings of the US National Academy of Science (PNAS)*. Dr. Burak Sonmez contributed to the research design, data analysis, and methodology section. Prof. Nick Allum contributed to the discussion section and carried out overall supervision.

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Summary

The thesis consists of three empirical articles, with each paper focusing on the specific domain of public understanding of science research field, namely racial disparities in civic scientific literacy, public support for the pro-environmental governmental policies, and public perception of scientists' trustworthiness.

Chapter 2 employs the General Social Survey data to study the role of racial social identity and racial ingroup evaluation in shaping the science literacy gap between whites and African Americans. In **Chapter 3**, the European Social Survey Round 8 data is used to explore the relationship between public support for the welfare state and the environmental state. Finally, **Chapter 4** utilizes the experimental data collected via Prolific to answer the question as to what are the attributes of scientists that make them preferable and more trustworthy in the public eyes.

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1. General introduction

1.1 Thesis background

I remember that time during my undergraduate degree when I first got introduced to the research field of science and technology studies. The idea of social researchers turning their heads to academia and scrutinizing how scientific knowledge is constructed via negotiations in the laboratories and universities – as Latour did in his famous book 'Science in Action: How to Follow Scientists and Engineers Through Society' (1987) – immediately caught my attention and took a top position in my subjective list of the most interesting and attractive topics that the social science can offer to a young scholar.

However, as time went by, what sparked my curiosity even more was the way how academia and scientific research is perceived by the public. Do people see scientists as some sort of intellectually advanced distant demigods who bring pure beneficence to the society, or are they considered more as down-to-earth humans that are prone to the same kind of biases and errors as anyone else and that the society should keep a watchful eye on? What does this depend on? Why some people tend to be immersed into the scientific agenda following the latest news and having an active stance in discussing science issues, while others say that these matters are too complicated for them to deal with and that there is only a hardly perceptible effect that science negotiations have on their day-to-day life?

These questions puzzled me a lot and I started delving more and more into the relevant literature to see how the idea of studying public attitudes to science emerged and reinforced itself, what is the current state-of-the-art research, and what can be done further. Perhaps as it is with all research fields and all disciplines, I soon discovered that the agenda of studies on public understanding of science has come a long way too, and the premises and intentions behind the very first nationally representative survey of public attitudes, beliefs, and knowledge about science conducted by Stephen Withey in the late 50s (1959) were grounded in a research paradigm that would seem rather shallow and even naïve today.

Looking back at the history of public understanding of science, Bauer (2009) identifies three landmark discourses - or paradigms, as he calls them – that dominated the field in their respective time, each having its own core concepts, study rationales, and research field boundaries.

The first period that lasted for roughly 25 years from the 60s to mid-80s went down in history as an era of research on civic science literacy (Shen 1975; Miller 1983). During that time, scientific literacy, broadly defined as 'the ability of the individual to read about, comprehend, and express an opinion on scientific matters' (Miller 1983: 30) has become a matter of increased interest and concern both for scientists and policy-makers. The reason for this lies in the growing awareness that science, however distant it might have seemed from the public at that point, did not constitute an autonomous impenetrable entity that could be guided and regulated exclusively by its own rules without any reference to the general public. Just the opposite, there was growing evidence that scientists and policy-makers can face a collective response from the public on a variety of societally significant matters - nuclear energy, vaccinations, climate change just to name a few – and that this response oftentimes might be driven by the lack of understanding of the science behind the disputed matter.

Thus, the public understanding of science research of that time got its motivation from the idea that, if the public has to be listened to, then it would be better to ensure that the public voice is based on a decent level of understanding of science, rather than on all kinds of easily spreading misconceptions, misinformation, and conspiracy theories. For that, the level of public knowledge of science should be carefully measured in the first place, and, if being low, the public should then be educated to express its views and concerns more informatively.

The implicit assumption that educating the public can make it more supportive for various scientific endeavors has become a matter of explicit scrutiny as the research on public and science progressed from the stage of 'science literacy' to 'public understanding' in the mid-80s. Confirming the 'the more you know, the more you love it' (Bauer 2009: 224) idea has now become a cherished goal for researchers in public understanding of science, which, in its turn, reflected the ongoing inability of scientists and policy-makers to abandon the public deficit model of science communication.

Two decades of search for the relationship between textbook science knowledge and attitude to science were neatly summarized in a meta-analysis by Allum and colleagues (2008), and the conclusion was unequivocal: if the relationship between those two concepts exists at all, it is rather weak, and science knowledge surely cannot account for a large fraction of variation in science attitudes. Hence, the rationalist agenda of public understanding of science has not found its confirmation – for good or for bad, the questions of how the public perceives science and why trust in science is constantly decreasing appeared to be by far more complex and multidimensional than it was originally pictured.

This finding has had a dramatic effect on science communication, prompting scientists and policymakers to rethink the way they communicate with the public. The juxtaposition of science and society was no more a valid option as it could only lead to the gradual decline of the authority of science and enhance its incapability of effectively implementing much needed scientific interventions – the repercussion of this confidence crisis could be witnessed up to this day (Kabat 2017).

In this vein, science communication started its drift from the 'science vs. society' agenda towards the 'science-in-society' (Bauer 2009: 222) one, that advocated for establishing a more equitable dialogue between science and the public and taking away from scientists and policymakers their previously indisputable right to make technocratic decisions and impose science policy without external control and accountability. The key questions of this period of research revolve around the topics of public engagement in science policy-shaping (Stilgoe et al. 2014), collaborative research, and the ways to restore public trust by democratising scientific research and making its principles and practices more transparent to the wider audience (Haerlin and Parr 1999).

Before coming to the PUS field, the acknowledgment of the multiplicity of expertise and various 'epistemic cultures' (Cetina 1999) that scientists and lay citizens produce has first become a matter of close scrutiny in the related field of science and technology studies. Unlike PUS research field that mostly adheres to quantitative methodology and seeks for describing the relationship between the concepts using large-scale survey data, or establishing causal effects in the experimental setting, science and technologies studies mostly adopt the qualitative research methodology. This allows for more in-depth understanding of the subtleties of scientific knowledge construction process, and it is very common for STS researchers to come to the laboratories or other academic institutions, blend in with the personnel and observe the social dynamic on a micro level.

Undergoing the evolutionary path from studying science ethos (Merton 1942) to assigning agency to inanimate objects (Callon 1986, Latour 1987), the latest developments in this STS field known under the name of actor-network theory (Latour 1996) indeed revolutionized the way the construction of scientific knowledge is theorized. According to this theory, scientists, very much like politicians, form alliances with other actors to facilitate the development and spread of new technologies, either one thinks of vaccines (Latour 1999) or electric cars (Callon 1987). From this perspective, restoring public trust in science can be considered as a primary goal for science policymakers if they wish not to face an ardent resistance – however reasonable and knowledgeable it might ne - when new technologies are about to enter the market.

While the history of research on public understanding of science might seem as a linear trajectory from research on science literacy to research on public engagement in science, it would not be entirely correct to say so. The overall agenda and the way how research questions are being posed indeed changes, yet the arsenal of concepts that underpin the research accumulates and recycles everything that has been of use in the past. Over the almost 60 years of research on public understanding of sciences, some questions have received quite enough attention and can be considered well scrutinized i.e. the relationship between science literacy and attitudes to science (Allum et al. 2008) or trust in science and scientists (Krause et al. 2019), while others are still in the making i.e. public attitude to artificial intelligence and robots (Zhang and Dafoe 2020).

Hence, please consider this thesis as a humble attempt to advance the knowledge about the public perception of science and scientists in the facets that I felt I was able to contribute to most fruitfully over these four vivid years of my PhD degree. Even though the thesis consists of three self-contained articles tapping into various domains within the public understanding of science research field, yet I would argue that there is a general thread that stitches together all the papers. The bonding thread becomes clear when we think about the questions that inevitably arise in mind when pondering whether the public should be (and how) included in the dialogue on science policy shaping.

When debating the extent to which lay citizens should be granted a voice in this regard, what might matter first at a surface level is the knowledgeability of people in the context of a discussed issue. While the prevailing notion is that engaging citizens into science policy discussion, overall brings more societal benefits than harm (e.g. Stilgoe et al. 2014), and this is a wholesome thing to do in terms of promoting accountability and transparency of science (Fuller 2011), researchers still argue who are those most proactive citizens that are willing to participate in negotiations (Powerll et al. 2011) and whether their level of knowledgeability and overall awareness is high enough to contribute to the discussion productively. This is where the concept of science literacy kicks in. Being unequally distributed among the population (Allum et al. 2018), some people report lower levels of science literacy than others depending on their sociodemographic profile. Thus, **Chapter 2** of this thesis builds upon this fact and joins the discussion about socioeconomic disparities in science literacy approaching it from the perspective of racial inequality.

As a disclaimer, while some researchers question the validity of the civic scientific literacy scale and argue that the items tapping into the acquaintance with the basic scientific facts should be substituted with the items measuring the knowledge of how the scientific institution actually works (Bauer et al. 2000), there is still a dominant tendency in recent polls and surveys to use the knowledge scales that are primarily based on the items delving into the basic knowledge of well-established scientific facts (Funk and Goo 2015; NSF 2018), and I adopt this approach too.

The second thought to consider when thinking about laypeople interacting with science policy is public trust in science. As broad as the question of public trust in the scientific community might sound to a general reader, it boils down to a simple branching: it is either people believe that the scientists being left unaccounted for are doing their job in such a way that increases the societal good and brings no or least possible harm, or – much within a flow of Beck's 'risk society' idea (Beck 992) – people tend to believe that terrible things might happen if scientists are left unattended. The body of polls and surveys on public trust in science is voluminous (e.g. Krause et al. 2019), yet not all the facets of this topic have received equal attention. What is left somewhat understudied – and what became the research topic in **Chapter 4** of this thesis – is what sociodemographic and work-related attributes of scientists matter in terms of their perceived trustworthiness and preferability by the public, net of the scientific message that is conveyed.

Chapter 3 of the dissertation is devoted to the very topic of public support for science policy. The world we live in has reached such an ultimate level of complexity that the challenges we face as humanity and the potentially detrimental consequences they might bring about in the future require us to act immediately. Perhaps the most serious challenge that must be dealt with is global climate change and its environmental, economic, and societal aftermath. There is a well-developed body of literature on factors of public acceptance of climate change (e.g. Hornsey et al. 2016) and governmental policies related to climate change (e.g. Poortinga et al. 2012). Building upon this evidence, my goal in this chapter was to add to the discussion from the fairly untrodden perspective and link public support for environmental policies with public support for the welfare state policies to establish whether public opinion about long-term environmental and short-term societal risks is homogenous or not.

1.2 Chapter overview

In **Chapter 2** I and Prof. Nick Allum employ the data from the General Social Survey (GSS) to study the role of race-based social identity and race-based ingroup evaluation in shaping racial disparities in science literacy. This chapter builds upon the existing literature (e.g. Plutzer 2013; Allum et al. 2018; Anderson 2015; NASEM 2016) that has so far studied the racial gap in science literacy mostly from the perspective of educational and economic disadvantages. However, the scholarship suggests that racial disparities tend to persist even when the most commonly used covariates such as education, religiosity, age, place of living, etc. are accounted for.

We, therefore, approach this issue from another perspective by inspecting how the strength of racial self-identification and racial ingroup evaluation can impact science literacy among African Americans compared to the white population. Employing the social identity theory

(Tajfel 1974, 1981; Tajfel and Turner 1986) as a theoretical framework, we have shown that the subjective perception of social closeness with the racial ingroup does not contribute to the explanation of the racial disparities in science literacy; however, there is evidence to suggest that the favourable ingroup evaluation is positively associated with African Americans' scores on science knowledge scale, compared to whites.

The novelty of this work comes from the fact that the topic of racial disparities in science literacy has not been studied previously from the perspective of racial social identity. Employing high-quality survey data, we were able to investigate the role of social identity and ingroup evaluation in shaping science knowledge among African Americans and whites, and thus advance the long-lasting discussion about the race-based differences in the uptake of science. The results of the analysis provoke a vital discussion as to what is the role of historically induced and socially absorbed distrust to science among African Americans in repelling them from endorsing science knowledge and how this can be overcome given the new empirical evidence that is provided in the chapter.

In **Chapter 3** I use the data coming from the European Social Survey Round 8 (2016) to study factors of public support for the environmental state (Meadowcroft 2008, Duit 2016) i.e. government measures aimed at curbing societal and economic risks related to supranational environmental threats such as global warming. The specific focus of this chapter is on disentangling the relationship between public support for the welfare and environmental states when taking into account other important predictors of pro-environmental attitudes such as values, climate change belief, and environmental concern. Employing the Value-Belief-Norm theory (Stern et al. 1999, Stern 2000) and running the structural equation model I show that people endorsing a positive view about government-driven welfare measures also tend to support state intervention into the environmental realm, although the magnitude of this effect is somewhat lower than that of factors coming from the Value-Belief-Norm theory.

The novelty of this work comes from combining the notions of public support for the welfare and environmental states in a single empirical model. While there is plenty of theoretical literature (e.g. Duit et al. 2016; Gough 2016) on how the emergence of the environmental state is connected to the development of the welfare state, none of the papers has so far explored whether public views of these two entities are related to each other or not. Wrapping up the paper within the Value-Belief-Norm framework that has been precisely developed to explain pro-environmental behavior and attitudes ensures that all essential factors have been accounted for when disentangling the relationship between the welfare and environmental states. The results of the analysis provoke a discussion as to what extent the measures aimed at promoting public support for the pro-environmental policies should rely on activating people's environmental identity, and whether it is possible to approach this objective by appealing to the notion of the government responsibility in regulating and curbing collective risks (e.g. such as the one we are witnessing currently with the case of COVID-19).

In **Chapter 4** I and co-authors Prof. Nick Allum and Dr. Burak Sonmez develop and carry out a conjoint experiment via Prolific online participant recruitment engine to explore what are the scientist's attributes that the general public tends to rely on most when it comes to making judgments about scientist's credibility and trustworthiness. By invoking the social identity theory (Stern et al. 1999, Stern 2000) and inspecting the effects of scientist's race/ethnicity, sex, political leaning, scientific field, and domain of work, we show that the political ideology of scientist plays the most important role in shaping his/her perceived trustworthiness, with Independent scientists being treated as more preferable compared to those leaning either towards the Democrat or Republican side of the spectrum. Moreover, we find that work-related attributes such as the scientific field and work domain (government, industry, or university) matter more in terms of scientist's preferability compared to their basic socio-demographic traits i.e. sex and race/ethnicity.

The novelty of this research comes from its specific focus on the public preferences for scientists and their trustworthiness as opposed to the abundant existing research on trust in institutionalized science per se (e.g. Krause et al. 2019) and public perception of controversial scientific topics e.g. global warming (Hamilton et al. 2015) or vaccines (Larson et al. 2016). We were able to show that when disentangling the complex relationship between science and the public, the expert claims made by scientists cannot be scrutinized separately from the public image that the scientists happen to hold as their perceived trustworthiness as experts goes far beyond the mere contents of the message that they convey. This chapter thus advances the discussion around the proclaimed failure of the scientific community to signal to the wider audience the integrity of their research (Jamieson et al. 2019) by revealing what are the cognitive heuristics and implicit biases that the public holds about scientists with various sociodemographic profiles and working backgrounds.

1.2.1 Publication plan

Chapter 2 is co-authored with Prof. Nick Allum and is currently under review for publication in *Public Understanding of Science*.

Chapter 3 is single-authored and will be submitted to the *Environmental Politics*.

Chapter 4 is co-authored with Prof. Nick Allum and Dr. Burak Sonmez and will be submitted to the *Proceedings of the US National Academy of Science (PNAS)*.

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2. Social Identity and Racial Disparities in Science Literacy

Research on African-Americans' relationship with science, while relatively sparse, in general suggests higher levels of alienation than among their white counterparts, whether in the form of less positive attitudes to science, or lower scientific literacy. In this paper we examine the role of racial social identity and ingroup evaluation as putative mechanisms that produce these disparities. Race-based social identity could be associated with attitudes to and engagement with science if the social gains from science are seen as inequitably distributed along racial dimensions. We use data from the General Social Survey (GSS), pooled over three waves, as the basis for our investigation. The results indicate that expressing social closeness with people of the same race is not associated with African-American scores on a science knowledge scale. However, we provide evidence that favourable ingroup evaluation is positively associated with African-Americans' scores on the same science knowledge scale.

Keywords: *scientific literacy; racial disparities; social identity theory; public understanding of science*

2.1 Introduction

The underrepresentation of Black Americans in STEM occupations, along with racial differences in educational experiences, lower levels of general literacy and restricted access to scientific information have been posited as important factors associated with racial disparities in knowledge about science (e.g. Anderson 2015). Indeed, reports show that the share of Black Americans working in the field of science, technology, and engineering has been low at least since 1970, and continues to be so now (Landivar 2013). Blacks are less likely to select STEM majors at college and they have higher chances of dropping out (Griffith 2010; Chen 2009). In terms of schooling, Blacks' overall experience also tends to be less positive than that of whites (for a review see Kao and Thompson 2003; see also Fordham and Ogbu 1986; Lynn and Parker 2006). Concomitantly, levels of basic and health literacy for Blacks are lower than for other race and ethnic groups (NASEM 2016: Chapter 3; Kutner et al. 2006; Rikard et al. 2016). It would be unsurprising, then, if science literacy followed the same pattern, plausibly also dependent on this common set of structural features.

Recent research suggests, however, that the racial cleavage in science knowledge is not only a mere reflection of broader patterns of social and economic disadvantage. Racial disparities in science knowledge persist even when people with the same educational levels are compared (Funk and Goo 2015: 5; NSB 2018: 41-43). Adjusting for basic or 'foundational' literacy and a range of other covariates, Allum et al (2018) found that a substantial knowledge gap remains. This indicates that there may be something more at play than observably structural explanations for disparities in science knowledge. As Anderson (2015) notes, there arguably exists an historically-established "complex relationship between science and the African-American community". Blacks tend to be more anti-scientific in their attitudes (Gauchat 2008) and have a lower level of trust in science (Gauchat 2011; 2012). They also consider scientific misconduct to be a bigger issue compared to whites, and this is especially so in the medical realm (Funk et al. 2019).

All of this is unsurprising: the legacy of ‘scientific racism’, as Plutzer puts it (2013: 147; see also Fairchild 1991; Williams 1974) is strong and may well drive some of the ways in which African-Americans perceive science. Apparent cases of science-driven discrimination (Dennis 1995) such as Galton’s early work on eugenics (1892) and Jensen’s research on race-based differences in IQ, published in 1969, attracted widespread media attention (Sowell 1973) and remains one of the most controversial scientific episodes of the 20th century. This and other famous cases such as that of the Tuskegee Syphilis Experiment (Fairchild and Bayer 1999; e.g. Reverby 2001) could have left a profound imprint on the collective memory of African-Americans (Assmann and Czaplicka 1995; Halbwachs 1992). This could quite reasonably give rise to suspicious - if not downright antagonistic - attitudes to science. This, in turn, could drive alienation and institutional distrust, and a lack of motivation to engage with science, including with formal and informal science education.

The perception that science does little for Black Americans is wryly captured in Gil Scott-Heron’s ironic paean to the space race of the 1960s: “The man jus' upped my rent las' night 'cause Whitey's on the moon. No hot water, no toilets, no lights. But Whitey's on the moon”. For Scott-Heron, the fact that it is *white* Americans who are on the moon is significant. The salience of race in one of the most spectacular scientific achievements of the last century derives from the harsh contrast between the deprived material conditions experienced by Blacks at the end of the 1960s while seemingly unlimited federal resources were simultaneously being channelled to the space race. Thus, it is plausible that race-based social identity could be associated with attitudes to and engagement with science, if the social gains from science are seen as inequitably distributed along racial dimensions.

In the present paper, we take up this theme and adopt a social psychological approach based on social identity theory (Tajfel 1974, 1981; Tajfel and Turner 1986) along with the related idea of stereotype threat (Aronson 2004). In doing so, we seek to elaborate on findings emerging from recent research by investigating how the salience of racial-identification and ingroup evaluation might be connected with disparities in science literacy.

2.2 Theoretical Framework and Hypotheses

2.2.1 Social Identity Theory

The cornerstone concept of social identity theory is, unsurprisingly, social identity. Produced by a process of social categorization, which implies systematising the social world according to meaningful and distinct categories, social identity describes the state of one's belonging to a certain social group and the meanings that this belonging entails. According to Tajfel, social identity is 'that part of an individual's self-concept which derives from his knowledge of his membership in a social group (or groups) together with the value and emotional significance attached to that group membership' (Tajfel 1981: 255).

A subjective interpretation of a group membership is implied by social identity theory and the concept of a social group is regarded as flexible as well, being treated as 'a cognitive entity that is meaningful to the subject at a particular point in time' (Tajfel 1974: 69). Therefore, it should not be confused with sociological categories which imply an external, observer-driven categorization of social objects (Turner and Reynolds 2001: 137-138). The core mechanism implied by the theory, namely, dividing people into ingroup and outgroup, brings about three theoretical principles underpinning the dynamics of intergroup behaviour: a) the desire to maintain a positive social identity; b) fulfilment of this desire by making a favourable comparison with a relevant outgroup c) leaving, or changing the value of the social group, if the social identity provided by it appears to be unsatisfactory (Tajfel and Turner 1986: 16). However, not every identity is equally important. The concept of 'master statuses' (Jaret and Reitzes 1999: 716-717; see Rosenblum and Travis 1996) refers to those substantial characteristics (race, gender, class and sexual orientation are examples) that overwhelm other identities in structuring social situations. Racial identity is arguably the most pivotal among them, since it is rarely possible to mask one's phenotypical traits that are used by others in a process of categorization and thus escape or alter its consequences[1].

While whites' racial identity is stereotypically associated with being more educated (Allen 1996) and having higher social status (Saperstein and Penner 2012), Blacks are oftentimes subjected to negative prejudices about their behavior and intellectual abilities (e.g. Peffley et al. 1997). Even though the awareness of such negative stereotypes could in principle lead to enhanced social solidarity, the need constantly to refute unfounded allegations can lead to a substantial decrease in well-being (Hughes et al. 2015) and ultimately result in the internalization of negative racial stereotypes and a distorted view of oneself and one's abilities (Williams and Mohammed 2013). Our intuition is that science is seen as alienating for at least some Black Americans (this is not saying that it may not be alienating for some whites too). That being so, it is reasonable to suggest that variation in the salience of racial identity for Americans could shape some of the variation in their attitudes and knowledge in relation to science. Accordingly, our first research question is: how is the salience of racial self-identification associated with science literacy for Blacks compared to whites?

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[1] Although racial self-identification might be a subject to fluidity and impermanence (see Telles and Paschel 2014; Harris and Sim 2002; Mowen and Stansfield 2016), this is more common for those having mixed ancestry or multiracial parents, and usually does not affect most of population, whose racial self-identification tends to be stable over time. However, see Saperstein and Penner (2012) on how self-classification and categorization by others are deeply intertwined with individual's social status.

2.2.2 Racial Divide in the Salience of Racial Self-identification

There is substantial empirical evidence to suggest that racial self-identification plays an essential role in structuring the everyday life of African-Americans and that it is less salient among whites. Distinctiveness theory suggests a plausible explanation for this fact, arguing that self-identities based on traits that readily distinguish a person from others around them tend to be more salient than those that do not (Mehra et al. 1998). Hence, African-Americans that make up a visible racial minority are more likely than whites to embrace racial self-identification as a crucial component of their social identity. This is consistent with findings from survey research. Blacks, on average, report feeling closer to the people of their race (Williams et al. 2012; Wong and Cho 2005; Wong 1998; Thornton et al. 2012) and are more likely to mention race as an identity that is 'most important to you in describing who you are' (Smith 2007: 388). This feeling of overall closeness translates into the acknowledgment of common history and common fate (Bobo and Johnson 2000: 95) which, in turn, gives ground for race-based political engagement (e.g. Gurin et al. 1990; Tate 1994).

Not only do Blacks tend to *feel* that they are united with other Blacks but this perceived social closeness is also intertwined with long-term socioeconomic conditions. Racial disparities perpetuate in a host of different ways, for instance in terms of place of living (Emerson et al. 2001; Iceland and Weinberg 2002), studying (Roscigno 1998; Goldsmith 2009) and strategies for finding a job (Mouw 2002).

Whites, on the contrary, tend to put less emphasis on their racial belonging (Wong and Cho 2005; Croll 2007). Being a dominant racial identity in the US, whiteness serves as the 'unmarked norm against which other identities are marked and racialized' (Rasmussen et al. 2001). While being barely noticeable to whites themselves, white racial self-identification can be an object of aspiration and is linked with the achievement of higher social status (Sapperstein and Penner 2012; Telles and Paschel 2014).

In this way, given that the racial identity is more prominent among Blacks than among whites, and recognising that the premises for science alienation could be entrenched in Black racial self-identification, we hypothesize that, for Black Americans, *stronger racial self-identification will be associated with lower levels of civic scientific literacy. (Hypothesis A).*

2.2.3 Ingroup Evaluation

Our second research question focuses more specifically on ingroup evaluation as a vital part of the self-identification process and asks *how ingroup evaluation is associated with science literacy for Blacks compared to how it is associated for whites.* We explain the rationale for asking this question in what follows.

Retaining a positive social identity is an important task for an individual, and there are several options for doing so, according to social identity theory. The most common way is to make a favorable comparison with a relevant outgroup. One can also abandon a social group that has a lower status (Tajfel and Turner 1986; Ellemers and Haslam 2011). Since changing one's racial identity is quite problematic because of the hardly-permeable borders dividing racial identities (Hughes et al. 2015: 28), emphasising the distinctiveness of one's own racial group and amplifying its advantages over the outgroup can become a common practice to maintain a positive identity for members of devalued groups.

This social mechanism of raising collective self-esteem (Crocker and Luhtanen 1990) that manifests itself in accentuating one's distinctiveness e.g. by celebrating race-specific cultural heritage (Tajfel 1974: 83) is likely especially vital for Black Americans: as their self-identification is very much based upon repelling identity-threatening stereotypes. Allport noted that African Americans ‘‘have heard so frequently that they are lazy, ignorant, dirty, and superstitious that they may half believe the accusations, and since the traits are commonly despised… some degree of in-group hate seems almost inevitable’’ (1954: 152, cited by Burkley and Blanton 2009: 287). Whilst this was in the context of the Jim Crow America of the 1950s, there is little reason to think that things have changed radically in the intervening years.

Positive ingroup evaluation and even ingroup bias, as a radical form of favourable ingroup comparison (Rudman et al. 2002; Kiecolt and Hughes 2017), does not imply that Blacks should necessarily endorse a positive cultural notion of science per se, but it could nevertheless serve as a ground for resisting a stereotype threat. Stereotype threat is a widely studied socio-psychological phenomenon that provides insight into how self-identification interacting with commonly held stereotypes might influence one’s actions and worsen performance in the area which is subject to the stereotyping (Steele 1997; Aronson 2004). Social-psychological experiments (e.g. Steele and Aronson 1995) have shown that African-American students underperform considerably compared to whites in a verbal test when it is framed as a test of abilities, rather than one exploring general psychological factors. Presumably, the need to confront negative societal stereotypes about their intellectual abilities is what puts on them ‘an extra cognitive and emotional burden not borne by people for whom the stereotype does not apply’ (Aronson et al. 2002: 114) resulting in more stress and weakened performance. Salient racial self-identification, in this regard, can play the role of catalyst making African-Americans to internalize more deeply the negative racial stereotypes (Armenta 2010; e.g. Shih et al. 1999).

In contradistinction to this tendency, those that hold positive outlooks about members of their racial in-group will be more likely to question and resist racial intelligence stereotypes. This in turn may mitigate their negative effect on performance (Aronson et al. 2002). Thus, treating a positive ingroup evaluation as a signal that the individual's level of 'inferior anxiety' (Steele and Aronson 1995: 797-798) is reduced and that they are less subjected to, or at least affected by, a stereotypical notion of intellectual capacities throughout the life course, we expect to see that for *Black Americans, higher levels of positive ingroup evaluation will be associated with higher levels of civic scientific literacy (Hypothesis B).*

2.3 Data, Measures and Analytical Strategy

2.3.1 Data

Data for this study come from the General Social Survey (GSS), which is a biennial, face-to-face probability survey of the adult population of the US covering a wide range of social and political attitudes and beliefs, including racial identity. The GSS has also featured measures of science literacy since 2006. The variables required for our analysis are only found together in the same questionnaire version in three of the survey years available (2008, 2010, 2016, see Appendix 1). We, therefore, combine respondents from all of them into one dataset. In doing so, we depart from the assumption that when dealing with such fundamental socio-psychological attribute as racial self-identification, the time effect of 8 years (2008-2016) could be neglected as it is too short to drive profound macro-level changes in how entire nation perceives their racial identity. Likewise, looking at the time effects from the perspective of racial disparities in science literacy, while the research on adult population is sparse, studies conducted among students suggest that the science test score gap between whites and Blacks tends to be stable over time (Quinn and Cooc 2015).

The response rates the GSS survey waves were 70.4% and 70.3% in 2008 and 2010, respectively, and 61.3% in 2016[2]. Survey weights were applied in the regression modelling to account for an equal-probability multi-stage cluster sampling design of the GSS.

2.3.2 Measures

Following the literature on civic scientific literacy (Miller 1987; 1998; 2010; 2016; Allum et al. 2008), *science literacy* was measured as a number of correct ('True' or 'False') answers to a set of 14 quiz-type questions examining respondents' knowledge of basic scientific facts, the idea of probability and the principles of experimental research (see also Gauchat 2012; Allum et al. 2018). 'Don't know' and refusals were treated as wrong answers. The list of items used to comprise this variable along with correct responses is presented in Appendix 2.

Respondents' *race* was measured with a dummy variable, indicating whether a person is white or Black. In this question, the interviewer was asked to code respondent's race silently and ask a direct question only in the case of doubt. Those who fell into the category of 'other race' were omitted from the analysis because the heterogeneity within this category makes it impossible to capture the salience of a specific racial identity.[3]

Racial self-identification and *ingroup evaluation* were measured in a variety of ways (for a review see Wong and Cho 2005: 703). In our case we use five items included in the GSS to capture how strongly one associates oneself with one's race ingroup and how one evaluates the

[2] http://gss.norc.org/Documents/other/Response%20rates.pdf

[3] Another way to ask about a race in a survey is to refer to respondent's self-categorization. In General Social Survey (GSS), this option is provided by a variable *racecen1*, which counts a first mention on the following question: "What is your race? Indicate one or more races that you consider yourself to be." While studies report that the gap between how interviewer and oneself can see oneself's racial belonging can exist (Saperstein and Penner 2014), this is not the case in the present analysis. Crosstabulation shows that 99% of whites or Blacks identified as such by an interviewer considered themselves as whites or Blacks respectively when asked about their racial self-categorization.

members of the ingroup. Item wordings, response scales, and some examples of previous use of these items, are shown in Table 1.

Table 1[4]. Measures of racial self-identification and ingroup evaluation

Question wording	Scale	Some examples of usage
In general, how close do you feel to Blacks/whites? (*close*)	1 (Not at all close) - 9 (Very close)	Hughes and Tuch (2003) as a measure of social distance Kiecolt et al. (2017) as an indicator of racial self-identification
What about having a close relative marry a Black/white person? (*mar*)	1 (Strongly oppose) - 5 (Strongly favour)	St. Jean (1998); Djamba and Kimuna (2014) as an attitude to marriage outside own race. Barkan and Cohn (1994) as a measure of racial prejudice
What about living in a neighborhood where half of your neighbors were Blacks/whites? (*live*)	1 (Strongly oppose) - 5 (Strongly favour)	Weaver (2008) as a measure of social distance Barkan and Cohn (1994) as a measure of racial prejudice
The second set of characteristics asks if people in the group tend to be hardworking or if they tend to be lazy. Where would you rate Blacks/whites in general on this scale? (*work*)	1 (Lazy) – 7 (Hardworking)	Kiecolt et al. (2017); Hughes et al (2015) as measures of racial ingroup evaluation
Do people in these groups tend to be unintelligent or tend to be intelligent? Where would you rate Blacks/whites in general on this scale? (*intl*)	1 (Unintelligent) – 7 (Intelligent)	

[4] In the questionnaire there are ten questions, as each of those items in the table was asked separately of all respondents about both Blacks and whites. For the purposes of this analysis, they were recoded and the answers in respect of the other race category were discarded. This means that, for each of the five items, Black respondents' answers are about Black people and whites' answers about whites, in order that they can be interpreted as measures of self-identification and ingroup evaluation.

In order to investigate the latent nature of these concepts, an exploratory factor analysis was conducted on the 5 standardized items. A two-factor model with oblique rotation (Promax) yielded the most comprehensible result (see Appendix 3). The first factor is related to the variables touching upon the issue of social distance (interracial marriage and composition of neighbourhood), thus indicating the measure of the salience of racial self-identification, while the second one is mainly composed of variables exploring capacities (industriousness and intelligence) of peer ingroup members, indicating the overall ingroup evaluation. The item referring to the general estimation of racial affinity (*close*) was almost equally explained by both factors. Factor score estimates were saved and used as independent variables in further analysis.

We also employ three variables that previously have been suggested as potential confounders on science literacy - respondent's *level of education*, *participation in college science courses*, and *foundational literacy*. Level of education is measured by the highest year of school completed, yet we acknowledge that this is just a proxy for education level, and better operationalization would take into account heterogeneity of quality of education based on geographical regions and socioeconomic status of the households. Those having a college degree and taking science courses while studying generally tend to be more knowledgeable in science (Miller 2010; Plutzer 2013; NSB 2018: 37; Funk and Goo 2015: 4). An examination of the relationship between foundational literacy, using the same variable as we do here (*wordsum*, a vocabulary test administered to all GSS respondents) and science knowledge was carried out by Allum et al. (2018), who found that the inclusion of foundational literacy accounted for part of the covariance between race and science literacy. Hence, we include it in our analyses. We also adjust for *religiosity*, *family income*, *respondent's age*, *gender*, and *political affiliation*. Details of all these covariates are shown in Table 2.

Table 2. Descriptive statistics of variables used in the analysis, n = 1,300

Variable		Mean	SD	Min	Max
Civic scientific literacy	R's score on a science knowledge quiz	8.81	2.78	1	14
Black	Whether R is Black (1 = Yes, 0 = No)	0.17		0	1
Racial self-identification	Factor 1 saved scores	-0.02	0.75	-2.85	1.51
Ingroup evaluation	Factor 2 saved scores	-0.04	0.66	-2.54	2.08
College-level science courses	Whether R has taken any college-level science courses (1 = Yes, 0 = No)	0.43		0	1
Education	Highest year of school completed	13.78	2.79	0	20
Female	Whether R is female (1 = Yes, 0 = No)	0.56		0	1
Age	R's age	47.99	17.05	18	89
Foundational literacy	Total number of correct answers on a Wordsum vocabulary test	6.15	1.83	0	10
Church attendance	How often R attends religious services (0 = Never, 8 = More than once a week)	3.50	2.80	0	8
Independent	Whether R identifies as Independent, Independent, near Democrat, or Independent, near Republican (1 = Yes, 0 = No)	0.40		0	1
Republican	Whether R identifies as not strong or strong Republican (1 = Yes, 0 = No)	0.27		0	1
Family income	R's inflation-adjusted family income, standardized	0.01	0.95	-1.13	2.93

Note: Baseline race is white and those categorized as 'other' were omitted from the analysis. Baseline political preference is Democrat (not strong or strong), and those affiliating themselves with 'other party' were omitted from the analysis. The number of observations corresponds to the fully specified regression models (Table 3, Models 7 and 8).

2.3.3 Analytical Strategy

In order to test our hypotheses, we fit a set of multivariate linear regressions with interaction terms. The interaction terms of race, with racial self-identification and ingroup evaluation respectively, allow us to establish whether the effects of these two variables on science knowledge differ for whites and Blacks. We expect that racial self-identification and ingroup evaluation have significantly different associations for Blacks than for whites, who, in this regard, might be considered as a baseline for a comparison. We begin with models that predict science knowledge from the set of control variables and education-related covariates. The purpose here is to assess the magnitude of the racial disparity in science literacy, which is our explanandum in the models that follow. We then examine the zero-order relationships between the identity variables and science knowledge, without controls and interactions, before presenting fully specified models with all covariates included.

2.4 Results

Table 3 presents parameter estimates for the models outlined above. The first model with controls only indicates that Blacks, on average, tend to score almost two points less on the science knowledge scale than whites, which is consistent with previous findings (Allum et al. 2018). Women, non-Democrats, older and more religious people have also, on average, poorer science knowledge, while higher family income is associated with higher knowledge. Model 2 adds covariates that account for the various facets of relevant educational and cognitive achievement. Having more years of schooling, undertaking at least some science-related college courses, and having a higher level of foundational literacy are all positively related to science knowledge. When these variables are accounted for, the association with race diminishes by one third, family income drops by more than a half, and the association with political affiliation becomes small and insignificant.

Models 3 and 4 provide the first direct look at our hypotheses. Both interaction terms go in the same direction, yet they are not significant at the 5% level. Model 3 shows that for whites, a one-unit increase (which is approximately one standard deviation) in the level of racial self-identification is associated with a -0.502 decrease in civic scientific literacy, while for Blacks the interaction term is positive, and the slope therefore becomes almost indistinguishable from zero. A similar pattern is recognizable in Model 4. For whites, a one unit increase in the level of ingroup evaluation is associated with a -0.646 reduction in science literacy, whereas for

Blacks the decrease in literacy is very close to zero for the same 1-unit change in their ingroup evaluation.

Models 5 and 6 build upon the previous models by combining controls with interaction terms. This changes the picture somewhat. The same pattern is visible in Model 5 as in Model 3, with the coefficients being all attenuated and non-significant. Whites who identify more strongly as white, score less well on science knowledge, while for Blacks the effect of racial identification approaches zero. However, for racial ingroup evaluation, the effect sizes are greater than in the model with no controls. The slope for Blacks is 0.256 (i.e. -0.412 + 0.668) while for whites it is again negative (-0.412).

Models 7 and 8 are full-specification models combining controls, educational variables, and interaction terms. While a slight diminution in the magnitude of interaction coefficients compared to models 5 and 6 is noticeable, the principal relationships remain the same. Whatever the racial discrepancy in the effect of racial self-identification might be, it remains insignificant in Model 7, and Model 8 continues to show a negative slope of ingroup evaluation for whites and a positive slope for Blacks.

Figures 1 and 2 correspond to Models 7 and 8 and present the predicted science literacy scores for Blacks and whites at various levels of racial self-identification and ingroup evaluation respectively. While increasing levels of racial self-identification do not make Blacks score any higher on the science scale, higher values of ingroup evaluation are associated with the consistent raise of their science literacy scores. This is contrary to whites, for whom higher ingroup evaluation leads to the observable decrease in science literacy.

To summarise, no model has suggested that for Blacks more salient racial self-identification might lead to a lower level of civic scientific literacy, which leads us broadly to rejecting hypothesis A. In fact, the models of interest (3, 5, 7) point out that the association of racial self-identification and science literacy for whites seems to be more negative than for Blacks. Regarding hypothesis B, the situation is less ambiguous. None of our models have been able to show a higher level of ingroup evaluation associated with poorer knowledge of science for Blacks. On the contrary, the more positively the African-Americans evaluate their ingroup, the higher tends to be their observed level of science knowledge. We regard hypothesis B, therefore, as receiving some support.

Figure 1. Predicted science literacy scores for Blacks and whites across the values of racial self-identification.

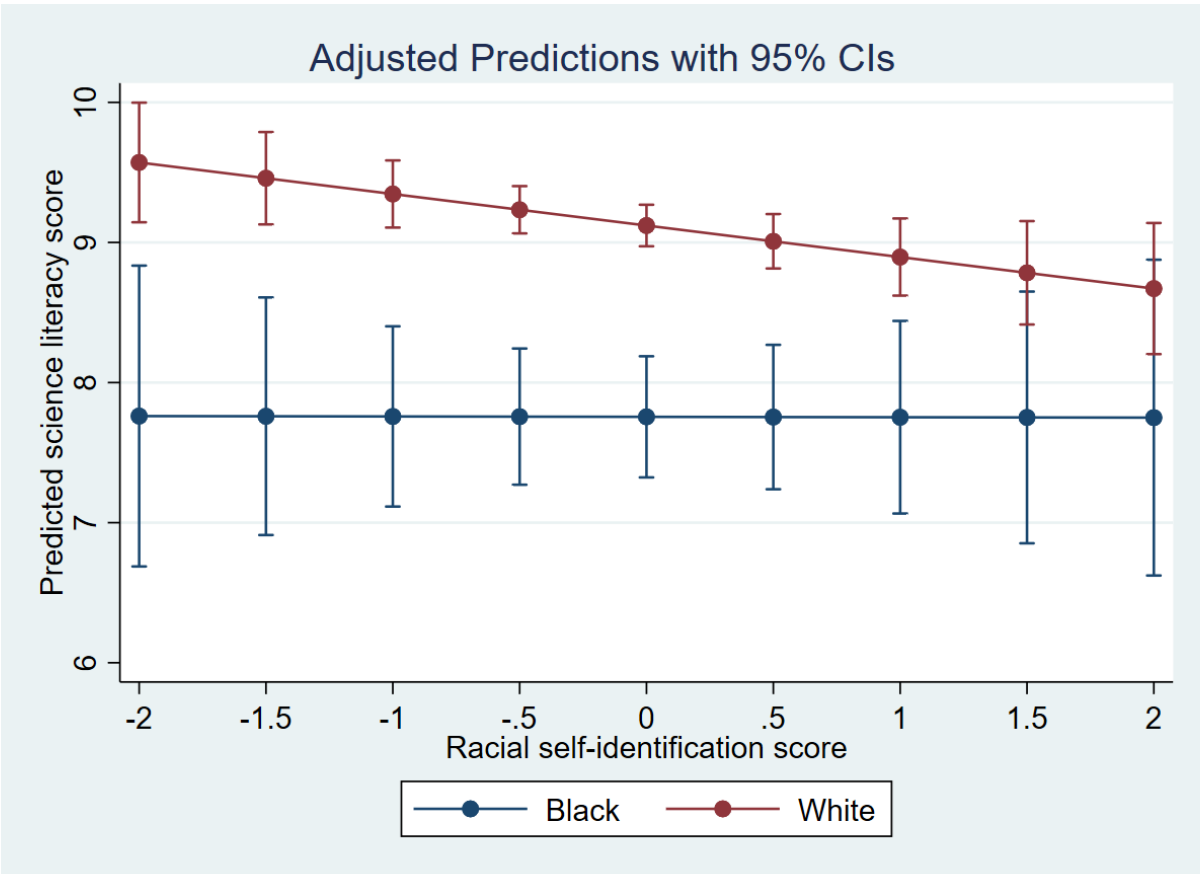

Figure 2. Predicted science literacy scores for Blacks and whites across the values of ingroup evaluation.

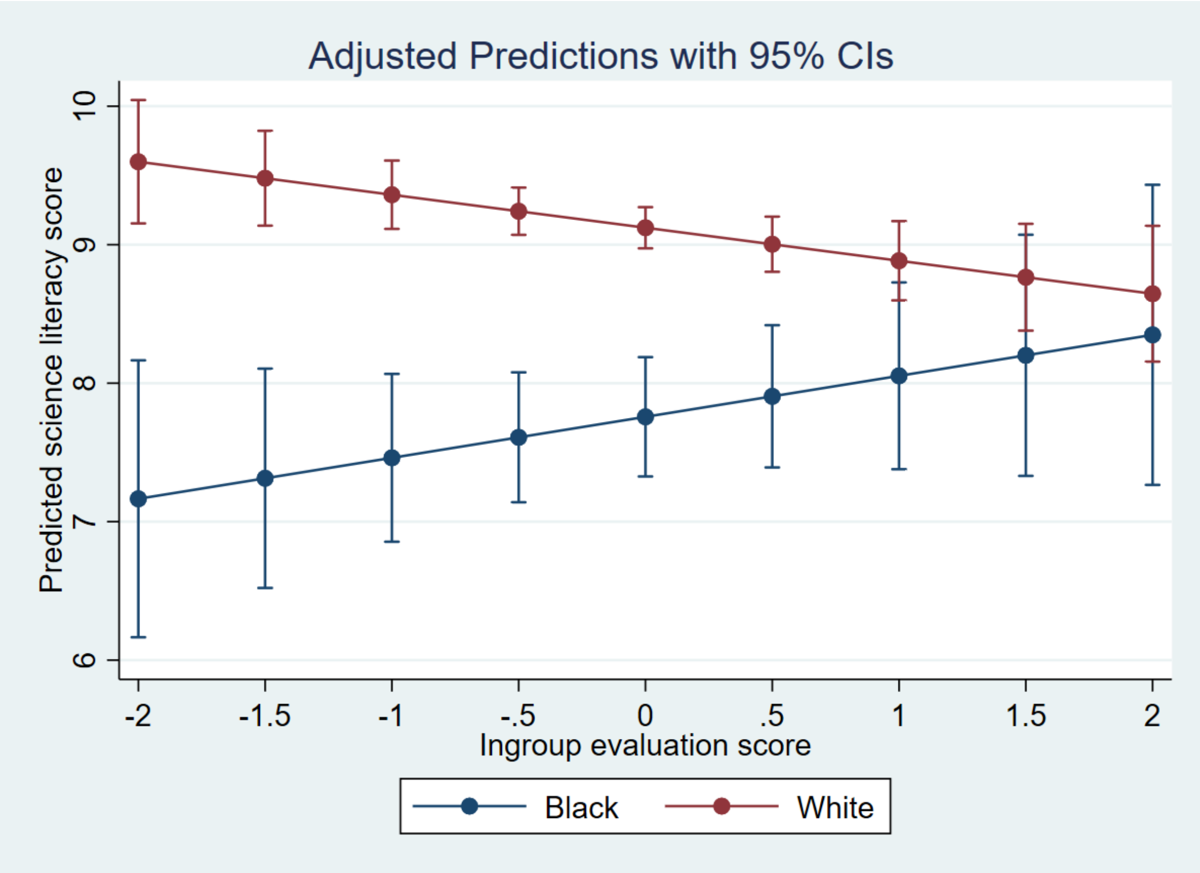

Table 3. Parameter estimates for the models on civic scientific literacy[5]

	Civic scientific literacy							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Race and Controls								
Black	-1.905***	-1.283***	-2.048***	-2.065***	-1.687***	-1.694***	-1.366***	-1.365***
	(0.116)	(0.135)	(0.237)	(0.238)	(0.228)	(0.228)	(0.241)	(0.239)
Female	-0.660***	-0.837***			-0.626***	-0.642***	-0.777***	-0.789***
	(0.079)	(0.089)			(0.156)	(0.157)	(0.152)	(0.153)
Age	-0.026***	-0.026***			-0.024***	-0.024***	-0.024***	-0.024***
	(0.002)	(0.002)			(0.004)	(0.004)	(0.004)	(0.004)
Independent	-0.212**	-0.099			-0.156	-0.152	-0.088	-0.094
	(0.088)	(0.093)			(0.172)	(0.169)	(0.162)	(0.159)
Republican	-0.207*	-0.034			0.107	0.070	0.036	0.005
	(0.110)	(0.125)			(0.211)	(0.212)	(0.192)	(0.190)
Family income	0.682***	0.184***			0.625***	0.608***	0.206***	0.199***
	(0.042)	(0.047)			(0.072)	(0.072)	(0.073)	(0.073)
Church attendance	-0.084***	-0.099***			-0.107***	-0.109***	-0.098***	-0.099***
	(0.015)	(0.017)			(0.032)	(0.031)	(0.028)	(0.028)
Education-related								
Education		0.157***					0.181***	0.180***

[5] The difference in the number of observations per each model is due to the number of ballots available for each combination of variables. A multiple imputation procedure was conducted using the R package Amelia (Honaker et al. 2011) to see whether the results of the regression modeling in the full specification models (7, 8) are held when the loss in observations caused by missings in controls and educational variables is compensated for. Although the magnitude of the effect varies, it does not change the very patterns of the relationships between variables.

	Civic scientific literacy							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		(0.022)					(0.035)	(0.035)
College-level science courses taken		0.714***					0.526***	0.533***
		(0.125)					(0.195)	(0.196)
Foundational literacy		0.444***					0.427***	0.428***
		(0.025)					(0.047)	(0.047)
Interaction terms								
Racial self-identification			-0.502***		-0.391***		-0.225**	
			(0.113)		(0.122)		(0.107)	
Black x Racial self-identification			0.388		0.369		0.222	
			(0.280)		(0.292)		(0.277)	
Ingroup evaluation				-0.646***		-0.412***		-0.238**
				(0.131)		(0.130)		(0.112)
Black x Ingroup evaluation				0.523*		0.668**		0.534**
				(0.294)		(0.272)		(0.263)
Constant	11.091***	6.043***	9.002***	9.010***	10.795***	10.847***	5.657***	5.709***
	(0.154)	(0.319)	(0.086)	(0.088)	(0.300)	(0.303)	(0.511)	(0.508)
Observations	6,153	3,720	1,620	1,620	1,421	1,421	1,300	1,300

	Civic scientific literacy							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Likelihood	-14,999.790	-8,445.311	-4,007.740	-4,004.421	-3,410.107	-3,410.441	-2,917.731	-2,916.999
Akaike Inf. Crit.	30,015.580	16,912.620	8,023.479	8,016.842	6,840.215	6,840.883	5,861.462	5,859.997

Note: *p<0.1; **p<0.05; ***p<0.01. Design-corrected standard errors reported in parentheses. White is a reference category for race. Male is a reference category for gender. Democrat is a reference category for political preference.

2.5 Discussion

This research derives its motivation from the idea that racial disparities in scientific literacy can be explained by introducing into the analysis the notion that differing attachments to racial identity interact with culturally-fashioned and transmitted perceptions of science. While it has already been shown that the way race predicts scores on a science knowledge scale is partially mediated by factors such as education or foundational literacy (Allum et al. 2018), the present study adds to the discussion by showing that how one associates oneself with, and assesses the traits of one's racial ingroup, has different associations with scientific literacy for white and Black Americans. While these differential associations cannot account for the overall disparity between these groups, they suggest that positive in-group evaluation for Blacks is something that is linked to greater science literacy.

Contrary to our expectations, there is little evidence that the salience of racial identity itself is associated with lower scientific literacy amongst Blacks and, on the basis of our analysis at least, it cannot be regarded as a plausible explanation for observed disparities between white and Black Americans. While it is impossible to deny the historical trace of 'scientific racism' (Plutzer 2013; Fairchild 1991) affecting the well-being of racial and ethnic minorities in America, perhaps one might venture that the narratives perpetuating this malevolent experience are not as pronounced within the collective memory of African-Americans as might have been expected.

An alternative explanation might be due to 'stereotype lift' (Walton and Cohen 2003) – the psychological mechanism which could in theory counterbalance the negative prejudice about science among Blacks. For some African-Americans, the stereotypical notion of a Black person who cannot be knowledgeable in science to the same degree as a white American might serve as a motivation for enhanced test performance (although it is fair to say that a knowledge quiz administered on the door-step is a low stakes test). Resisting the ‘chronic internalization’ (Burkley and Blanton 2009: 287) of negative stereotypes about the ingroup and using social stigma as a self-protective mechanism (Crocker and Major 1989) could in principle be boosting Blacks’ interest in science and facilitating their uptake of scientific knowledge. This is also in line with the plentiful research showing that greater salience of racial identity brings more awareness about racial discrimination (e.g. Shelton and Sellers 2000; Sellers and Shelton 2003; Operario and Fiske 2001), thus prompting people to find ways to bypass such prejudice. This idea, however, requires further empirical scrutiny.

We found support for the idea that favourable ingroup evaluation is associated with higher science literacy for Black Americans. The positive evaluation of an ingroup that is generally stereotyped as less knowledgeable and intelligent could mean that for some Black Americans these stereotypes do not play a defining role in self-perception and in fact defying or ignoring these stereotypes through boosting ingroup evaluation can alleviate the burden of stereotype threat (Aronson et al. 2002; Armenta 2010) and open the way to more engagement with science and concomitantly greater knowledge. The degree to which positive ingroup evaluation among minorities encourages engagement with science is an area in which more research could be directed.

Another notable finding, about which we had no firm prior expectations, is that increased salience of racial identity and positive ingroup evaluation are both associated with lower science literacy for white Americans. While the research on white racial identity suggests that it tends to be particularly strong among less educated males (Croll 2007) and flourish in poor socio-economic environments (Oliver and Mendelberg 2000), our study suggests that the science literacy of whites is negatively associated with their racial identification, even when various facets of educational attainment and income level are taken into account. We might speculate here that increased identification with the dominant racial group perhaps stands as a proxy for more parochial, less cosmopolitan values. Science is arguably an inherently cosmopolitan enterprise and scientific knowledge may sit uneasily with a rather blinkered mindset praising one's belonging to a dominant racial group. This is consistent with Croll's (2007) observation that white racial identity is especially salient among those who reject multiculturalism and belief that Unites States is, or should be, a white nation.

In this paper we were able to leverage high quality survey data to explore the association between identity, race and science literacy. However, surveys often provide a broad but shallow basis for inference. In the present case, one of the limitations is that the questions on identity in the GSS are very general in scope. It is possible that questions tapping identity-salience more directly linked to scientific issues may yield different results. For instance, Dawson (2018) suggests that marginalised social groups do not express firm lack of interest in science; rather, the underlying reasons for their disengagement should be sought in the way in which the structure of scientific discourse per se provokes their perceived powerlessness and the feeling of inferiority to the present cultural order, ultimately excluding them from crucial science practices and limiting their ability to be heard and perhaps to listen too. At all events, there is much more to be learned about the basis of disparities in science literacy and an urgent societal need that they be diminished.

2.6 References

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2.7 Supplemental material

2.7.1 Appendix 1

Ballot distribution of the items of interest, GSS 2006-2016

Variable/Year	2006	2008	2010	2012	2014	2016
Controls						
sex	A B C D	A B C	A B C	A B C	A B C	A B C
age	A B C D	A B C	A B C	A B C	A B C	A B C
partyid	A B C D	A B C	A B C	A B C	A B C	A B C
coninc	A B C D	A B C	A B C	A B C	A B C	A B C
attend	A B C D	A B C	A B C	A B C	A B C	A B C
Civic scientific literacy composites						
hotcore	B C	A B C	A C	B C	B C	A B
radioact	B C	A B C	A C	B C	B C	A B
boyorgrl	A B C	A B C	A C	B C	B C	A B
lasers	B C	A B C	A C	B C	B C	A B
electron	B C	A B C	A C	B C	B C	A B
bigbang	B C	A B C	A C	B C	B C	A
condrift	B C	A B C	A C	B C	B C	A B
evolved	B C	A B C	A C	B C	B C	A B
earthsun	B C	A B C	A C	B C	B C	A B
solarrev	B C	A B C	A B C	B C	B C	A B
odds1	B C	A B C	A C	B C	B C	A B
odds2	B C	A B C	A C	B C	B C	A B
expdesgn	B C	A B C	A C	B C	B C	A B
Education-related						
colsci	B C	A B C	A C	B C	B C	A B
wordsum	A B C	A B	A B C	A B	A B	A B
educ	A B C D	A B C	A B C	A B C	A B C	A B C
Race-related						
race	A B C D	A B C	A B C	A B C	A B C	A B C
closeblk	A C	A C	A C	A C	A C	A C
closewht	A C	A C	A C	A C	A C	A C
marblk	A B	A B	A B	A B	A B	A B
marwht	A B	A B	A B	A B	A B	A B
liveblks	A B	A B	A B	A B	A B	A B
livewhts	A B	A B	A B	A B	A B	A B
workblks	A B	A B	A B	A B	A B	A B
workwhts	A B	A B	A B	A B	A B	A B
intlblks	A B	A B	A B	A B	A B	A B
intlwhts	A B	A B	A B	A B	A B	A B

Note: The information is taken from the General Social Survey Data Explorer available at: https://gssdataexplorer.norc.org/. The GSS survey year and ballots including all the relevant variables and used in the analysis are highlighted in green.

2.7.2 Appendix 2

The list of items used to construct a civic scientific literacy scale.

1. The center of the Earth is very hot. (True)
2. All radioactivity is man-made. (False)
3. It is the father's gene that decides whether the baby is a boy or a girl. (True)
4. Lasers work by focusing sound waves. (False)
5. Electrons are smaller than atoms. (True)
6. Antibiotics kill viruses as well as bacteria. (False)
7. The universe began with a huge explosion. (True)
8. The continents on which we live have been moving their locations for millions of years and will continue to move in the future. (True)
9. Human beings, as we know them today, developed from earlier species of animals. (True)
10. Does the Earth go around the Sun, or does the Sun go around the Earth? (Earth around Sun)
11. How long does it take for the Earth to go around the Sun: one day, one month, or one year? (One year)
12. Now, think about this situation. A doctor tells a couple that their genetic makeup means that they've got one in four chances of having a child with an inherited illness. A. Does this mean that if their first child has the illness, the next three will not have the illness? (No)
13. B. Does this mean that each of the couple's children will have the same risk of suffering from the illness? (Yes)
14. Now, please think about this situation. Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to one thousand people with high blood pressure and see how many of them experience lower blood pressure levels. The second scientist wants to give the drug to five hundred people with high blood pressure, and not give the drug to another five hundred people with high blood pressure, and see how many in both groups experience lower blood pressure levels. Which is the better way to test this drug? (500 get the drug and 500 don't)

2.7.3 Appendix 3

EFA standardized loadings, n = 1,620

Item	Factor 1	Factor2	Communality	Uniqueness
close	0.25	0.17	0.13	0.87
mar	0.73	-0.10	0.48	0.52
live	0.44	-0.02	0.19	0.81
work	-0.05	0.55	0.28	0.72
intl	-0.02	0.48	0.22	0.78

Note: SS loadings: 0.76 (F1) and 0.53 (F2); Total of 26% of the variance is explained by the fit. 59% of them are explained by F1, 41% by F2. Correlation of regression scores with factors: 0.76 (F1) and 0.68 (F2). Multiple R2 of scores with factors: 0.57 (F1) and 0.46 (F2). Factor correlation is 0.48. Please see Table 1 in the main body of the paper for item wordings.

3. Does Public Support for the Welfare State Translate into Support for the Environmental State?: Evidence from the European Social Survey

Climate change is a serious global threat and national and supranational measures are needed to mitigate its negative effects. Collective approaches to eradicating Beveridge's 'five giants' of want, disease, ignorance, squalor, and idleness were established in the immediate post WW2 period and are known under the name of the welfare state. The idea of the environmental state emerged around the 1980s acknowledging the state's crucial role in mitigating a sixth 'giant' – environmental risks. This paper adopts the Value-Belief-Norm theory to study the relationship between public support for the welfare and environmental state measures. Employing Round 8 (2016) data of the European Social Survey and performing structural equation modeling the paper shows that climate change belief is the strongest predictor of support for the environmental state, while the welfare state support has a significant yet modest positive effect. The implications for social policy are discussed.

Keywords: *climate change belief; environmental state; welfare state; Value-Belief-Norm theory; structural equation modeling*

3.1 Introduction

The scientific consensus on climate change is not at all comforting – climate change is indeed happening, is mostly caused by human activity, and large-scale collaborative measures are necessary to be taken to mitigate its detrimental societal consequences (Giddens 2009, IPCC 2015, CCC 2015, Royal Society 2010). The need for action is accompanied by the proliferation of debates around the ethical foundations of mitigation policies, which focus on the ways to overcome a 'double injustice' predicament (Gough 2011), curb regressive effects of climate change policies (Buchs et al. 2011), and respect overall environmental justice principles (Walker 2012).

While the idea of the state taking measures to prevent global environmental hazards might seem as something obscure and distant to the public view, there is one area of government's responsibility that people are already well accustomed to. Alleviating economic burden and increasing life chances of the most vulnerable social groups (e.g. elderly, disabled, unemployed people) which comes under the name of a *welfare state* (Beveridge 2000, Espring-Andersen 2013) is something that seems trivial to the modern world and has been a subject of abundant empirical research (e.g. Roosma et al. 2013, Reeskens and Van Oorschot 2013, Van Oorschot 2006).

The notion of the *environmental state* (Meadowcroft 2008, Duit 2016) is similar, yet instead of focusing on protecting the well-being of people in need, it emphasizes the central role that the state is to play in reducing collective environmental risks. State's ability to influence collective decision making, respond to distributional conflicts, employ coercive and legal power and operate on the supranational level (e.g. by shaping the European Union policy) makes it a powerful actor (Duit et al. 2016) whose intervention can be potentially more impactful than bottom-up approaches to climate change management based on the principles of ecological citizenship (Dobson 2007).

However, state efficiency could be constrained by people who possess skeptical views on the reality of climate change (Rahmstorf 2004, Hoffman 2011, Lahsen 2013). The risk society (Beck 1992) and reflexive modernization (Beck et al. 1994, Nowotny et al. 2001) discourses emphasize the increasing role lay public plays in co-producing and legitimizing scientific expertise. The attenuation of the deficit model of science communication (Bucchi 2008) has led to a situation when scientists and policymakers have to obtain public support before implementing new policies or regulations. There is evidence that the local population is capable of curtailing environmental projects by expressing their collaborative suspicion and disapproval (e.g. Upham and Shackley 2007, Jones and Eiser 2009). This opposition is viable not only with respect to local, not-in-my-backyard (Heiman 1990) type of agenda but could also be stretched out to nationwide 'organization of denial' (Jacques et al. 2008) if it receives a substantial media coverage (Antilla 2005, Carvalho 2007).

There is voluminous empirical research on factors of climate change acceptance and disbelief (e.g. McCright and Dunlap 2011a, McCright and Dunlap 2011b, Poortinga et al. 2011; see Hornsey et al. 2016 for a meta-analysis). The general conclusion is that values and concomitant political and environmental worldviews predict climate change perception better than sociodemographic determinants such as gender, income, or level of education (Hornsey et al. 2016). This observation sparked the development of the Value-Belief-Norm theory (Stern et al. 1999, Stern 2000) as a framework of modeling public environmental belief and environmentally significant personal behavior as a function of personal values and worldview (e.g. Poortinga et al. 2012).

Given that the environmental state might be seen as an extension of the welfare state in which the fight against the five 'giant evils' of want, disease, ignorance, squalor, and idleness (Beveridge 2000) now encompasses a new enemy of global environmental threats, as well as acknowledging the crucial role that laypeople play in shaping public policy in the age of risk and uncertainty (Beck 1992), I ask: *do Europeans who are supportive of the welfare state also favor government intervention into the environmental realm?* Conceptualizing this question within the framework of the Value-Belief-Norm theory and accounting for political orientation allows for examining whether the effect of a welfare state support is robust or attenuated by other factors that are commonly related to the environmental state support.

3.2 Theoretical Framework and Hypotheses

3.2.1 What is the Environmental State?

The idea of the government taking a leading part in resolving environmental issues and mitigating the consequences of environmental degradation is known under various names. Ecostate (Meadowcroft 2005, 2012), Green state (Dryzek et al. 2003), ecological state (Lundqvist 2001), all these concepts are similar to what this paper will further refer to as the environmental state, broadly understood as 'a state that possesses a significant set of institutions and practices dedicated to the management of the environment and societal–environmental interactions' (Duit et al. 2016). This approach to the eco-management somewhat counteracts the notion of ecological citizenship (Dobson 2007, Hayward 2006) that emphasizes the bottom-up drive of sustainable development and questions the efficacy of government-driven measures.

There is an ongoing discussion as to what constitutes the environmental state and how to rank nations according to their environmental performance (e.g. Dryzek et al. 2003, Jahn 2014, Duit

2016). The latest classification was introduced by Duit (2016) who attempted to arrange nations according to their concern about the environmental issues and came up with four types of environmental states – established, emerging, partial, and weak – that reflect the degree to which the government utilizes its available means – taxation, knowledge generation, policy implementation - to improve the ecological situation. What prevents researchers from coming up with one universal classification is the crucial role that national and historical contexts play in shaping the environmental state in different countries, thus making it more challenging to distill universally comparable indicators of the state performance in this area (Meadowcroft 2008, p. 331-332). However, as Meadowcroft puts it, the very idea of ecological management could not be conceived without the prior recognition of the environmental domain as a potential area of state's responsibility, and its acknowledgement as one of the key areas of political contention (2012).

3.2.2 The Relationship Between the Welfare and the Environmental States

It is commonly accepted in the literature on the history of the environmental state that its evolution has been heavily influenced by the course of the welfare state development (e.g. Gough 2016). Hereinafter, I use a common understanding of the welfare state as a state which decommodifies (Rice 2013, p. 94, Esping-Andersen 2013) social risks and promotes social and economic wellbeing of its citizens.

In a global sense, the development of both welfare and environmental states serve as the response to the challenges brought about by the forces of 'industrialization, urbanization and democratization' (Gough et al. 2008) that could not be coped with adequately by the market, voluntary actions or local authorities (Duit et al. 2016, p. 9, Meadowcroft 2005). Both welfare and environmental states can be considered as an extension of the government to the areas that were previously unregulated by the central authority. State intervention into both domains of societal and environmental protection involves balancing between the implementation of new rules to the market and operating within economic and political constraints; both ideas of the welfare and environmental states are deeply immersed into the discussion of their normative nature and are substantiated by the reasoning of social justice and equality (Meadowcroft 2005, p. 4-8).

Although the parallel trends in the development of these two social systems could hardly be refuted, there are still considerable differences that set welfare and environmental states apart and provoke their separate analysis. Global environmental concerns raise supranational challenges that require collaborative actions and could be barely influenced by the effort of a single country or region; they presume a greater level of uncertainty and unpredictability of the aftermath, putting at a hypothetical risk the entire humankind. The environmental state is also characterized by the preference of the regulatory measures over the fiscal ones in the way it approaches its challenges, and there is a crucial role that scientists and scientific expertise play in measuring, defining, and modeling environmental threats and proposing possible solutions for its taming (Gough 2016). In contrast, the rise of the welfare state primarily served as a response to the domestic challenges that were less complex in their nature; they were curbed mostly by the fiscal strategies and had almost no scientific expertise in the core of their analysis.

Contemplation over the similarities and divergences in the historical development of these two institutional mechanisms has led to the question of whether the properties of the environmental state are more likely to be observed in already well-established welfare states compared to other socio-political systems. Koch and Fritz (2014) empirically tested this tentative assumption which received a name of a ‘synergy hypothesis’ – the proposition that social-democratic welfare states are more likely to embrace the attributes of the environmental state than liberal market economies (Koch and Fritz 2014, p. 680; Dryzek et al. 2003). However, they concluded that the 'welfare development is largely unrelated to ecological development, and social-democratic countries do not perform better in terms of ecology than liberal ones' (Koch and Fritz 2014, p. 695-696).

To sum up, two perspectives are plausible when thinking about the relationship between public support for the welfare and environmental state. One of them would suggest that, given that both welfare and environmental states presume and legitimize a central role of the government in taking care of its citizens and protecting them from various risks and hazards, as well as taking into consideration the temporal precedence of the welfare state over the environmental one that might influence public thinking, I suggest the following hypothesis: *people expressing higher support for the welfare state would also express higher support for the environmental state (H1a).*

However, bearing in mind the ultimate differences between the kind of challenges that welfare and environmental states are designed to tackle and presuming the predicament that laypeople might find themselves in when trying to comprehend the long-term effects of the environmental change and calculate their risks, it might also be that *people supporting the welfare state would express lower support for the environmental state, or that there would be no statistically significant relationship (H1b).*

The next section introduces the Value-Belief-Norm theory and dwells on the role that values, environmental beliefs, and concerns play in shaping public views on the environmental responsibilities of the government.

3.2.3 The Value-Belief-Norm Theory

The V-B-N theory (Stern 2000, Stern et al. 1999, Stern et al. 1995a) is a framework for studying factors of environmentally significant individual behavior, whether in a form of pro-environmental political activism, eco-friendly consumption practices, or other. This theory posits that there is a top-down causal effect ladder from individual values and ecological worldview down to personal pro-environmental norms and pro-environmental behavior, with the mediation of perceived beliefs about the adversity of consequences and personal ability to reduce environmental threat.

There is evidence of a fruitful application of the V-B-N theory to the studies of willingness to pay for the park conservation (Lopez-Mosquera and Sanchez 2012), choosing an eco-friendly car (De Groot and Steg 2010), or accepting several supply- and demand-side measures of reducing negative environmental effect (Poortinga et al. 2012). An attempt has been made to extend this framework to a cross-national perspective (Oreg and Katz-Gerro 2006).

While in its initial form, the V-B-N theory implements the division between egoistic, altruistic, and biospheric values[6] (Stern and Dietz 1994), in this study I use the value classification proposed by Schwartz and colleagues. Schwartz considers values to be 'desirable transsituational goals varying in importance, which serve as a guiding principle in the life of a person or other social entity' (Schwartz 1992, p. 21). There are two main value dimensions in Schwartz's theory: Openness to change vs. Conservation and Self-enhancement vs. Self-transcendence (Cieciuch et al. 2014, Schwartz et al. 2012). While the first opposition roughly contrasts desire for change with desire for preserving the status quo and is less relevant for the goals of the present research, the latter pair counterpoises concern about personal wellbeing

[6] Although this typology of values differs from that of Schwartz's and colleagues, there is quite a bit of assurance that they overlap considerably, with self-transcendence incorporating altruistic and biospheric views, and self-enhancement resonating with egoistic ones (Schultz and Zelezny 1999, Stern et al. 1995b, p. 1630).

with that of others and nature, thus tapping precisely into the discourse on environmental protection.

There is an ample body of evidence to claim that holders of self-transcendence value orientation are more environmentally cautious in their beliefs, behavior, and worldview. Karp's early research (1996) showed that self-transcendence is positively related to a wide array of environment-friendly consumer and political types of behavior; Schultz and Zelezny (1999) reported that self-transcendence predicts ecocentric rather than anthropocentric concern. Furthermore, the environmental quality value which echoes the domain of self-transcendence is positively associated with environmental concern, support for the governmental intervention into environmental problems, and acceptability of some energy-saving measures. (Poortinga et al. 2004).

Drawing on the Value-Belief-Norm theory, I expect to see that *self-transcendence will be positively linked to the belief in climate change (H2a).* Moreover, treating the very belief in the reality of climate change as a manifestation of the ecological worldview, *climate change belief will be positively related to climate change concern (H2b)*, and both *climate change belief (H2c)* and *climate change concern (H2d) will be positively related to public support for the environmental state.*

3.2.4 Political Orientation and Perceived Role of the State

Acknowledging the pivotal role that the political leaning plays in defining public perception of the government and its responsibilities, I extend the Value-Belief-Norm framework by accounting for people's political orientation. Left political orientation is commonly associated with increased support towards the economically insecure social groups, as well as with more trust in state capacity to successfully tackle various kinds of societal challenges. In contrast, right-wing ideology, as Jost et al. (2003) suggest, primarily emphasizes the resistance to change and acceptance of social inequality (see also Thorisdottir et al. 2007) which has direct implications on the perception of the responsibilities that should be within the scope of the government. Baslevent and Kirmanoglu's (2011) study reports that supporters of the right-wing parties were more skeptical of various welfare schemes, even when values and other sociodemographic variables were accounted for. Moreover, a paper by Piuorko et al. (2011) revealed that at least in liberal democracies left orientation is related to self-transcendence, while the right views are more supported by those endorsing self-enhancement value orientation. Building upon this, I expect that *self-transcendence will be negatively associated with the right political orientation (H3a)* and that *the* r*ight political orientation will be negatively associated with public support for welfare (H3b) and environmental (H3c) states.*

3.3 Materials and Methods

3.3.1 Data

Data for this paper comes from the European Social Survey (ESS 2018) which is a biennial cross-national survey held across European countries and its satellites. The survey employs probability-based sampling and aims for a representative population of each country aged 15 or more. This study uses Round 8 of the ESS which was conducted during 2016 in 23 countries. The core section of the survey on human values combined with rotating sections on welfare attitudes and public attitudes to climate change provide the proper ground for testing the hypothesizes of the research.

3.3.2 Measures

Public support for the environmental state. This measure was constructed out of three questions on public acceptance of various policies aimed at tackling the consequences of climate change (see Table 1 for question wordings). The policies consist of increasing taxes on fossil fuels, using tax money to support renewable energy sources, and implementing legislation against the commercial distribution of energy inefficient household appliances. People responded using a 5-point scale ranging from ‘Strongly in favor’ to ‘Strongly against’. The coding was reversed so that the higher values of the created latent construct reflect higher levels of support for the environmental state.

Climate change belief. Three items were used to measure three dimensions of climate change belief. The *reality* measure asked on the 4-point scale whether the respondent believes that climate is changing at all. The initial answer coding from ‘Definitely changing’ to ‘Definitely not changing’ was reversed so that the higher values reflect the belief in the existence of climate change. The *cause* measure asked people to contemplate about the roots of climate change and choose between natural and human-driven causes. Finally, the *impact* measure asked respondents to evaluate the possible aftermath of climate change on society (11-point scale, from ‘Extremely good’ to ‘Extremely bad’). The latent factor was created out of these variables, and its higher scores reflect more critical beliefs about climate change and its repercussions.

These or similar questions commonly constitute the core of the opinion polls on climate change (see Capstick et al. 2015 for the systematic review; see also Leiserowitz et al. 2017) broadly tapping into the notion of climate skepticism (Rahmstorf 2004, Poortinga et al. 2011, Hoffman 2011, Lahsen 2013).

Climate change concern. The level of concern about climate change was measured with the direct question 'How worried are you about climate change?'. Participants were asked to respond using the 5-point scale from 'Not at all worried' to 'Extremely worried'. Unlike the questions on the belief that tap into the cognitive perception of climate change, this measure aims at reflecting the degree of personal importance attached to climate change and thus can be considered as an indicator of the broader environmental concern (Steg et al. 2011).

Public support for the welfare state. Following the ESS module proposal, this study treats public support for the welfare state as a latent factor that was constructed out of three items asking the respondents to assess on the 11-point scale the responsibility of the government to ensure a reasonable standard of living for such economically insecure social groups as elderly people and unemployed, as well as to provide child care services for employees with children. The obtained factor captures the broad scope of governmental responsibilities (Roosma et al. 2014) and provides a generalized measure of public attitude towards them. Lower values of the factor indicate less support for the welfare state, higher values – more support. The employed indicators are regularly used in studies of social policy (e.g. Emery 2012, Baslevent and Kirmanoglu 2011, Calzada and Del Pino 2011) and are said to be robust in terms of their cross-national measurement equivalence (Roosma et al. 2013).

Self-enhancement and self-transcendence value orientations. ESS measures personal value orientations with the modified version of the Portrait Value Questionnaire (Schwartz et al. 2001) which is an adapted variant of the Schwartz Value Survey (Schwartz 1992, Schwartz and Boehnke 2004, Lindeman and Verkasalo 2005) and is designed to be used in surveys of the general population. PVQ attempts to make the value questionnaire less cognitively demanding so it does not cause difficulties to fill in for people having no schooling. It provides respondents with a set of verbal portraits and asks them to relate themselves with the described person on the 6-point scale (from 'Very much like me' to 'Not like me at all'). The coding of the items was reversed so that higher values represent more agreement with the proposed trait.

The ESS Portrait Value Questionnaire consists of 21 items that are meant to represent 10 values – power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity, and security (Schwartz 2003, p. 267-268). These values form two orthogonal dimensions – Self-enhancement vs. Self-transcendence and Openness to change vs. Conservatism – that capture broader value orientations (Schwartz 2003, p. 269-270). This study ignores the latter dimension as it is less relevant in the context of the environmental issues and focuses on the effects of Self-enhancement and Self-transcendence as these concepts strongly resonate with the values that were initially implemented in the Value-Belief-Norm theory (Schultz and Zelezny 1999, Stern et al. 1995b, p. 1630). Five items constitute the self-transcendence value orientation, and four items form the self-enhancement value orientation[7] (see Table 1). Higher scores on the created constructs represent its greater weight in the psychological portrait of the person.

Political orientation. The following question: 'In politics, people sometimes talk of "left" and "right". Using this card, where would you place yourself on this scale, where 0 means the left and 10 means the right?' was used to assess the political leaning of the respondents. This measure has a rich tradition of operationalizing political views in the opinion polls (Barnes 1971, Klingemann 1972) and there is evidence showing that individual left-right self-identification tends to be stable over time (Sears and Funk 1999). The 11-point answer scale

[7] For the sake of model parsimony and since the 'lower-order' values (i.e., Benevolence and Universalism for Self-transcendence, and Power and Achievement for Self-enhancement) are beyond the scope of this paper they are omitted with manifest variables loading directly on the 'higher-order' value orientations. In the ESS PVQ, the value of Hedonism which is usually attributed to Self-enhancement is treated as a part of the Openness-to-Change value orientation and therefore is not included in the analysis (Schwartz 2003, p. 311).

implemented in the ESS is considered to be the most valid response format for this question (Kroh 2007).

3.4 Data Analysis

As a first step, the descriptive statistics of the observed items were drawn, and the measurement model with 5 latent variables – public support for the environmental state, public support for the welfare state, climate change belief, self-enhancement, and self - transcendence – was carried out to inspect the loadings of the observed indicators on the latent variables (see Tables 1 and 2). The Expected Parameter Change values (EPC) of the measurement model were considered to account for the substantial misspecifications brought by the absence of parameters in the model. Following the guidelines by Saris et al. (2009, p. 570) the parameters with EPC > |0.2| were added to the model to improve fit, that is the covariances between WEL1 and WEL2 (std. EPC .339), WEL1 and WEL3 (-.204), and V2 as an indicator of Self-transcendence (-.277).

After that, the structural model was fit with public support for the environmental state being explained by political orientation, climate change belief, public support for the welfare state, and climate change concern. Other paths required by the hypotheses were also defined – see Figure 1 for a full path diagram. The standardized coefficients were derived and compared, and the model's goodness-of-fit measures were assessed.

Table 1. Wordings, Standardized Factor Loadings and R^2 of the Observed Items in the Measurement Model (n = 44368; FIML[a])

Model factors and their respective observed items	Standardized factor loading[b]	R^2
Public support for the environmental state		
[…] To what extent are you in favour or against the following policies in [country] to reduce climate change?		
Increasing taxes on fossil fuels, such as oil, gas and coal. (ENV1)	.395[c]	.156
Using public money to subsidise renewable energy such as wind and solar power. (ENV2)	.591	.349
A law banning the sale of the least energy efficient household appliances. (ENV3)	.519	.269
Climate change belief		
Do you think the world's climate is changing? (CCB1)	.573[c]	.328
Do you think that climate change is caused by natural processes, human activity, or both? (CCB2)[d]	.490	.240
How good or bad do you think the impact of climate change will be on people across the world? (CCB3)	.542	.294
Public support for the welfare state		
[…] For each of the tasks I read out please tell me on a score of 0-10 how much responsibility you think governments should have.		
Ensure a reasonable standard of living for the old. (WEL1)	.687[c]	.471
Ensure a reasonable standard of living for the unemployed. (WEL2)	.491	.241
Ensure sufficient child care services for working parents. (WEL3)	.735	.540
Self-enhancement value orientation		
[…] Please listen to each description and tell me how much each person is or is not like you.		
It's important to him to show his abilities. He wants people to admire what he does. (V4)	.714[c]	.509
Being very successful is important to him. He hopes people will recognise his achievements. (V13)	.761	.579
It is important to him to be rich. He wants to have a lot of money and expensive things. (V2)[e]	.624	.374
It is important to him to get respect from others. He wants people to do what he says. (V17)	.558	.311
Self-transcendence value orientation		
[…] Please listen to each description and tell me how much each person is or is not like you.		
It's very important to him to help the people around him. He wants to care for their well-being. (V12)	.700[c]	.490
It is important to him to be loyal to his friends. He wants to devote153 himself to people close to him. (V18)	.663	.440
He thinks it is important that every person in the world should be treated equally. He believes everyone should have equal opportunities in life. (V3)	.557	.310
It is important to him to listen to people who are different from him. Even when he disagrees with them, he still wants to understand them. (V8)	.603	.364
He strongly believes that people should care for nature. Looking after the environment is important to him. (V19)	.549	.301

Note: Question wordings are taken from the ESS Round 8 questionnaire available at:
http://www.europeansocialsurvey.org/docs/round8/fieldwork/source/ESS8_source_questionnaires.pdf

All loadings are significant at $p < .01$

[a] Full Information Maximum Likelihood missing treatment.

[b] The completely standardized solution is presented, where both latent and observed variables are standardized.

[c] The unstandardized parameters of these factor loadings are fixed to 1 to define the scale of the corresponding latent variable.

[d] 5-point answer scale with the following categories: 'Entirely by natural processes', 'Mainly by natural processes', 'About equally by natural processes and human activity', 'Mainly by human activity', 'Entirely by human activity'.
[e] V2 also loads negatively on Self-transcendence (-.289, $p < .01$).

The listwise omission of observations with missing information would have resulted in 33355 cases out of 44387 being used (~25% decrease), so the full information maximum likelihood estimation (FIML) approach to missing treatment (Enders and Bandalos 2001) was implemented throughout the analysis as it utilizes all available data in the estimation of the model parameters.

While acknowledging the multilevel structure of data (people nested within countries), I deliberately focus on reporting the single-level model, as the multilevel framework does not seem to add value to the results of the analysis (see Supplementary Materials for discussion).

Table 2. Descriptive Statistics for the Variables in the Analysis

Item	Mean	SD	Min	Max	ICC
Public support for the environmental state					
ENV1 (1 = Strongly against, 5 = Strongly in favour)	2.77	1.23	1	5	0.055
ENV2	3.94	1.07	1	5	0.57
ENV3	3.53	1.17	1	5	0.035
Public support for the welfare state					
WEL1 (0 = Should not be government's responsibility at all, 10 = Should be entirely government's responsibility)	8.17	1.82	0	10	0.066
WEL2	6.73	2.27	0	10	0.059
WEL3	7.84	2.12	0	10	0.103
Climate change belief					
CCB1 (1 = Definitely not changing, 4 = Definitely changing)	3.48	0.69	1	4	0.052
CCB2 (1 = Entirely by natural processes, 5 = Entirely by human activity)	3.42	0.8	1	5	0.033
CCB3 (0 = Extremely good, 10 = Extremely bad)	6.74	2.2	0	10	0.035
Self-enhancement value orientation					
V4 (1 = Not like me at all, 6 = Very much like me)	3.77	1.4	1	6	0.105
V13	3.81	1.37	1	6	0.126
V2	2.89	1.34	1	6	0.137
V17	3.83	1.37	1	6	0.109
Self-transcendence value orientation					
V12 (1 = Not like me at all, 6 = Very much like me)	4.8	1.01	1	6	0.069
V18	5.04	0.95	1	6	0.084
V3	4.82	1.08	1	6	0.048
V8	4.62	1.08	1	6	0.068
V19	4.82	1.05	1	6	0.032
Other variables					
Political orientation (0 = Left, 10 = Right)	5.16	2.24	0	10	0.026
Climate change concern (1 = Not at all worried, 5 = Extremely worried)	3.01	0.93	1	5	0.062

Note: SD = standard deviation; ICC = Intraclass Correlation Coefficient. See Table 1 for item wordings. Number of observations varies per item.

3.5 Results

3.5.1 Descriptive Statistics and the Measurement Model

On average, Europeans tend to support government policies aimed at promoting social wellbeing and curbing environmental risks. Ensuring a reasonable standard of living for elderly people ($\bar{x}$ = 8.17 on the 0-10 scale) and subsidizing renewable energy sources ($\bar{x}$ = 3.94 on the 1-5 scale) are the most advocated welfare and environmental state measures respectively. People also tend to believe in the reality of climate change and consider its impact to be detrimental (see Table 2).

In the measurement model, all indicators load significantly on the respective latent factors (see Table 1). The standardized factor loadings range from .395 (ENV1) to .761 (V13). Overall, it is noticeable that the factor loadings for the concepts that have well-established tools for their measurement (self-transcendence, self-enhancement, public support for the welfare state) are higher than those for newly established latent constructs. Regarding residual variances, the picture varies depending on the construct. For instance, while the variation in ENV1 is explained little by its respective latent variable (R^2 = .156), for Schwartz's value items the portion of accounted variation does not fall below 30.1%. For some items e.g. V4 (R^2 = .509) and V13 (R^2 = .579) more than half of the variation is explained by the latent factor. The measurement model fits well with CFI = .958, TLI = .947, RMSEA = .032 (.031 - .033, p = 1), SRMR = .024. The χ^2(df = 122) = 5727.9 is significant ($p < .01$), yet it is sensitive to the sample size.

3.5.2 The Effect of the Welfare State Support (Hypotheses 1a-1b)

Figure 1 provides standardized parameter estimates for the structural model. When accounting for the effects of other factors, welfare state support has a positive yet relatively modest effect on support for the environmental state (.088, $p < .01$), thus corroborating H1a and rejecting H1b. In total, slightly more than a third ($R^2 = 0.32$) of variation in public support for the environmental state is accounted for by the model.

3.5.3 The Value-Belief-Norm Path (Hypotheses 2a-2d)

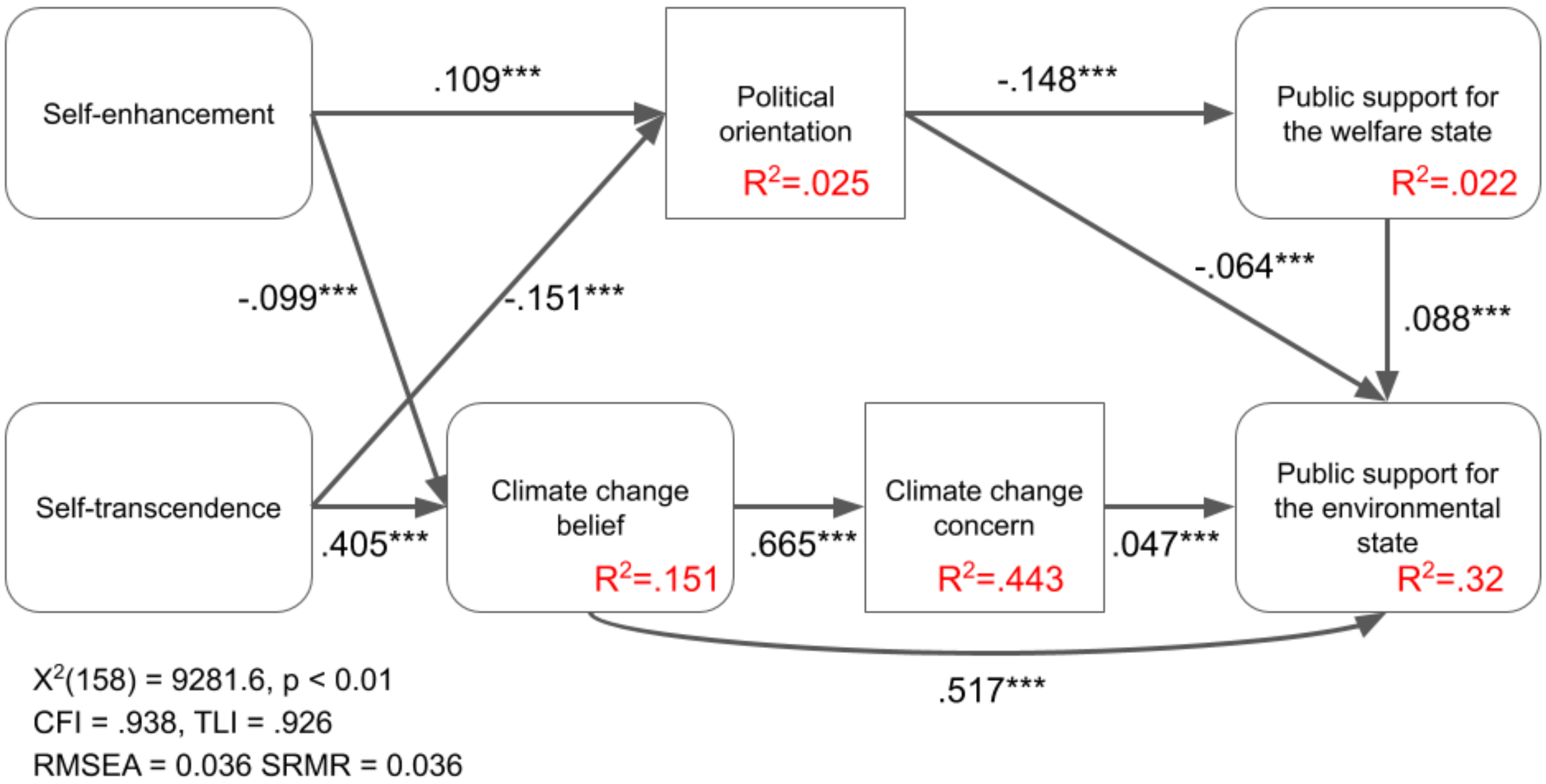
All the hypotheses derived from the V-B-N theory find their confirmation. Self-transcendence has a large standardized positive effect on climate change belief (.405, $p < .01$, H2a confirmed), while self-enhancement shows the opposite effect. Climate change belief strongly predicts climate change concern (.665, $p < .01$, H2b confirmed) and environmental state support (.517, $p < .01$, H2c confirmed). The effect of climate change concern on environmental state support is modest yet significant (.047, $p < .01$, H2d confirmed). Climate change concern is the most explained variable in the model with almost half of its variation ($R^2 = 0.443$) being accounted for by other variables.

3.5.4 The Role of Political Orientation (Hypotheses 3a-3c)

In line with the hypotheses, self-transcendence is negatively related to the right political views (-.151, $p < .01$, H3a confirmed), while there is a positive effect of self-enhancement. Corroborating H3b and H3c, right political orientation is negatively associated with support for the welfare (-.148, $p < .01$) and environmental (-.064, $p < .01$) states.

3.5.5 Model's Goodness-of-Fit

Overall, the model represents data well with conventional goodness-of-fit measures surpassing the thresholds, although the values decrease slightly compared to the measurement model. CFI = .938 and TLI = .926 are above .9, RMSEA = .036 (.035 - .037, p = 1) and SRMR = .036 are below .08 indicating the plausibility of the model. The χ^2(df = 158) = 9281.6 is significant (p < .01) yet it is sensitive to the sample size.



Note: Manifest variables are omitted. Rectangles represent single-variable constructs, ellipses – latent constructs.
* p < .1, ** p < .05, *** p < .01
[a] Full Information Maximum Likelihood missing treatment.
[b] The completely standardized solution is presented, in which both latent and observed variables are standardized.

Figure 1. Path Diagram with Standardized Regression Coefficients (n = 44378; FIML[a])[b]

3.6 Discussion

This research was driven by the question of whether Europeans who express support for the welfare state are also more likely to be supportive of the environmental state. The results suggest that when controlling for other covariates, there is a weak positive effect of support for the welfare state on support for the environmental state, and two lines of interpretation might be put forward in this regard.

The first somewhat conservative interpretation suggests that given the very modest effect of the welfare state support compared to other covariates, it is reasonable to exclude welfare state perceptions from the discussion on the environmental state and its public acceptance. From this perspective, welfare and environmental states should be treated as separate entities not only from the institutional perspective (Meadowcroft 2005, Dryzek et al. 2003) but in the public mind as well. While Koch and Fritz's article (2014) provides empirical evidence for suggesting that the green regulation is almost equally likely to be implemented both in welfare and more liberal regimes, this paper then extends this argument by saying that there is almost no continuity between public views on welfare and environmental regulations.

The fact that there is only a modest cross-national difference in people's responses to the items forming the concepts of public support for the environmental state and belief in climate change reassures this idea by giving ground for treating environmental state and climate change perceptions more as a socio-psychological trait that transcends national borders rather than a derivative from the type of socio-political regime in which people happen to live.

The opposite, more embracing interpretation of the results would stress the persistence of the effect of the welfare state support even in light of the entire Value-Belief-Norm theory that has been conceptualized in this research and is specifically tailored to explain environmentally significant behavior. From this perspective, while people's values and beliefs upon the existence and adversity of climate change account for a larger portion of the variation in their support for the environmental state, there is still room to trace the succession between the public images of welfare and environmental states. In other words, it suggests that the complex and controversial issue of environmental policy development (e.g. Gough 2011) that inevitably faces the need to be publicly legitimized could find its way to success not only through emphasizing the detrimental consequences of global warming and forcefully imposing the ecological identity upon the citizens; it can take a step back and appeal to the etatism-driven idea of the state and its functions. Extending the idea of societal protection by incorporating the notion of collective environmental risks and stretching the very notion of scientific expertise (e.g. Faucheux and Hue 2001) can become those steps that will make people less skeptical about the governmental measures that at first sight might be seen as an excessively exaggerated response to a remote danger and an arbitrary encroachment upon the principles of free-market self-regulation.

Apart from answering the main question of the research, this paper provides a fruitful application of the Value-Belief-Norm theory to the nonactivist environmental behavior (Stern 2000). Overall, the results of this research fall in line with the V-B-N theory validating this theoretical framework not only in explaining eco-friendly consumption practices (Poortinga 2012, De Groot and Steg 2010) or environmental activism (Stern et al. 1999), but also accounting for the government-driven green initiatives. Self-transcendence as the value orientation that emphasizes biospheric concern (Schultz and Zelezny 1999) prompts the environmental worldview making people believe in the existence of global warming, acknowledge its negative societal consequences and express concern about it. The stronger effect of climate change belief compared to climate change concern on support for the environmental state suggests that it is not enough to be worried about global warming to encourage the fight against it; rather it is the cognitive awareness of the issue and its implications that can truly reinforce the development of the environmental state and legitimize it in the public sphere.

Climate change belief, being the strongest predictor of support for the environmental state brings about the importance of promoting ecological worldview (Dunlap et al. 2000) among laypeople to alleviate the acceptance of the environmental policies. Most likely, future green policies will be associated with the price jump on certain types of products (e.g. fuel) and they will also require households to change their already established consumption patterns. Both consequences might be perceived with a certain degree of resistance and therefore it is important for people not only to succumb to the changes in legislation but interiorize them and express full rationally justified personal support.

Political orientation is another factor that affects support for the environmental state when values, climate change belief and other variables are considered. In line with prediction, people leaning towards the right wing of the political spectrum are more reluctant to accept governmental intervention into the environmental realm. While research on the US has shown that conservative political views is a prominent characteristic of climate change deniers (McCright and Dunlap 2011b), it is still to be discovered to what extent economic and identity-protective (Kahan et al. 2012) motives fuel European right-wing supporters' denial of the green state.

Certain limitations of the paper should be acknowledged and might drive further research. First, I unintentionally discard from the analysis the small group of people who are most adamant in their refusal to believe in the existence of climate change. Due to survey design, the respondents who believed that believing that the climate change is definitely not changing (n = 978, ~2% of total n) were not asked other climate change related questions and therefore could not be included in the empirical model. Further research might focus precisely on this group of radical climate change deniers (Rahmstorf 2004, Hoffman 2011, Lahsen 2013) and explore whether their perception of the environmental state is related to their views on the welfare state. If it appeared that there is a positive relationship that would open an avenue for convincing these people of the need to impose taxes on environmentally unfriendly fuels and ban energy-inefficient household appliances through accentuating the general responsibility of the government to take care of its citizens and to reduce personal and collective societal risks. Propagating the features of the environmental state without intervening into the identity of climate change skeptics might be especially promising given how unlikely it is for people to abandon the core constituent parts of their social identity (Kahan et al. 2012, Kahan 2015) even in the presence of solid scientific evidence.

Secondly, I limit the focus of this paper to one type of environmentally significant behavior, namely what is called the nonactivist behavior in the public sphere (Stern 2000). Although arguably this type of environmental behavior fits best the idea of the environmental state as it brings to the fore public support for the state-driven initiatives, there are other types of behavior that are worth inspecting within the proposed framework. For example, it seems intriguing to explore whether the perceived efficacy of the welfare state (e.g. Roosma et al. 2014) might be related to public readiness to engage in environmental activism – involvement in environmental organizations, demonstration attendance, petition signing – and what might be the causal mechanisms explaining this relationship (Stern 2000, see also Fielding et al. 2008).

Lastly, from the methodological point of view, while some of the constructs implemented in this paper (e.g. values and public support for the welfare state) are robust in terms of their explanatory potential and are extensively used in various studies, others are less reliable. The construct of public support for the environmental state although having a great potential to become widely used has not yet been implemented in other surveys in the way it is treated in this paper, and therefore future research should focus on elaborating and refining its methodological properties.

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3.8 Supplemental material

Multilevel SEM

Implementing a single-level model on the data with nested structure (people within countries) might obscure the real parameter estimates by neglecting the country-level differences. The multilevel structural modeling can handle nested data by decomposing variable variance into *within-level* and *between-level* variance, i.e. the one coming from individual-within-country and country differences (Heck 2001, Hox 2002, 2013). While this line of argumentation is indeed sensible, the reason I focus on pooled sample analysis is low values of intraclass correlation coefficient (ICC) across the implemented manifest variables, as well as the inability of basic two-level models to capture country-level differences properly and the convergence issues with more complex two-level models.

The ICC value shows the proportion of variance in a variable which is accounted for by the between level and in case of multilevel factor analysis values higher than .10 indicate that it is desirable to account for the country-level differences in explaining item variation (e.g. Dedrick and Greenbaum 2011, Hox 2002). In this study, the ICC values range from 3.3% to 13.7%, with only 5 items exceeding the 10% cut-off (see Table 2 in the main paper). This suggests that the multilevel analysis might be redundant as there is no particularly noticeable variability across countries.

However, an attempt has been made to run several multilevel models to see whether they can provide any additional insight. Following Hox et al. (2017, p. 300-301), the model with *null* between level (i.e. no defined variance-covariance structure) reports poor goodness-of-fit: CFI = 0.6, TLI = .587, RMSEA = .057, $SRMR_{within}$ = .046, $\chi^2(df = 368) = 40922.1$ ($p < .01$). The model with *independent* between level (i.e. variances are specified, covariances are fixed to 0) reports somewhat better goodness-of-fit: CFI = 0.915, TLI = .907, RMSEA = .027, $SRMR_{within}$

= .044, $SRMR_{between}$ = .368, $\chi^2(df = 348) = 8951.9$ ($p < .01$). As Hox puts it, 'if the independence model holds, there is family-level variance, but no substantively interesting structural model' (2017, p. 300).

The last step in Hox's algorithm is to inspect the model with *saturated* between level i.e. by estimating the full variance-covariance structure. Another name for this type of multilevel setting is a within-cluster model (Stapleton et al. 2016) and it assumes no meaningful interpretation for the second level because there are no substantially defined constructs. However, the optimizer has not found the solution for this model and it has not converged.

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4. Public Perception of Scientists: Partisan and Non-partisan Thinking

Many studies have focused on public trust in science as an institution, and in scientists themselves. The trustworthiness of scientists is often bound up with the messages that they convey and the context in which they communicate. However, in the current study, we examine how the public perceives scientists based on the attributes of scientists themselves, irrespective of their scientific message and its context. Using the online opt-in representative sample of the US adults and running a conjoint experiment, we specifically investigate how scientists' attributes such as sex, race/ethnicity, political ideology, place of work, and field of studies affect their perceived preferability as a scientific adviser to local government. We find that scientists' party identification appears to be the most prominent factor defining their preferability: respondents are prone to partisan bias, preferring scientists who are politically congenial, while Democrat respondents also endorse Independent scientists. Moreover, we find that the effects of place of work and field of studies on scientists' preferability are more pronounced than the effects of socio-demographic characteristics (e.g. sex and race/ethnicity). People tend to prefer scientists affiliated with natural sciences such as physics, medical, and environmental science to those in economics, and especially Democrats prefer those working in universities rather than industry. Identifying the cognitive shortcuts that people use in evaluating scientists can help the wider scientific community foster communication between science and the public sphere.

Keywords: *public perception of scientists; partisanship bias; social identity theory; conjoint experiment*

4.1 Introduction

Understanding how citizens perceive and engage with science is becoming a matter of increasing concern for public policy. The extant body of research in this field is voluminous, but some key themes clearly emerge. Broadly, much of this research has examined civic scientific literacy (Miller 2016), attitudes to science (Allum et al. 2008), public engagement in science policy-shaping (Mejlgaard and Stares 2013; Makarovs and Achterberg 2018), as well as exploring public sentiment around polarizing issues e.g. global warming (Hamilton et al. 2015) or vaccinations (Larson et al. 2016). However, the central role in this field is assigned to the concept of trust in science (Gauchat 2012; Achterberg et al. 2017). Science as a public enterprise cannot prosper without public trust. Despite hot-button issues such as global warming and, more recently, COVID-19, activating partisan conflicts, the best evidence we have shows that overall, the US public expresses a high and stable level of confidence in the scientific community compared to other institutions (Krause et al. 2019).

As abundant as the research is on trust in science as an institution and in scientists themselves, fewer studies have examined in detail the attributes of scientists that are likely to make them appear more or less trustworthy amongst the public. What we do know is that the majority of Americans tend to regard scientists as intelligent, honest, and focused on solving real-world problems (Funk and Hefferon 2019), that scientists working for the universities rather than government or industry are perceived as more trustworthy (Castell et al. 2014), and that there is a gradient of authority related to the specialization within which scientists work (Gauchat and Andrews 2018).

Looking beyond these broad stereotypical perceptions of scientists is necessary in order to understand the public opinion dynamics of particular controversies. Scientists play a pivotal role in communicating the contents of their research to a wider audience and informing policymakers about the implications of their discoveries (O'Brien 2013). Trust in scientists has been found to shape public opinion about scientific controversies (Brewer and Ley 2011), mediate how exposure to mass media translates into beliefs about global warming (Hmielowski et al. 2014), and it can potentially have a positive effect on public trust in science media (Brewer and Ley 2013).

Despite enjoying a high level of public trust in broad terms, the scientific community can face a struggle with signalling the integrity of research to a general audience. One of the reasons for this is that the institutionalized instruments that underpin research integrity – e.g. study preregistration, funding disclosure, peer-reviewing– that are used to indicate adherence to accepted codes of scientific code of conduct are not always transparent and uniformly interpreted by general audiences (Jamieson et al. 2019). The other – even more fundamental reason – is the perceived social distance between scientists and the public (Bourdieu 1985). This divide is reinforced by keeping lay people outside of the dialogue on science policy (Stilgoe et al. 2014) and cultivating the image of scientific research as monolithic and not prone to any kind of 'human' indeterminacy and frailty (Locke 1999). As a consequence, Fiske and Dupree (2014) show that as much as scientists are viewed as competent and intelligent, they are also perceived as 'low-warmth' professionals who are distant from the general public and thus oftentimes unable to ignite trustworthiness and convey the credibility of their research. This status quo hampers the dissemination and legitimization of scientific outcomes and does not facilitate the convergence of opinion between scientists and the public. However, a question that has been somewhat overlooked is whether scientists themselves should be treated as a homogeneous group or whether public preference for scientists is unequally distributed based on their socio-demographic, partisan, and professional characteristics. We aim at addressing this gap by studying how the characteristics of scientists themselves contribute to how they are perceived by the public, irrespective of the scientific message conveyed – a message that may itself trigger heterogenous reactions that color perceptions of the scientists themselves.

For instance, during the COVID-19 pandemic, public perceptions of the chief medical advisor Anthony Fauci are doubtlessly influenced by whether his public health messages have implications congenial to citizens' political ideology.

To accomplish this aim, we run a conjoint experiment that permits us to estimate the relative contribution of a set of scientists' personal attributes to their perceived favorability without being confounded by other contextual factors. We present experimental subjects with a sequence of paired conjoint profiles asking for their preferences between two potential candidates for the role of scientific advisor to local government.

4.2 Theoretical Framework and Hypotheses

4.3 Employing Social Identity Theory to Studying Preferences for Scientists

Social identity theory (Tajfel 1974; Tajfel 1981; Turner and Tajfel, 1986) posits that individuals navigate through the social world by categorizing people into groups, namely into those to whom they feel closeness and similarity (in-group) and those who are perceived as distant and even threatening to them (out-group). One way to maintain a positive social identity for an individual is to demean the out-group by stereotyping some qualities of its members in an intentionally exaggerated way. Stereotypes, hence, serve as a cognitive shortcut that allows people to engage with motivated reasoning –making quick judgements without spending cognitive resources on conscious scrutiny (Kahneman 2011).

In this paper, we examine 5 distinct characteristics of scientists that we believe are the most pertinent when it comes to looking at what might trigger people's judgments about the favorability of scientists and their work that are in principle unrelated to the competences and motivations that scientists might bring to their work. These characteristics are *sex; race/ethnicity; place of work; field of studies; and political identification*.

4.3.1 Sex

Stereotypes concerning sex roles penetrate many aspects of living and are deeply embedded in the current social order. A considerable fraction of these stereotypes conveys a denigrating message about women and often denies that they possess certain traits that are historically seen as owned exclusively by men, such as high-level intellectual abilities (Bian et al. 2017) or strong leadership competencies (Hentschel et al. 2019). Moreover, women are still often expected to prioritize family and caregiving over professional achievements and to engage with household duties more than men (Ellemers 2018). Academia is also subjected to the sex disparities (Carli et al. 2016). Men outnumber women in the number of science majors they take at college, even though up to high school both sexes enrol in roughly the same number of math and science courses (Hill et al. 2010). As a consequence, women tend to be underrepresented in science, especially in the STEM field. The latest NSF Indicators report suggests that although women constitute 52% of the college-educated workforce in 2018, they account for less than a third of all the scientists working in the fields of engineering (16%), computer science and mathematics (27%), and physical science (29%) (NSF 2019). With these considerations in mind, our first expectation is that *women fit the archetypal image of a scientist less well and that therefore they will be perceived as less preferable and trustworthy than male scientists (Hypothesis 1)*.

4.3.2 Race/ethnicity

Another crucial factor that can affect the perception of scientists is their race. People coming from minority ethnic backgrounds are often subjected to prejudice regarding their intellectual abilities and capacity for work (Pieterse 1992; Bogle 2001). Negative stereotyping has been shown to induce stress among African-Americans when they are undertaking tasks framed as tests of cognitive abilities (Steele and Aronson 1995). African-American and Hispanic populations tend to score lower on science literacy than whites, even when educational attainments are accounted for (Allum et al. 2018; NASEM 2016), and they feel more alienated from science overall (Plutzer 2013).

The disparity persists when considering academic employment (Landivar 2013). The latest NSF data shows that ethnic minorities make up only between 10% to 22% of the total science and engineering workforce in the US in 2018 – most dramatically underrepresented in life sciences (10%), physical sciences (11%), and engineering (12%) (NSF 2019). This brings us to the hypothesis that *Black and Hispanic scientists will be perceived as less preferable and trustworthy compared to white (Hypothesis 2.1).*

The opposite set of stereotypes surrounds the identity of Asian Americans. In line with the notion of 'model minority' (Kawai 2005) attributed to Asians, and suggesting a generally positive appraisal of this group, Asians are perceived as more industrious, academically successful (Chang and Demyan 2007) and nerdy (Zhang 2010) than whites and other minorities. They are viewed as more likely to succeed in such intellectually demanding jobs as engineering, computer science and mathematics (Leong and Hayes 1990). Hence, we expect that *Asian scientists will be perceived as more preferable and trustworthy compared to white (Hypothesis 2.2)*.

4.3.3 Place of Work

Levels of public trust in institutions vary depending on whether they are state, industry or academic. Scientists working in these domains may be viewed differently too. NSF data highlights that 40% of the US population has a 'great deal of confidence' in the scientific community in 2016, while half this fraction trusts major companies (18%), organized labor (13%), the executive branch of the federal government (13%), and congress (6%) (NSF 2018).

There is a long debate about the impact of market efficiency and private profits on the integrity of the scientific enterprise (Chalmers and Nicol 2004). The opponents of the commercialization of research claim that it can lead to widely occurring conflicts of interests, restricted public access to the benefits of research and constraints on the circulation of ideas within the broader scientific community (Small and Mallon 2007). Privately funded scientists may be motivated more by the external (profit) rather than intrinsic (public good, benevolence) factors, thus compromising the credibility of their scientific claims (Critchley 2008).

Scientists working for the governmental research institutes, albeit being less vulnerable to accusations of profit-related self-interest, are open to being mistrusted from a different perspective. Public confidence in the government has been gradually eroding from the 1960s up until now (PEW 2019). One of many potential reasons for this is a growing perception that important information is concealed from the public (Rainie and Perrin 2019), leading to the emergence of alternative narratives or conspiracy theories e.g. about 9/11 (Wood and Douglas 2013) or the John F. Kennedy assassination (Swami and Furnham 2014) or more recently QAnon (Tollefson 2021).

Nevertheless, universities, although undergoing democratization and being increasingly demanded for transparency, accountability and public participation (Stilgoe et al. 2014, Fuller 2011), are still regarded as the most credible producers of scientific knowledge as far as the public is concerned. Therefore, we propose the hypotheses that *scientists coming from industry will be viewed as less preferable and trustworthy (Hypothesis 3.1)* and *those working for universities will be viewed as more preferable and trustworthy (Hypothesis 3.2) than scientists working for the government.*

4.3.4 Field of studies

There is a rich scholarship on how scientific disciplines engage in boundary-work (Gieryn 1983; 1999) to delineate themselves from each other and from non-science, thus legitimizing knowledge claims, attracting more resources and gaining influence in the public sphere (Cetina 2009; Kagan 2009).

Gauchat and Andrews examined how the public maps sciences according to their 'cultural authority', that is to say the perceived scientific prestige of the field and the degree of autonomy it possesses in relation to the institutions and actors holding political and economic power (Gauchat and Andrews 2018, Gauchat 2011). They show that while hard sciences such as physics, medicine, and biology tend to score high on the dimension of scientific prestige and stay neutral in terms of their autonomy-heteronomy, economics appears to the US public as characterized by heteronomy and moreover is not perceived as a very scientific discipline (Gauchat and Andrews 2018).

Some fields are prone to permeation by conspiratorial theories. Contentious topics such as vaccination (Kata 2010), infectious diseases (Cohen and Carter 2010), climate change (Douglas and Sutton 2015) – and their respective scientific fields (e.g. medical and environmental sciences) – are more likely to be contaminated by conspiratorial narratives and undermined as sources of valid and indisputable knowledge than, say, physics whose authority is rarely questioned.

Given this, we hypothesize that *physicists and those coming from environmental and medical sciences will be viewed as more preferable and trustworthy than economists (Hypothesis 4.1)*, and *physicists will be viewed as more preferable and trustworthy (Hypothesis 4.2) than those coming from environmental and medical sciences.*

4.3.5 Partisanship

Party identification (partyID) could be used as a perceptual screen to quickly identify trustworthy actors (Fiske and Dupree, 2014). Relatedly, partyID is known to affect how people process information and make inferences from data (Kahan et al. 2017). The idea of motivated (Lewandowsky and Oberauer 2016; Chen et al. 1999) or identity- protective (Kahan et al. 2007) cognition boils down to the notion that when facing controversial questions that are in principle to be processed via objective and unbiased scrutiny, people are rather inclined to shape their answers and attitudes in a way that shields their core beliefs and identities from being threatened. Thus, if scientists visibly endorse a particular political ideology, people tend to apprehend the content of those scientists' messages differently depending on their own political orientation. The ongoing debate on climate change serves as a clear example of motivated thinking (McCright and Dunlap 2011). Empirical research shows that increased levels of education (Hamilton et al. 2015) and scientific literacy (Kahan et al. 2012) lead to more acceptance of climate change among Democrats, yet do not change opinions among Republicans. Similar narratives can be found in the discussion on nanotechnologies (Kahan et al. 2009) and vaccination behavior (Kahan et al. 2010).

Building upon this idea, we hypothesize that *people will more likely prefer those scientists who express the same political stance as they do, e.g. Democrats will more likely prefer those scientists who identify as Democrats, and Republicans will more likely prefer Republican* *scientists (Hypothesis 5.1).* Additionally, the effect of partisanship for scientists working for the government or universities may differ from that which operates for those working for commercial organizations, since scientists working in industry may be perceived as less principled and to allow their ideological positions to influence how they present their work when there is a conflict of interest. Therefore, we also anticipate that *the effect of scientists' partisanship will interact with their place of work (Hypothesis 5.2).*

4.4 Materials and Methods

We adopt a conjoint survey experiment design, which is extensively used in marketing research to reveal multidimensional consumer preferences (Green et al. 2001). This survey experimental design had little traction in social and political science until Hainmueller, Hopkins, and Yamamoto (2014) established a formal model linking the conjoint design to the Neyman-Rubin causal model, without invoking strong model assumptions. Following their canonical study, conjoint experiments have been designed to study various topics, such as immigration preferences (Hainmueller and Hopkins 2015); the social construction of illegality (Flores and Schachter 2018); attitudes toward asylum seekers (Bansak et al. 2016); and more frequently, candidate preferences (Sen 2017, Kirkland and Coppock 2018). Unlike traditional factorial survey experiments, conjoint experiments are designed to optimize the capacity to decompose the effects of multidimensional traits simultaneously. More precisely, a conjoint design allows researchers to disentangle the effects of multiple causal factors on subjects' preferences, choices or ratings over distinct candidates or stimuli through hypothetical scenarios. Hainmueller and colleagues argue that conjoint experiments can measure individuals' choices in real-world situations, comparing their experimental estimates to behavioral benchmarks in real-world outcomes to ensure external validity.

Given the methodological advantages outlined above, we regard the conjoint design to be well suited for studying public perceptions of scientists, who are often presented by media to the public on the basis of their personal characteristics and professional affiliations. Thus, in our conjoint design, we created a scenario where respondents are asked to compare and judge the profiles of hypothetical scientists, in five rounds, who vary along multiple dimensions, such as sex, race/ethnicity, scientific field, place of work, and in some randomly selected cases, political party identification. SI Appendix provides both the details of the scenario and a full list of attributes in these dimensions.

The experiment was designed in Qualtrics and performed in March of 2020 after the study was preregistered at https://osf.io/fe2s9 and granted ethical approval at the University of ***** (ETH1920-0447), with US adults recruited through Prolific, which provided us with a high quality online opt-in representative sample based on age, sex, and ethnicity (Peer et al. 2017). SI Appendix provides the demographic characteristics. All questions and question blocks were randomly ordered to avoid spillover effects. Following the suggestions of Hainmueller et al. (2014), we employed a paired profiles conjoint with forced-choice design (see SI Appendix, Fig. S1.), in which two scientist profiles are presented next to each other. The main advantage of this design is that it allows respondents to compare two scientists on each attribute simultaneously and encourage them to more thoroughly engage with the information about the scientists. Additionally, in our design the respondents were also asked to rate both profiles on rating scales in order to measure different dimensions of trust for a robustness check (see SI Appendix, S7-10.). Research subjects may use cognitive shortcuts in evaluating profiles, for instance, over-weighting the first attribute shown to them or some particularly salient attributes. Hence, we randomized the order of the attributes for each pair of profiles. Last but not least, drawing on the same strategy as adopted by Kirkland and Coppock (2018) and Sen (2017), in order to directly test the salience of partisanship and its impact on other attributes, a randomly half of respondents were shown the scientists' political party identification in the paired profiles while the others were not. Our main outcome variable measures research subject's scientist preference, which is asked "Which of these two scientists do you prefer to elect as the member of the Board of Scientific Councillors in your district?" In order to reflect on the multidimensionality of trust (general trust, epistemic trust, and normative trust), we also employ three more outcome variables on 7-point scales (see SI Appendix, Table S3.). In analyzing the effects of our experimental manipulations on these four dependent variables, we follow an alternative non-parametric estimation strategy as suggested by Hainmuller et al. (2014). That is, the causal quantity of interest is called the Average Marginal Component Effect (AMCE) rather than the Average Treatment Effect (ATE), which precisely represents how much the probability of choosing a scientist profile would change, on average, if one of the scientist's attributes (e.g. scientific field) was changed from one level to another (e.g. from economics to physics). The AMCEs can effectively be estimated without bias, using a following linear regression model:

$$y_{ijk} = \alpha + \sum_{l=1}^{4} \beta_l' x_{ijkl} + \epsilon_{ijk}, \qquad [1]$$

where y_{ijk} is respondent i's preferences for scientist $j \in \{1,2\}$ in the k^{th} task ($k \in \{1, 2, 3, 4, 5\}$); α is an intercept; x_{ijkl} is a vector of dummy variables showing that scientist j in the k^{th} task of respondent i trusted or mistrusted; β_l is a vector of those dummy variables' coefficients; and ϵ_{ijk} represents individual-level idiosyncrasies, an error term. We make the required assumption that the errors are independent of each other and of scientist attributes, which is justified by the experimental design. Since the respondents are given two profiles to evaluate in five rounds, standard errors are clustered by respondent to avoid biased estimates of the variance. We separately estimate Equation 1 based on two subsets of sample, in which scientists' dimension of party identification is randomly added to the list of attributes for some respondents. In addition, we condition the estimation on the research subject's political identification to detect heterogeneous treatment effects.

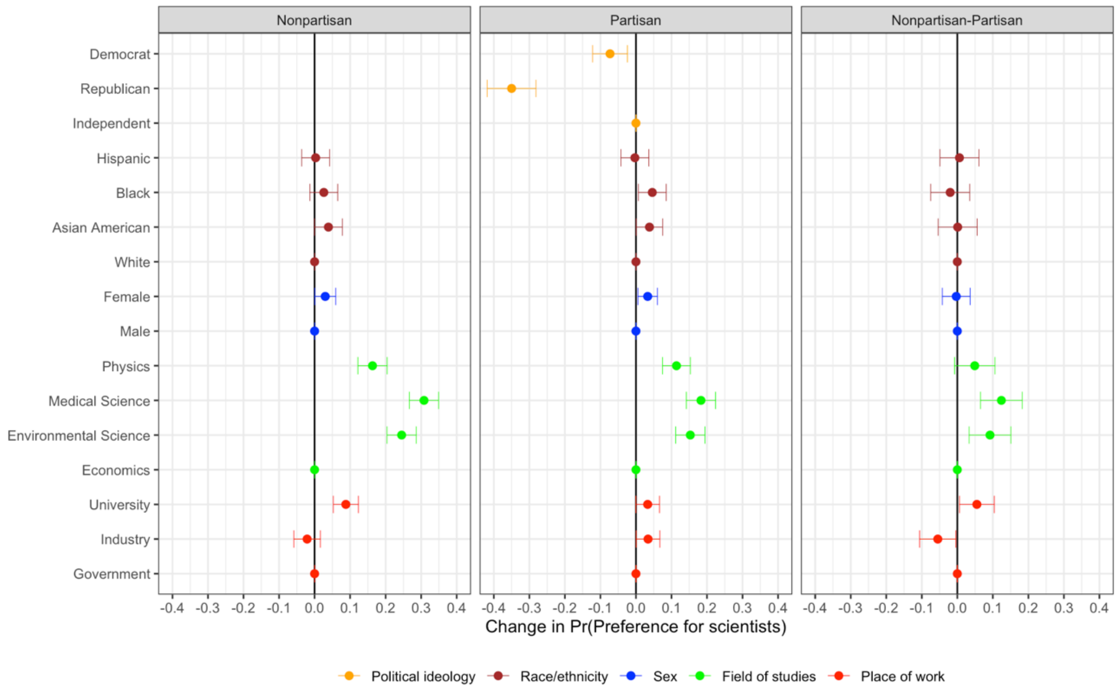
4.5 Results

4.5.1 Estimated Average Marginal Component Effects

We present average marginal component effects (AMCEs), as well as reporting marginal means in SI Appendix. First, we separately present the effects of scientists' attributes for those respondents who were randomly selected to receive and not to receive the attribute of scientists' political party identification in the conjoint profiles. Second, we examine how the attribute of place of work is moderated by scientist's political party identification. Third, we report conditional AMCEs and marginal means to examine potential heterogeneous treatment effects of scientists' attributes by respondents' political party identification. Last but not least, we also test the effects of scientists' attributes on the extent to which they are perceived to be trustworthy along several dimensions of trust (see SI Appendix, Fig. S8).

In column one of Fig. 1, the effects of changes in attributes of scientists on the probability of preferring for scientists are shown without the party identification attribute whose presence in conjoint profiles randomly varies across respondents. The results indicate that respondents clearly prefer scientists who are specialized in natural sciences by a margin of 16-31 percentage points (SI Appendix, Table. S4.), relative to scientists in economics, corroborating *Hypothesis 4.1*. In contrast to our expectation for *Hypothesis 4.2*, scientists coming from physics are favored less compared to those coming from medical and environmental science (SI Appendix, Fig. S10.). The results also support *Hypothesis 3.2*, that respondents are more likely to prefer scientists working at universities to scientists working for the government, by a margin of 9 percentage points (SI Appendix, Table. S4.). Even though respondents slightly prefer Asian American, Black and female scientists relative to white male scientists, these effects are very small. (SI Appendix, Fig. S10.). While the finding confirms *Hypothesis 2.2*, it does not confirm that male scientists are perceived more favorably, compared to female scientists (*Hypothesis 1*). When we move to subgroup analysis, we find that Republican respondents are more likely to prefer male scientists, while Democrats favor female scientists (SI Appendix, Fig. S6. and S11).

Fig. 1. Estimated Average Marginal Component Effects. Dots represent point estimates of AMCEs, and segments represent their 95% confidence intervals. Standard errors are clustered at respondent level.



The second column of Fig. 1 shows that, overall, respondents who were exposed to the partisanship attribute, are less likely to prefer partisan scientists relative to politically independent scientists. We examine heterogeneity in these treatment effects by partisanship later. Additionally, once respondents know the political orientation of scientists, the effects of scientific field and place of work are attenuated. The last column of Fig. 1 indicates that respondents statistically significantly alter the marginal weight given to the attribute of scientific field and place of work if they are shown the attribute of political party identification. By contrast, the difference in AMCEs for other attributes is insubstantial.

Analyzing within-design interactions (SI Appendix, Fig. S9.), we find that the change in probability of favoring a scientist working in industry and university, relative to scientists in government does not significantly vary depending on scientist's partisanship in reference to the baseline level, in contrast to our expectation in *Hypothesis 5.2*.

4.5.2 Heterogeneous Effects by Respondent's Party Identification

We reproduce our results conditioning on respondent's own partisanship (SI Appendix, Fig. S6. and S11.). If respondents are not exposed to information regarding scientists' partisanship, being Democrat increases the preference for female scientists by 8 percentage points (SI Appendix, Table. S5.), while Republicans are 6 percentage points less likely to choose female scientists. We also observe that both Republicans and Democrats have a pronounced preference for scientists in natural sciences relative to economists, but Democrats substantially favor environmental scientists more than Republicans do. Although our main theoretical prediction is confirmed -- that respondents prefer scientists working at the universities relative to scientists working for the government -- disaggregated results show that this is true only for Democrat respondents, not Republican respondents. In addition, while Democrat respondents equally favor Democrat and politically independent scientists, Republicans only favor scientists who share their political orientation. This finding confirms our *Hypothesis 5.1*.

The effects of scientists' ethnicity/race and place of work also vary between Democrats and Republicans. Specifically, while scientists in industry are preferred by Republican respondents, Democrat respondents choose scientists at universities over others. Democrats are also 7 and 4 percentage points more likely to favor Asian American and Black scientists respectively, relative to their white counterparts (SI Appendix, Table. S6.). Both Democrats and Republicans remain indifferent to scientists' ethnicity or race except for the case of Asian American and Black scientists.

4.6 Discussion

In this research, we have examined how the presence of various characteristics of scientists can shape public perceptions of them and their preferability for a scientific public advisory role. The strength of our research design, using a conjoint analysis, means that we can evaluate the effect of these attributes simultaneously.

Our results show, rather reassuringly, that the scientific field and type of institution in which scientists work matters more than their ascribed characteristics of sex, race and ethnicity. Those working at universities and in natural and medical sciences are favored over economists and those working in industry or government. This broadly aligns with previous survey findings, where medical and university scientists are amongst the most trusted (Gauchat and Andrews 2018).

Exposure to scientists' partisan sympathies does not alter the importance of demographic features of scientists but is important in weighing the impacts of scientific field and workplace. Overall, there is a preference for scientists in a local scientific advisory role to be politically neutral. However, we find that when we disaggregate these preferences for Democrat and Republican respondents, we find that both groups show a penchant for scientists sharing their own party ID, although in the case of Democrats, politically independent scientists are marginally preferred. It is noteworthy that political orientation acts as a cue in assessing the trustworthiness of scientists despite the fact that in many, if not most, instances, this would have little influence on scientific work. That said, this experiment asks respondents to choose a scientific advisor to local government, which arguably is a role more open to the influence of politics than basic or applied research.

Overall, we find that our results tend to support previous research showing that natural and medical scientists will find it easier to garner trust than social scientists. Race, ethnicity and sex do not appear to act as strongly negative cues, which is contrary to what might have been expected. Consistent with the polarized political landscape in the U.S. more generally, perceptions of partisanship on the part of scientists seem likely to generate differences in the extent to which they are trusted by different groups, rendering consensus on hot scientific topics more elusive.

As for the study's limitations, one of the artifacts of the experimental design that could inflate the disparity in the effects of the scientific field is the way scientific disciplines are worded in the conjoint profile description. While two of them – medical science and environmental science – contain the word ‘science’ in the wording, the other two – physics and economics – do not. Having the word ‘science’ in the phrasing of the scientific discipline could have triggered the respondents to pick scientists from these disciplines as their overall profile might have sounded more professional and relevant to the legend of the experiment, which states that the respondents were asked to choose a member of the board of scientific councilors. While the significance of this effect cannot be estimated with the present data, further research should be more cautious about framing the attribute levels in the conjoint setting, ensuring that all of them share the same principles of wording.

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4.8 Supplemental material

4.8.1 S1. Survey Experiment and Sample Characteristics

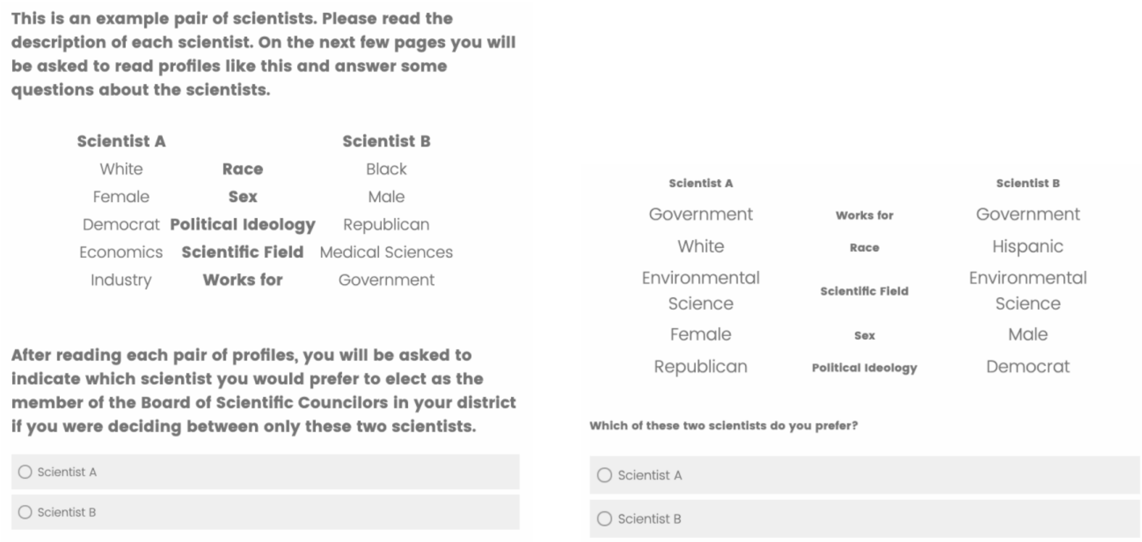
Our survey experiment was fielded in the United States in March 2020. We recruited 1005 participants through Prolific Academic, a large online panel with over 40,000 active participants. Based on Prolific's representative quota sampling, Figure *S2* shows that our sample is fairly representative of the U.S. population in terms of age, sex, and ethnicity.

Our empirical strategy is based on a conjoint survey experiment. This experimental technique allows us to identify individuals' perception of scientists, simultaneously manipulating multiple attributes of scientists through different profiles (Hainmueller et al. 2015). This experimental design provides research subjects with paired profiles of scientists, whose attributes are randomly varied, to ask their preferences over the profiles. In doing so, we are able to identify the causal impact of each attribute of scientists over research subjects' preference for a certain profile. Employing the conjoint experiment, we also aim to better unveil attitudes on sensitive questions such as the effect of scientist's sex or race on public preferences, since this experimental design allows respondents to justify any particular preference with a number of reasons (Hainmueller et al. 2014).

In our conjoint design, we created a scenario where respondents are asked to compare and judge the profiles of hypothetical scientists, in five rounds, who vary along multiple dimensions, such as sex, race/ethnicity, scientific field, place of work, and in some randomly selected cases, political party identification. In addition, in our design, respondents also rate the profiles of scientists on a scale based on their perceived trustworthiness (see *S3*). Table *S1* shows the list of attributes and values for scientists used in the conjoint experiment. Figure *S1* also illustrates the instructions and paired conjoint profiles as seen by respondents during the study.

Table S1. The Conjoint Table

Attributes	Scientist A (Levels)	Scientist B (Levels)
Race/Ethnicity	∈ {White, Black, Hispanic, Asian}	∈ {White, Black, Hispanic, Asian}
Sex	∈ {Male, Female}	∈ {Male, Female}
Political Party Affiliation	∈ {Democrat, Republican, Independent}	∈ {Democrat, Republican, Independent}
Scientific Field	∈ {Physics, Medical science, Environmental science, Economics}	∈ {Physics, Medical science, Environmental science, Economics}
Domain of Work	∈ {University, Government, Industry}	∈ {University, Government, Industry}



(a) Instructional page

(b) An example of paired profiles

Fig. S1. Conjoint Profiles

Variable	Stats / Values	Freqs (% of Valid)	Graph	Missing
sex	1. Male	492 (49.0%)		0
[factor]	2. Female	513 (51.0%)		(0%)
age	Mean (sd) : 45.2 (15.9)	63 distinct values		0
[integer]	min < med < max:			(0%)
	18 < 45 < 99			
	IQR (CV) : 28 (0.4)			
ethnicity	1. White/Caucasian	741 (73.7%)		0
[factor]	2. African American	135 (13.4%)		(0%)
	3. Hispanic	39 (3.9%)		
	4. Asian	67 (6.7%)		
	5. Native American	2 (0.2%)		
	6. Pacific Islander	2 (0.2%)		
	7. Other	19 (1.9%)		
politics	1. Democrat	519 (51.6%)		0
[factor]	2. Republican	192 (19.1%)		(0%)
	3. Independent	294 (29.2%)		
education	1. Less than High Schoo	9 (0.9%)		0
[factor]	2. High School / GED	102 (10.2%)		(0%)
	3. Some College	233 (23.2%)		
	4. 2-year College Degre	98 (9.8%)		
	5. 4-year College Degre	371 (36.9%)		
	6. Masters Degree	146 (14.5%)		
	7. Doctoral Degree	18 (1.8%)		
	8. Professional Degree	28 (2.8%)		
religion	1. No religion	452 (45.0%)		0
[factor]	2. Christianity	466 (46.4%)		(0%)
	3. Buddhism	12 (1.2%)		
	4. Hinduism	8 (0.8%)		
	5. Judaism	18 (1.8%)		
	6. Islam	13 (1.3%)		
	7. Any other religion	36 (3.6%)		

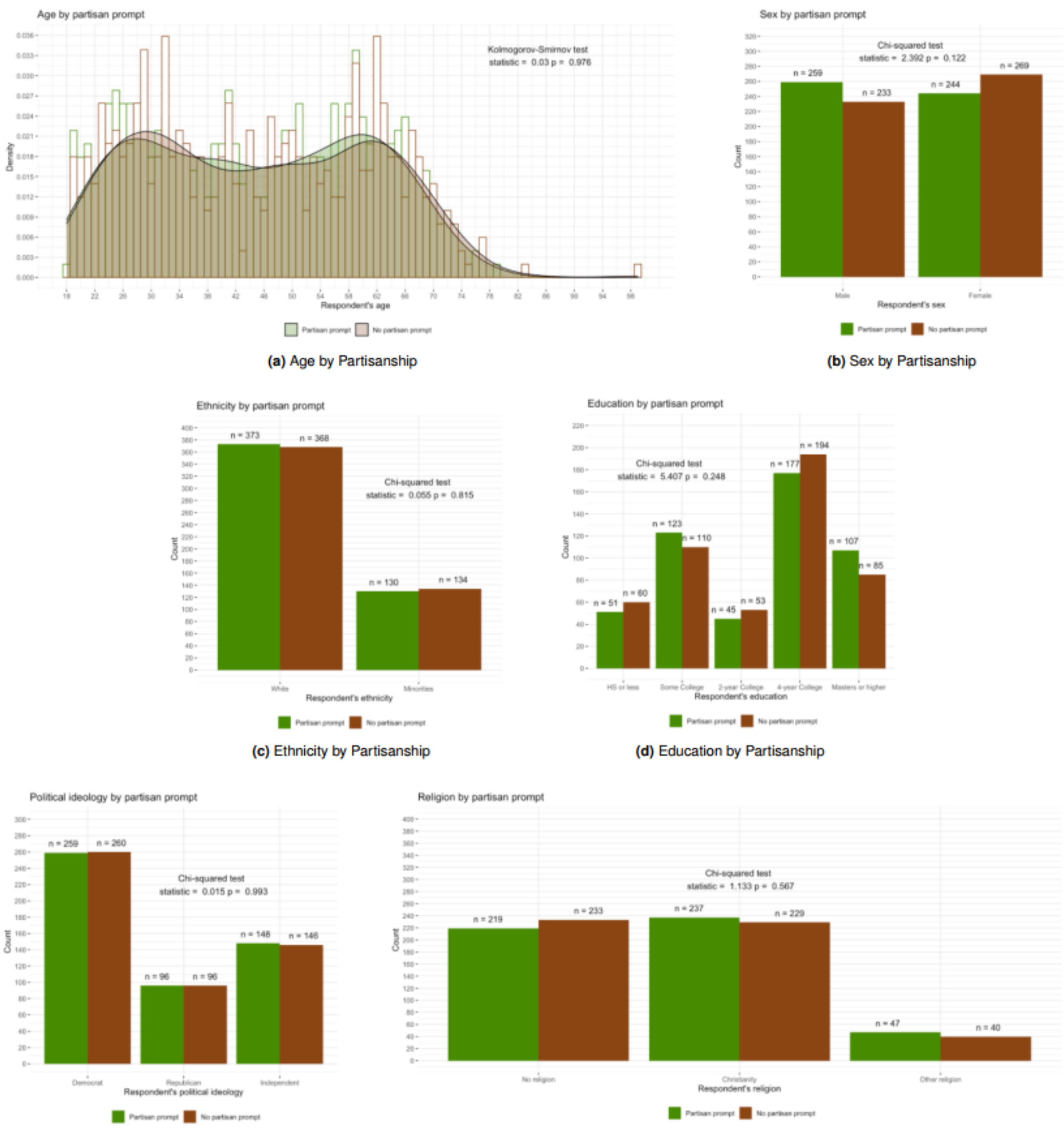
Fig. S2. Sample characteristics

4.8.2 S2. Covariate Balance Testing and Carryover Effect Testing

Table *S2* and Figure *S3* show that the randomization of receiving partisan prompt in a paired profiles conjoint balanced potential confounding factors on average. This ensures the internal validity of the between-subjects design by conducting the Kolmogorov–Smirnov and Chi-squared tests for covariate balance check below.

Table S2. Covariate Balance Check

Covariate	Not receiving partisan prompt (n=502)	Receiving partisan prompt (n=503)
Age		
Age	45.37	45.00
Sex		
Male	0.46	0.51
Female	0.54	0.49
Ethnicity		
White/Caucasian	0.73	0.74
African American	0.14	0.13
Hispanic	0.05	0.03
Asian	0.06	0.08
Native American	0.00	0.00
Pacific Islander	0.00	0.00
Other	0.02	0.02
Party Affiliation		
Democrat	0.52	0.51
Republican	0.19	0.19
Independent	0.29	0.29
Education		
Less than High School	0.01	0.01
High School / GED	0.11	0.09
Some College	0.22	0.24
2-year College Degree	0.11	0.09
4-year College Degree	0.39	0.35
Masters Degree	0.13	0.16
Doctoral Degree	0.02	0.02
Professional Degree (JD, MD)	0.02	0.03
Religiosity		
No religion	0.46	0.44
Christianity	0.46	0.47
Buddhism	0.01	0.01
Hinduism	0.01	0.01
Judaism	0.01	0.03
Islam	0.01	0.01
Any other religion	0.04	0.03



(a) Age by Partisanship

(b) Sex by Partisanship

(c) Ethnicity by Partisanship

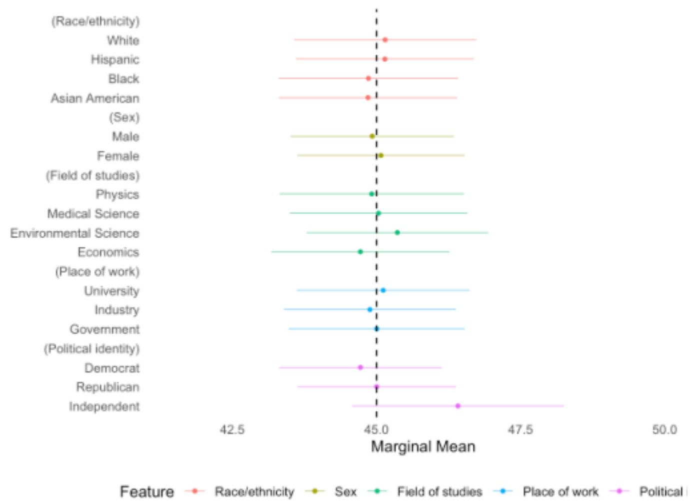
(d) Education by Partisanship

(e) Political Identification by Partisanship

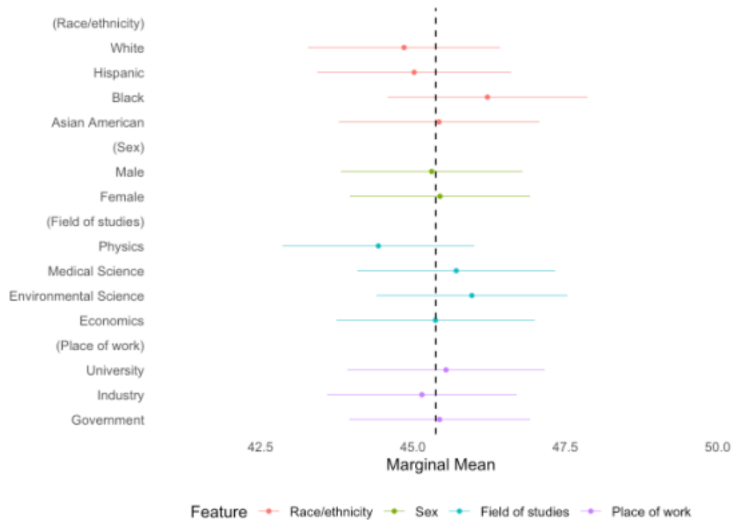
(f) Religion by Partisanship

Fig. S3. Covariate balance

We also controlled whether our within-subjects design is balanced. In order to ensure that each level of attributes is uniformly distributed, we compared a covariate (respondent's age) across different levels of attributes. Confidence intervals of marginal means in Figure *S4* show that the potential imbalance does not significantly affect our estimates.



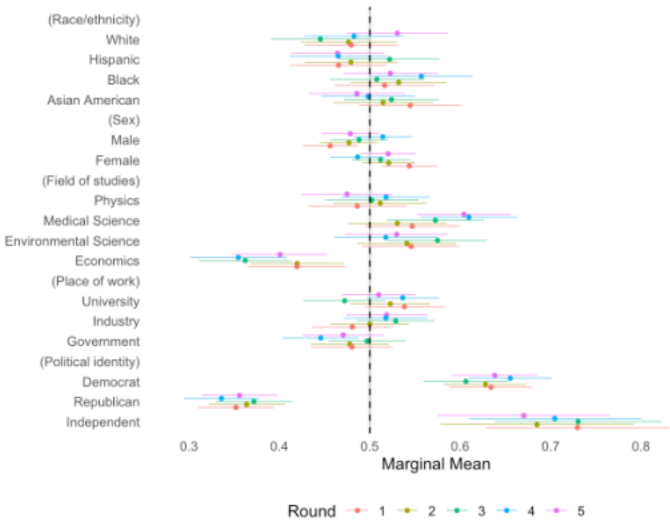
(a) Balance testing using respondent's age for profiles with partisan prompt



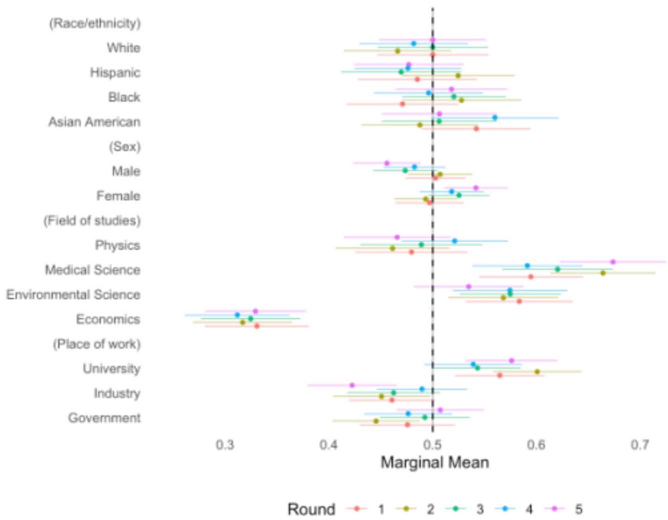
(b) Balance testing using respondent's age for profiles without partisan prompt

Fig. S4. Balance testing

In ensuring the internal validity of within-subjects design in our conjoint experiment, we also checked the assumption that respondents do not assess the profiles in subsequent rounds with carrying over the effect from one task to another so that multiple observations from the same respondent can be treated as independent of one another. Figure *S5* shows that there is no considerable pattern for such instances.



(a) Profiles with partisan prompt



(b) Profiles without partisan prompt

Fig. S5. Testing Carryover Effects

4.8.3 S3. Heterogeneous Treatment Effects by Respondent's Party Identification

The main results show that respondents, on average, are less likely to prefer partisan scientists, relative to politically independent scientists. Nonetheless, we are aware that our sample distribution is skewed to Democrats as other opt-in online survey panels. This may obscure some heterogeneous treatment effects by respondent's partisanship. Therefore, we also provide the results of heterogeneous treatment effects by respondent's partisanship. As Tables *S5*, *S6*, *S7* and Figure *S6* show, while Republicans are more likely to prefer their co-partisan scientists, relative to politically independent scientists, Democrats favour less their co-partisan scientists relative to independent scientists. That said, we should note that measuring respondents' support for their co-partisan scientists (the difference between two conditional AMCEs across subgroups: Republican and Democrats respondents) through average marginal component effects is based on a reference category. Therefore, the choice of reference category has inferential consequences in conjoint analyses. In order to show differences in preferences between partisan subgroups, we also directly estimate the subgroup differences using conditional marginal means and differences between conditional marginal means, in addition to the difference-in-AMCEs (see Figures *S10* and *S11*).

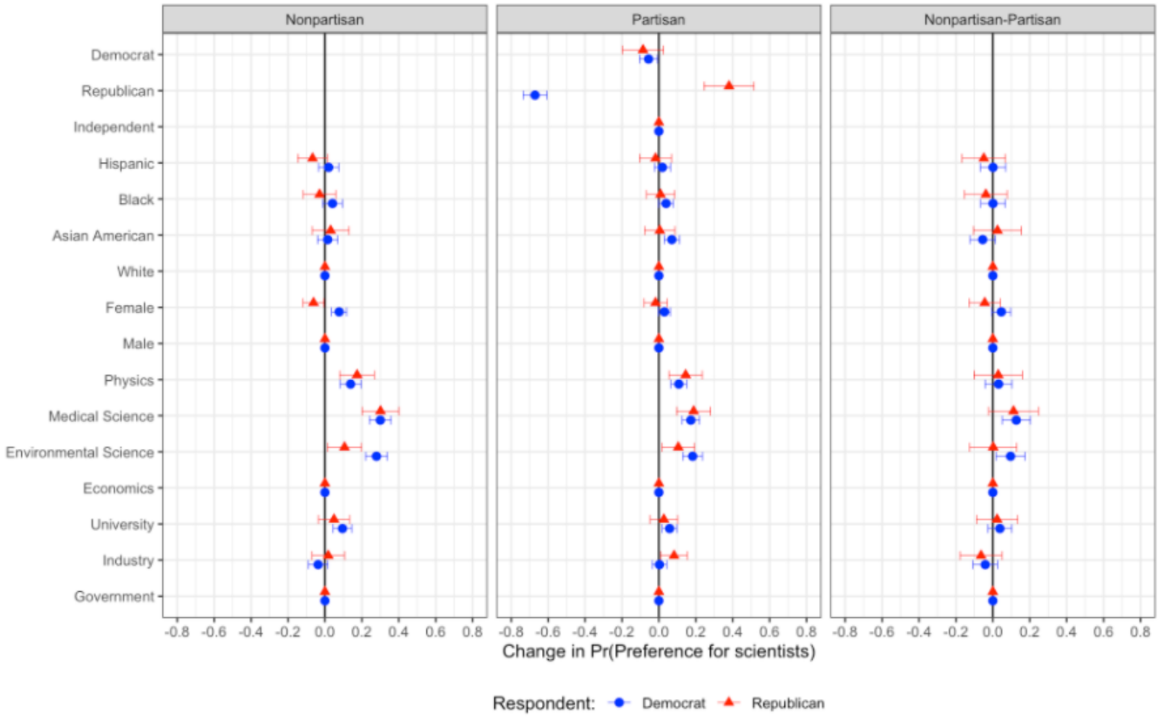


Fig. S6. Heterogeneous Treatment Effects by R's Political Identification

4.8.4 S4. Alternative Operationalization – Multidimensionality of Trust

In understanding public perception of scientists, we also analyze trust in scientists from various angles (Fiske and Dupree 2014), including credibility and fairness, in addition to public preferences. That is, scientists can earn public's trust in their competence or qualifications but not necessarily their fairness when conducting research. Hence, we distinguish general trust (how much would you trust Scientist A and B?) from epistemic trust (where would you place your assessment for this candidate's qualifications?) and normative trust (how much would you agree that this potential candidate cares about the best interests of the public when conducting his/her research?). Measuring these three alternative dependent variables, we used a 7-point scale (e.g. where 7 is strongly trust and 1 is strongly mistrust) rather than a binary variable approach to be able to test our main findings with an alternative measurement model. Table *S3* and Figure *S7* report the descriptive statistics and distributions of these three variables.

Table S3. Descriptive Statistics of Trust Variables

	Mean	Std.Dev	Min	Median	Max
1. General trust	5.26	1.25	1.00	6.00	7.00
2. Epistemic trust	5.63	1.09	1.00	6.00	7.00
3. Normative trust	5.38	1.22	1.00	6.00	7.00

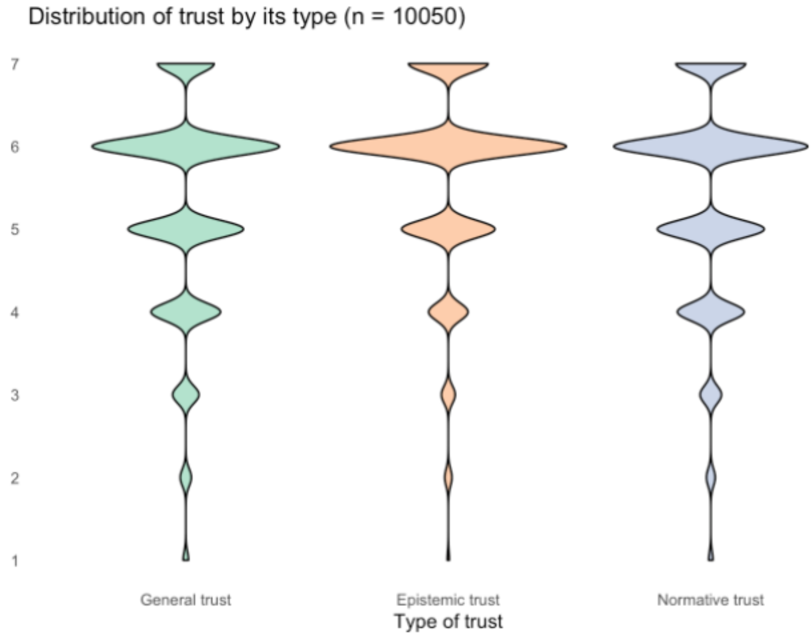
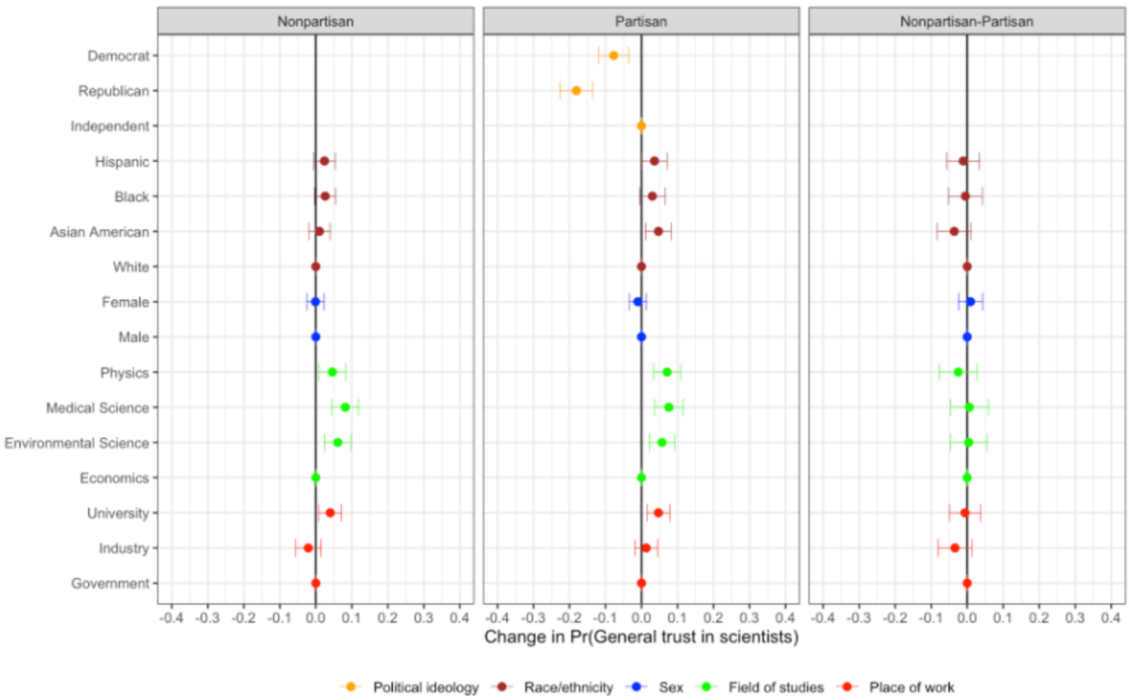


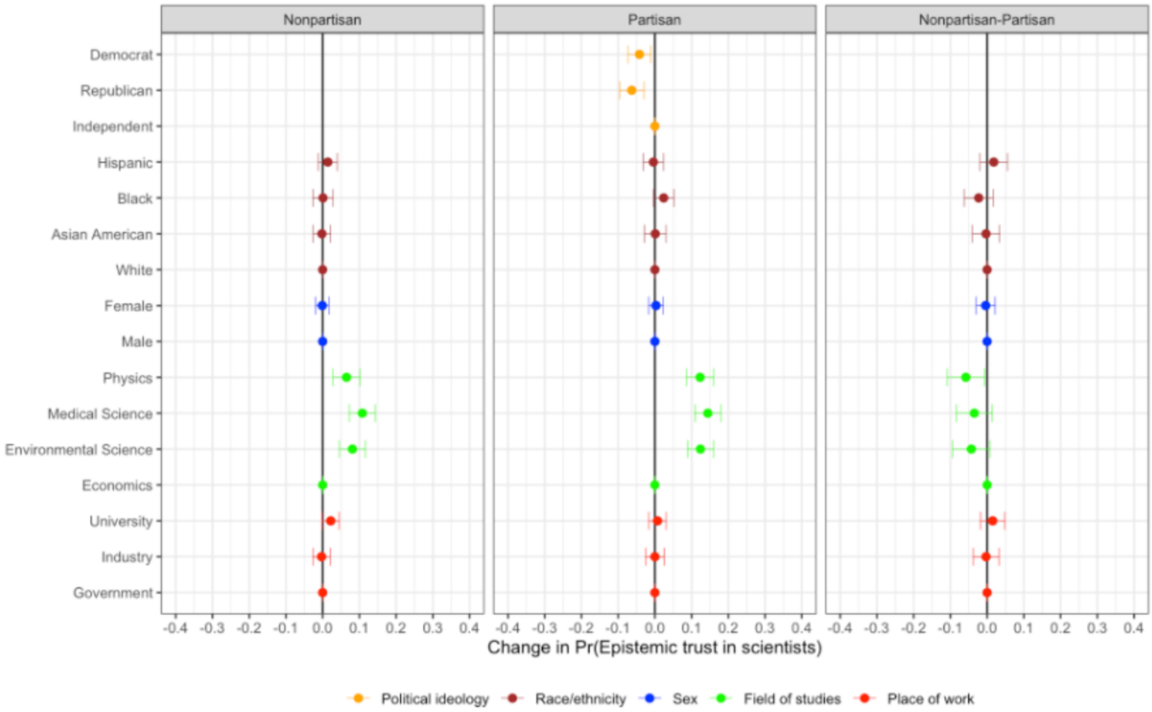
Fig. S7. Distribution of Trust

Tables *S8*, *S9*, *S10* and Figures *S8* demonstrate that the majority of our main findings hold across all dimensions of trust albeit with reduced effect sizes. That is, while respondents trust natural scientists more by 3-11 percentage points relative to economists, the effects for sex and race/ethnicity are either muted or are negligible across all measures of trust. Given that respondents are less likely to trust partisan scientists relative to politically independent scientists across all measures of trust, the effects of partisanship become relatively smaller, but the effects of field of studies become more salient when respondents evaluate the trustworthiness of scientists based on their qualifications, namely epistemic trust. Thus, once scientist's competence is the focal point in determining trustworthiness, the impact of partisanship becomes less salient.

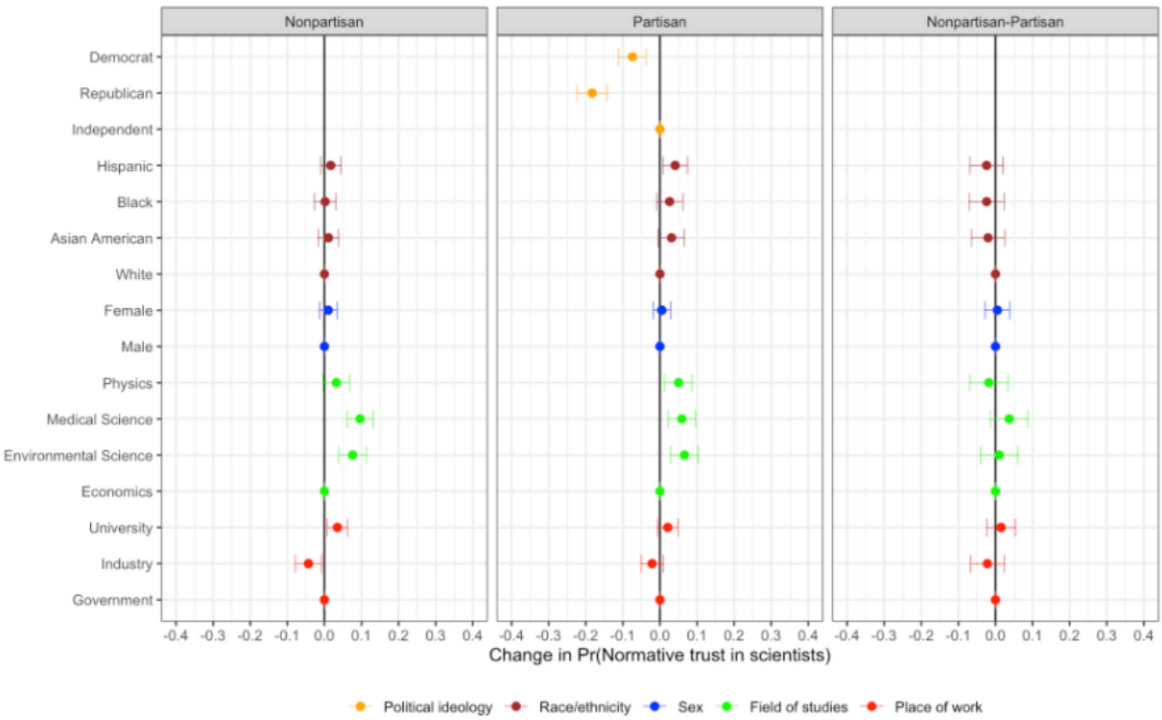
Considering the perceived prestige of the scientific fields (4), we confirmed one of our hypotheses that scientists working in the fields of physics, medical and environmental science are perceived as more trustworthy relative to those from economics, especially in the context of epistemic trust. In line with the main results, we confirm another set of hypotheses that respondents are more likely to trust scientists working at universities, relative to scientists working for the government, but they are less likely to trust scientists in the industry in context of the normative trust. Overall, this shows that people trust natural scientists more than economists, and the gap becomes wider when trust is conceptualized based on competences. Also, people become less trusting towards scientists working for the industry when trust is concerned with public interests.



(a) General Trust



(b) Epistemic Trust

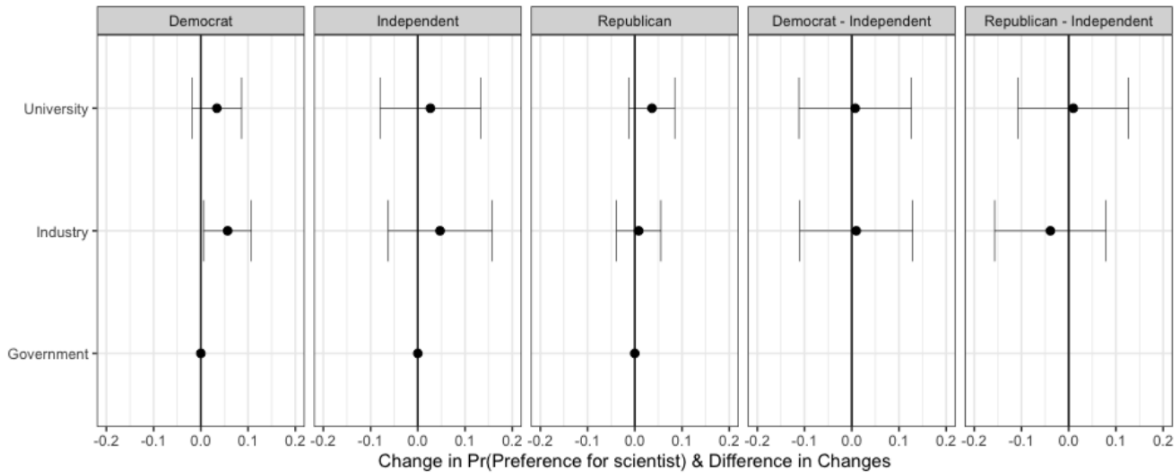


(c) Normative Trust

Fig. S8. Multidimensionality of Trust

4.8.5 S5. Additional Results (Within-design Interactions)

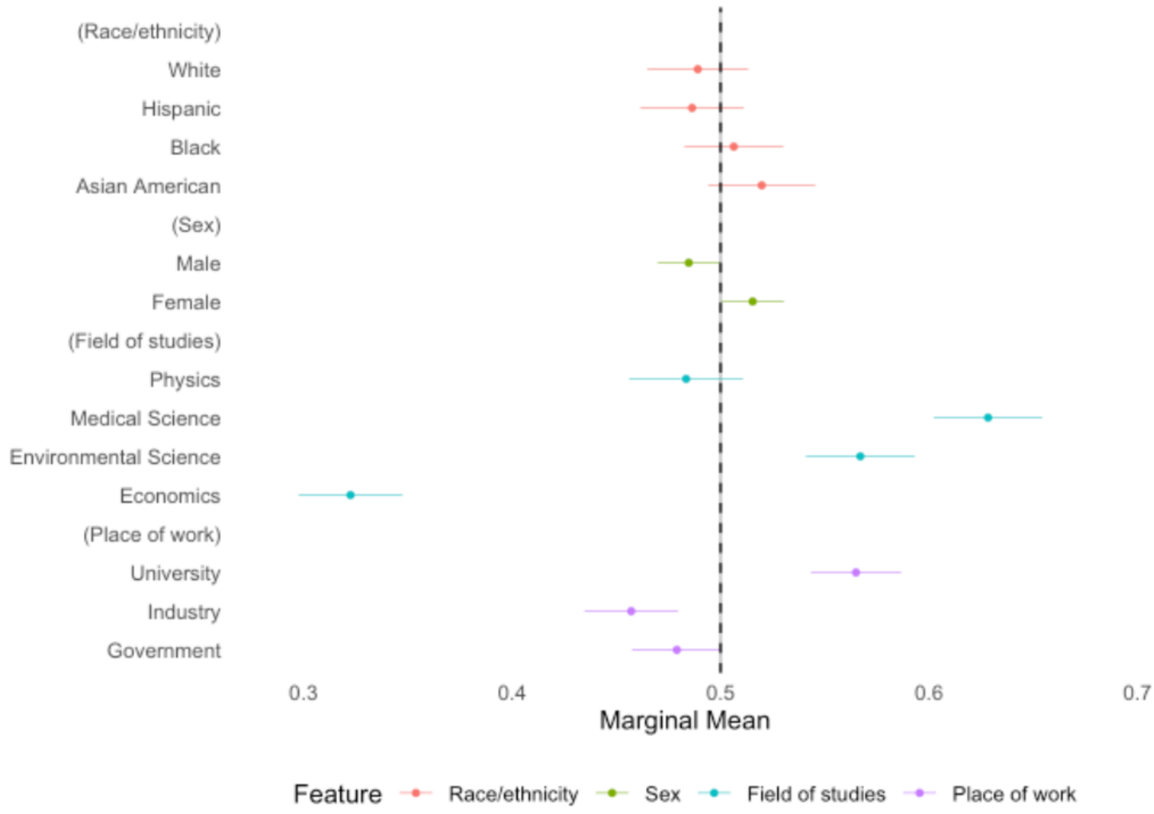
Given the results in Table *S11* and Figure *S9*, we test the hypothesis that the effect of the attribute "domain of work" on favouring a scientist varies across scientist's party identification attribute, corresponding conditional average marginal component effects (AMCEs) and average component interaction effects (ACIEs) for the attribute: scientist's party identification. The first three panels represent the estimated AMCEs of scientists' domain of work, conditional on the scientist's party identification. The rightmost two panels show the average component interaction effects (ACIEs) with respect to party identification and domain of work. Overall, there appear to be no substantively meaningful differences in preferences for the attribute "domain of work" conditional on scientist's party identification, in reference to the baseline level (being politically independent).



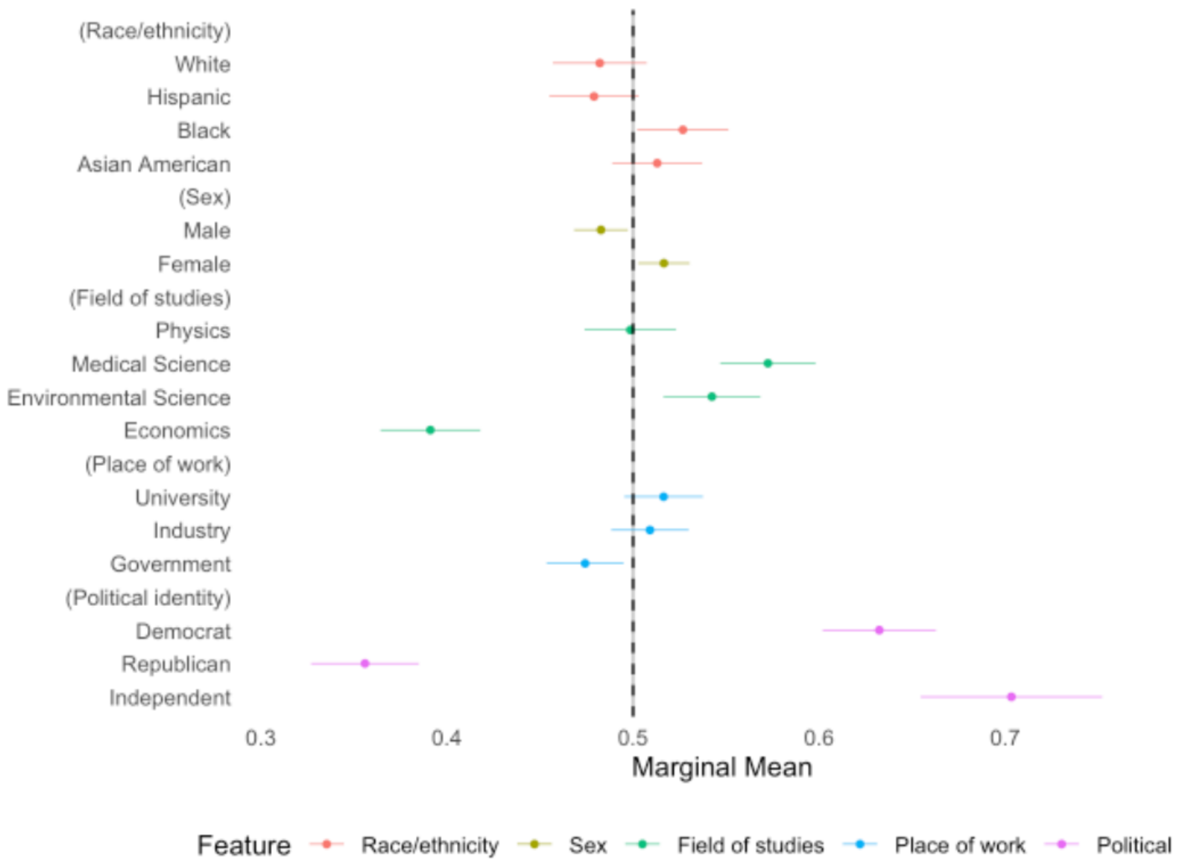
4.8.6 S6. Marginal Means – Subgroup Preferences

In identifying the heterogeneous treatment effects by respondent's party identification, we have previously estimated the average marginal component effects of different attributes across two subgroups defined by party identification (Democrats and Republicans), relative to Independents. However, Leeper et al. (2020) shed light on an important point that conditional AMCEs can be substantially misleading when interpreting the degree of favoring or disfavoring between subgroups, since interactions are sensitive to the baseline category used in regression analysis. In other words, they demonstrate that the size and the direction of differences-in-AMCEs have negligible relationship to the underlying degree of favorability of the subgroups toward profiles with certain features. Following this, the baseline category choices can make similar preferences look dissimilar and dissimilar preferences look similar. Given that, we should interpret AMCEs as the difference in the size of the casual effect for groups, but not as a way of descriptively characterizing differences in preferences between the groups. Therefore, as suggested by Leeper et al. (2020), we also provide marginal means of both our main results and subgroup preferences by respondent's party identification, since reporting marginal means enables us to demonstrate differences for all feature levels without being interpreted relative to the baseline categories. Overall, this provides us with an additional presentation of differences between group preferences.

The results of Figure *S10* confirm the main figure in the article to a large extent. However, when our interpretation is independent of the baseline levels, there are a couple of distinguished patterns that are worth mentioning. First, respondents clearly favor scientists in medical science more than scientists in any other discipline. Second, respondents favor scientists working at university and disfavor scientists working for industry the most, when the profiles lack scientist's party identification attribute. Nonetheless, when the profiles include scientist's party identification attribute, the favoring attitude toward university scientists became negligible, while the disfavoring attitude toward scientists working for government remained meaningful. Third, Republican scientists are the least favorite group, while Democrat and Independent scientists are favored to a greater extent. Given that our sample is skewed to Democrats, we also provide subgroup preferences by respondent's party identification in Figure *S11*. Accordingly, this subgroup analysis reveals important patterns. First, it confirms the previously reported heterogeneous treatment effects through the conditional AMCEs. That is, while Democrat respondents favor female scientists, Republican respondents favor male scientists. Furthermore, while Democrat respondents favor both environmental and medical scientists, Republican respondents only favor medical scientists. Another subgroup difference is that Democrat respondents only disapprove scientists working for industry, as well as preferring only scientists working at university. On the other hand, the level of favorability toward scientists by all attributes slightly dropped, when we introduced the attribute of scientist's party identification. Following this, the results show that respondents strongly favor their co-partisan scientists as hypothesised. Interpreting MMs of our baseline level (Independent) in the main analysis, we see that Democrats prefer politically independent scientists, while Republicans only prefer Republican scientists.



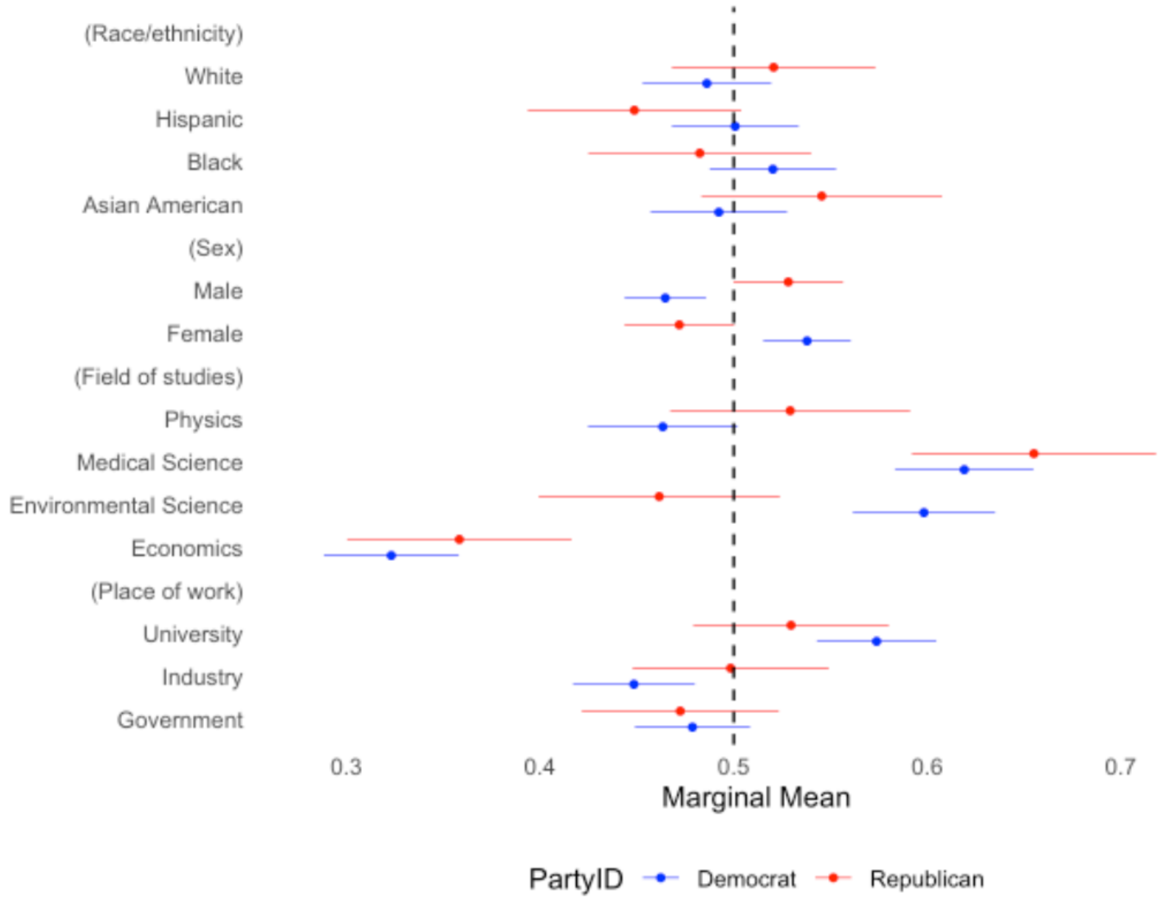
(a) Marginal means of the non-partisan profiles



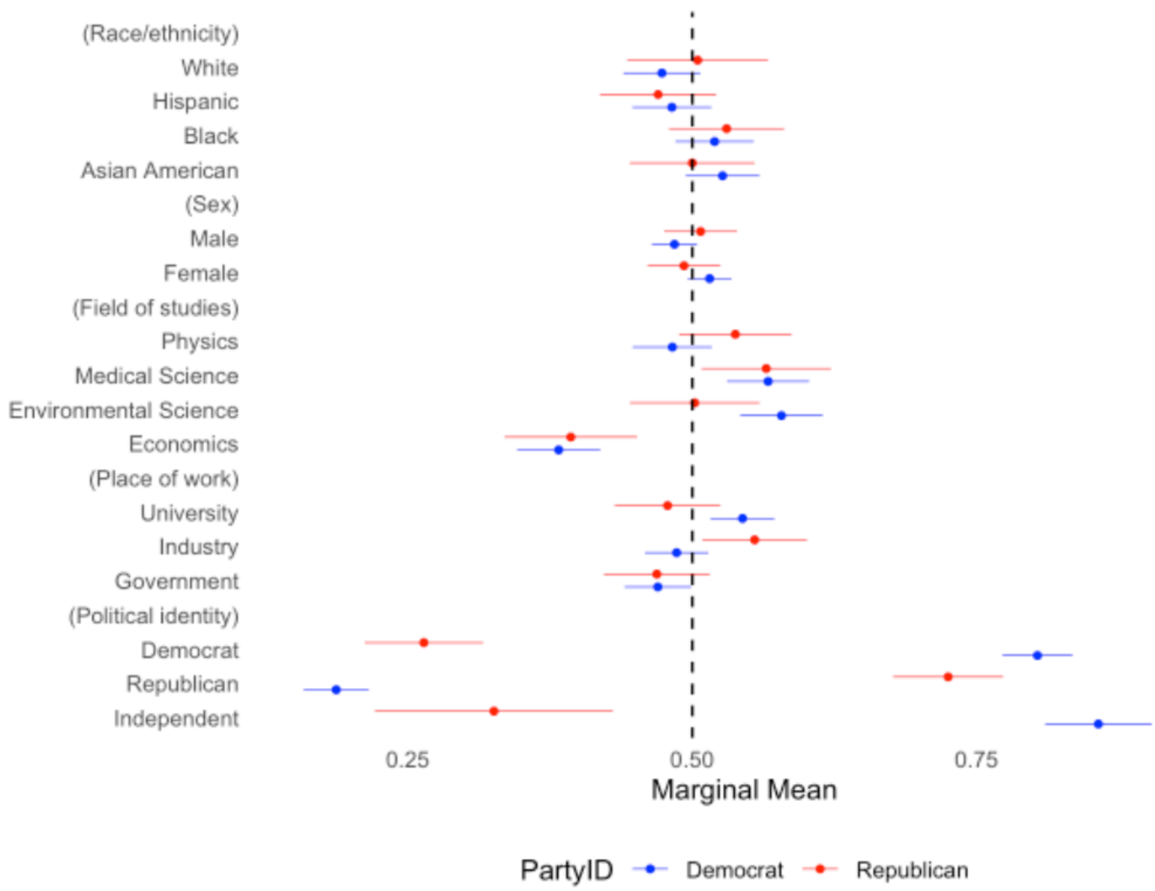
(b) Marginal means of the partisan profiles

Fig. S10. Marginal Means of the Main Model

Note: Marginal means represent the mean outcome across all appearances of a particular conjoint feature level, averaging across all other features. In our forced-choice conjoint design with two profiles per choice task, marginal means have a direct interpretation as probabilities: these MMs average 0.5 with values above 0.5 indicating features that increase scientist's favorability and values below 0.5 indicating features that decrease scientist's favorability.



(a) Marginal means of the non-partisan profiles by R's political identity

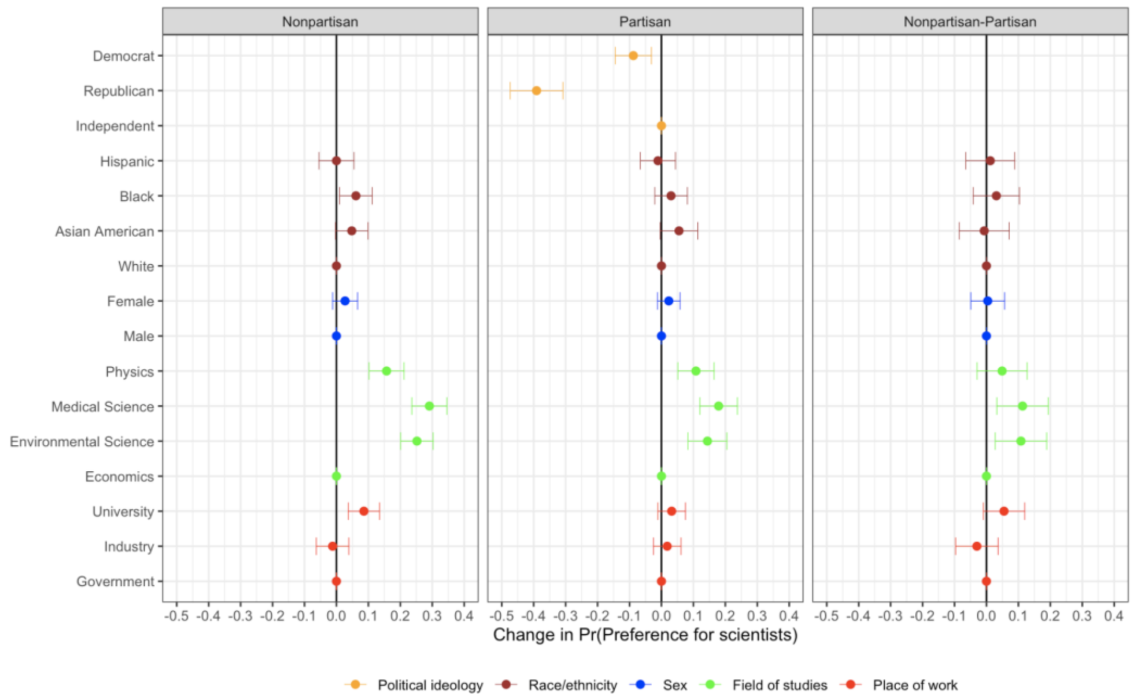


(b) Marginal means of the partisan profiles by R's political identity

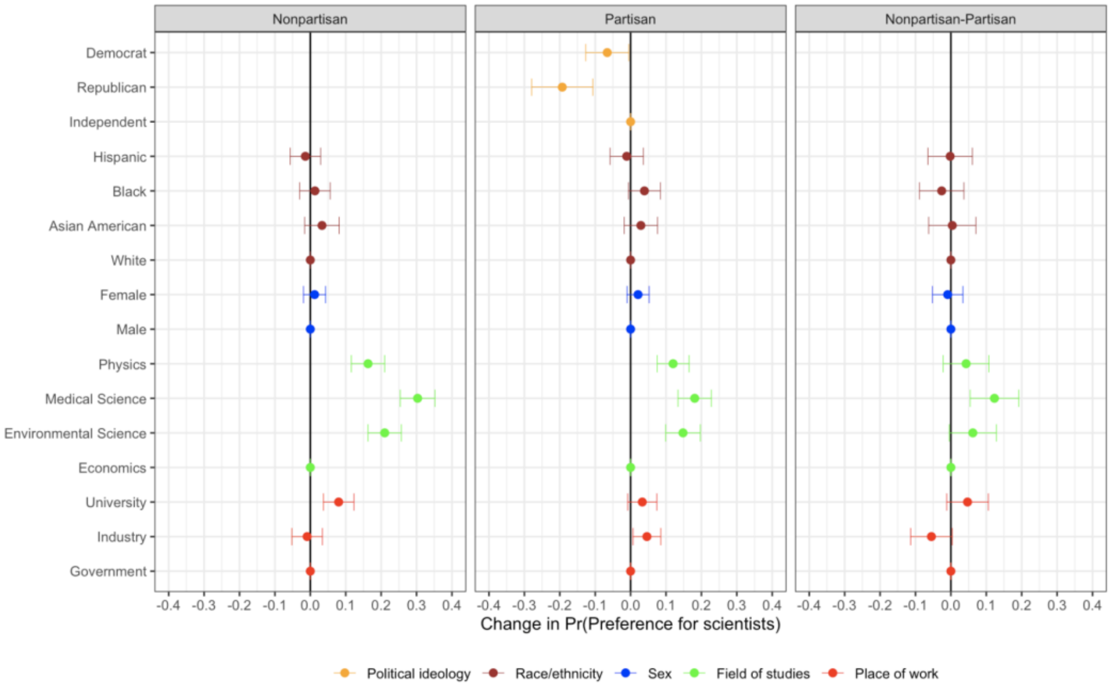
Fig. S11. Marginal Means of Subgroups (Party Identification)

4.8.7 S7. Analysis with Entropy Balancing

As a further robustness check, we tested that there were no other biases in our online quota sample that was representative of the U.S. population based on key demographic variables, such as age, sex, and ethnicity but politically skewed to Democrats. In order to ensure representativeness, we first implemented entropy balancing to weight our sample in terms of quota indicators: age, sex, ethnicity, and then partisan characteristics. This method adjusts differences in the first, second, and third moment of the covariate distributions, such as covariate means, variances, and skewness (for a detailed discussion, see Hainmueller and Xu (2013)). Tables *S12*, *S13* and Figures *S12* illustrate that we do not observe any major differences in the preferences for scientists when we adjust our sample to both quota and partisan characteristics.



(a) Estimated Average Marginal Component Effects with Quota-adjusted Weights (Age, Sex, Ethnicity)



(b) Estimated Average Marginal Component Effects with Partisanship-adjusted Weights

Fig. S12. Weighted Results

4.8.8 S8. Regression Outputs

Table S4. The Main Model – Aggregate Results

	(Non-partisan (n=2510))				(Partisan (n=2515))				(Non-partisan-Partisan (n=5025))			
	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value
Intercept	0.268	0.022	12.348	< 0.001	0.534	0.034	15.630	< 0.001	0.534	0.034	15.638	< 0.001
Democrat	NA	NA	NA	NA	-0.073	0.025	-2.979	0.003	NA	NA	NA	NA
Republican	NA	NA	NA	NA	-0.350	0.035	-10.099	< 0.001	NA	NA	NA	NA
Female	0.030	0.015	2.010	0.045	0.033	0.014	2.422	0.015	-0.003	0.020	-0.168	0.867
Asian American	0.039	0.020	1.895	0.058	0.038	0.019	1.959	0.050	0.001	0.028	0.025	0.980
Black	0.026	0.020	1.320	0.187	0.046	0.020	2.323	0.020	-0.020	0.028	-0.706	0.480
Hispanic	0.003	0.020	0.161	0.872	-0.003	0.020	-0.138	0.890	0.006	0.028	0.211	0.833
Env. Science	0.245	0.021	11.616	0.000	0.153	0.021	7.118	< 0.001	0.092	0.030	3.061	0.002
Medical Science	0.308	0.021	14.413	< 0.001	0.183	0.021	8.601	< 0.001	0.124	0.030	4.122	0.000
Physics	0.163	0.021	7.758	< 0.001	0.114	0.020	5.683	< 0.001	0.049	0.029	1.668	0.095
Industry	-0.021	0.019	-1.068	0.286	0.034	0.017	1.983	0.047	-0.055	0.026	-2.111	0.035
University	0.088	0.018	4.760	< 0.001	0.033	0.017	1.909	0.056	0.055	0.025	2.168	0.030

[1] Notes: Standard errors clustered at respondent level. Reference categories are: Independent, White, Male, Economics, Government

Table S5. Heterogeneous Treatment Effects by R's Party Identification - Non-partisan Model

	(Democrats (n=1300))				(Republicans (n=480))			
	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value
Intercept	0.246	0.03	8.175	< 0.001	0.38	0.049	7.817	< 0.001
Female	0.077	0.021	3.611	< 0.001	-0.062	0.029	-2.162	0.031
Asian American	0.015	0.028	0.532	0.595	0.031	0.051	0.598	0.55
Black	0.041	0.027	1.511	0.131	-0.029	0.045	-0.652	0.515
Hispanic	0.02	0.028	0.729	0.466	-0.067	0.041	-1.646	0.1
Environmental Science	0.279	0.03	9.329	< 0.001	0.106	0.047	2.267	0.024
Medical Science	0.3	0.03	9.94	< 0.001	0.301	0.051	5.862	< 0.001
Physics	0.139	0.029	4.759	< 0.001	0.174	0.048	3.602	< 0.001
Industry	-0.037	0.027	-1.39	0.165	0.018	0.045	0.396	0.692
University	0.095	0.026	3.703	< 0.001	0.049	0.043	1.144	0.253

[1] Notes: Standard errors clustered at respondent level. Reference categories are: Independent, White, Male, Economics, Government

Table S6. Heterogeneous Treatment Effects by R's Party Identification - Partisan Model

	(Democrats (n=1295))				(Republicans (n=480))			
	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value
Intercept	0.677	0.036	18.734	< 0.001	0.21	0.08	2.636	0.009
Democrat	-0.056	0.025	-2.222	0.026	-0.086	0.057	-1.519	0.129
Republican	-0.671	0.033	-20.035	< 0.001	0.38	0.069	5.508	< 0.001
Female	0.03	0.016	1.912	0.056	-0.018	0.032	-0.568	0.57
Asian American	0.07	0.021	3.367	0.001	0.005	0.042	0.125	0.9
Black	0.039	0.02	1.96	0.05	0.009	0.039	0.231	0.817
Hispanic	0.019	0.022	0.862	0.389	-0.018	0.044	-0.396	0.692
Environmental Science	0.183	0.027	6.805	< 0.001	0.105	0.045	2.303	0.021
Medical Science	0.173	0.024	7.129	< 0.001	0.188	0.047	4.034	< 0.001
Physics	0.108	0.022	4.849	< 0.001	0.145	0.046	3.133	0.002
Industry	0.003	0.020	0.154	0.877	0.082	0.037	2.197	0.028
University	0.058	0.020	2.859	0.004	0.027	0.038	0.713	0.476

[1] Notes: Standard errors clustered at respondent level. Reference categories are: Independent, White, Male, Economics, Government

Table S7. Heterogeneous Treatment Effects by R's Party Identification - Non-partisan-Partisan Difference Model

	(Democrats (n=2595))				(Republicans (n=960))			
	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value
Intercept	0.677	0.036	18.754	$<$ 0.001	0.210	0.080	2.644	0.008
Female	0.046	0.026	1.742	0.082	-0.044	0.043	-1.030	0.303
Asian American	-0.055	0.035	-1.605	0.109	0.025	0.066	0.385	0.700
Black	0.001	0.034	0.041	0.967	-0.038	0.059	-0.643	0.521
Hispanic	0.001	0.035	0.036	0.971	-0.049	0.060	-0.823	0.411
Environmental Science	0.096	0.040	2.386	0.017	0.002	0.065	0.026	0.979
Medical Science	0.127	0.039	3.267	0.001	0.112	0.069	1.620	0.105
Physics	0.031	0.037	0.859	0.391	0.029	0.067	0.432	0.666
Industry	-0.041	0.034	-1.207	0.228	-0.064	0.058	-1.102	0.270
University	0.038	0.033	1.149	0.251	0.023	0.057	0.397	0.692

[1] Notes: Standard errors clustered at respondent level. Reference categories are: Independent, White, Male, Economics, Government

Table S8. The Main Model – Results with General Trust

	(Non-partisan (n=2510))				(Partisan (n=2515))				(Non-partisan-Partisan (n=5025))			
	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value
Intercept	0.734	0.024	30.607	$<$ 0.001	0.751	0.029	25.689	$<$ 0.001	0.751	0.029	25.703	$<$ 0.001
Democrat	NA	NA	NA	NA	-0.077	0.021	-3.661	$<$ 0.001	NA	NA	NA	NA
Republican	NA	NA	NA	NA	-0.181	0.023	-7.883	$<$ 0.001	NA	NA	NA	NA
Female	-0.001	0.012	-0.109	0.913	-0.010	0.012	-0.865	0.387	0.009	0.017	0.512	0.608
Asian American	0.010	0.015	0.686	0.492	0.047	0.018	2.584	0.010	-0.036	0.024	-1.547	0.122
Black	0.026	0.015	1.690	0.091	0.030	0.018	1.642	0.101	-0.005	0.024	-0.197	0.843
Hispanic	0.024	0.015	1.618	0.106	0.036	0.018	1.988	0.047	-0.011	0.023	-0.478	0.632
Env. Science	0.061	0.019	3.266	0.001	0.057	0.018	3.122	0.002	0.004	0.026	0.134	0.894
Medical Science	0.082	0.019	4.346	$<$ 0.001	0.076	0.020	3.830	$<$ 0.001	0.006	0.027	0.214	0.831
Physics	0.046	0.019	2.419	0.016	0.071	0.019	3.730	$<$ 0.001	-0.025	0.027	-0.937	0.349
Industry	-0.021	0.018	-1.188	0.235	0.013	0.016	0.827	0.408	-0.034	0.024	-1.437	0.151
University	0.040	0.016	2.566	0.010	0.047	0.016	2.931	0.003	-0.006	0.022	-0.290	0.772

[1] Notes: Standard errors clustered at respondent level. Reference categories are: Independent, White, Male, Economics, Government

Table S9. The Main Model – Results with Epistemic Trust

	(Non-partisan (n=2510))				(Partisan (n=2515))				(Non-partisan-Partisan (n=5025))			
	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value
Intercept	0.809	0.021	38.935	$<$ 0.001	0.796	0.025	32.118	$<$ 0.001	0.796	0.025	32.135	$<$ 0.001
Democrat	NA	NA	NA	NA	-0.042	0.016	-2.559	0.011	NA	NA	NA	NA
Republican	NA	NA	NA	NA	-0.063	0.017	-3.626	$<$ 0.001	NA	NA	NA	NA
Female	-0.001	0.009	-0.141	0.888	0.003	0.010	0.316	0.752	-0.004	0.013	-0.329	0.742
Asian American	-0.002	0.012	-0.185	0.854	0.001	0.015	0.051	0.960	-0.003	0.019	-0.156	0.876
Black	0.001	0.014	0.046	0.963	0.024	0.014	1.670	0.095	-0.023	0.020	-1.156	0.248
Hispanic	0.014	0.013	1.136	0.256	-0.004	0.014	-0.265	0.791	0.018	0.019	0.952	0.341
Env. Science	0.081	0.018	4.365	$<$ 0.001	0.124	0.018	6.779	$<$ 0.001	-0.043	0.026	-1.662	0.096
Medical Science	0.108	0.018	6.185	$<$ 0.001	0.144	0.018	7.850	0.000	-0.035	0.025	-1.400	0.162
Physics	0.065	0.019	3.494	$<$ 0.001	0.123	0.019	6.544	$<$ 0.001	-0.058	0.026	-2.211	0.027
Industry	-0.003	0.012	-0.249	0.803	$<$ 0.001	0.013	0.016	0.988	-0.003	0.018	-0.182	0.856
University	0.022	0.012	1.839	0.066	0.007	0.012	0.600	0.548	0.015	0.017	0.860	0.390

[1] Notes: Standard errors clustered at respondent level. Reference categories are: Independent, White, Male, Economics, Government

Table S10. The Main Model – Results with Normative Trust

	(Non-partisan (n=2510))				(Partisan (n=2515))				(Non-partisan-Partisan (n=5025))			
	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value	Estimate	Std. Error	Statistic	P-Value
Intercept	0.768	0.023	34.070	< 0.001	0.795	0.027	29.756	< 0.001	0.795	0.027	29.772	< 0.001
Democrat	NA	NA	NA	NA	-0.074	0.019	-3.847	< 0.001	NA	NA	NA	NA
Republican	NA	NA	NA	NA	-0.183	0.021	-8.561	< 0.001	NA	NA	NA	NA
Female	0.010	0.012	0.822	0.411	0.005	0.012	0.414	0.679	0.005	0.017	0.293	0.770
Asian American	0.011	0.014	0.791	0.429	0.031	0.018	1.736	0.083	-0.020	0.023	-0.857	0.391
Black	0.002	0.015	0.164	0.870	0.026	0.018	1.403	0.161	-0.024	0.024	-0.994	0.320
Hispanic	0.017	0.014	1.173	0.241	0.041	0.017	2.356	0.019	-0.024	0.023	-1.077	0.281
Env. Science	0.076	0.019	4.074	< 0.001	0.066	0.019	3.539	< 0.001	0.010	0.026	0.368	0.713
Medical Science	0.096	0.018	5.463	< 0.001	0.059	0.019	3.114	0.002	0.037	0.026	1.429	0.153
Physics	0.032	0.018	1.748	0.081	0.050	0.019	2.675	0.007	-0.018	0.026	-0.685	0.493
Industry	-0.043	0.018	-2.475	0.013	-0.021	0.015	-1.403	0.161	-0.022	0.023	-0.952	0.341
University	0.035	0.014	2.455	0.014	0.021	0.014	1.434	0.152	0.015	0.020	0.725	0.469

[1] Notes: Standard errors clustered at respondent level. Reference categories are: Independent, White, Male, Economics, Government

Table S11. The Interaction Model – Conditional on Scientist's Party Identification

Political ideology	Place of work	Estimate	Std. Error	Statistic	P-Value
Independent	Government	NA	NA	NA	NA
Independent	Industry	0.047	0.056	0.842	0.400
Independent	University	0.027	0.054	0.490	0.624
Republican	Government	NA	NA	NA	NA
Republican	Industry	0.008	0.024	0.346	0.730
Republican	University	0.036	0.025	1.473	0.141
Democrat	Government	NA	NA	NA	NA
Democrat	Industry	0.057	0.026	2.208	0.027
Democrat	University	0.034	0.027	1.270	0.204
Democrat - Independent	Industry	0.010	0.061	0.157	0.875
Republican - Independent	Industry	-0.039	0.060	-0.646	0.518
Democrat - Independent	University	0.007	0.061	0.120	0.904
Republican - Independent	University	0.010	0.060	0.164	0.870

[1] Notes: Standard errors clustered at respondent level.

Table S12. The Main results with Quota-adjusted Entropy Weights

	Nonpartisan (n = 2510)				Partisan (n = 2515)				Nonpartisan-Partisan (n = 5025)			
Attribute value	Est.	Std. Error	Statistic	P-Value	Est.	Std. Error	Statistic	P-Value	Est.	Std. Error	Statistic	P-Value
Intercept	0.258	0.026	10.070	0.000	0.578	0.043	13.578	0.000	0.578	0.043	13.586	0.000
Democrat	NA	NA	NA	NA	-0.088	0.029	-3.058	0.002	NA	NA	NA	NA
Republican	NA	NA	NA	NA	-0.391	0.042	-9.287	0.000	NA	NA	NA	NA
Female	0.027	0.020	1.334	0.182	0.023	0.018	1.250	0.211	0.004	0.027	0.155	0.877
Asian American	0.048	0.026	1.837	0.066	0.055	0.030	1.861	0.063	-0.007	0.040	-0.180	0.857
Black	0.061	0.026	2.350	0.019	0.030	0.026	1.133	0.257	0.031	0.037	0.832	0.405
Hispanic	0.000	0.028	0.014	0.989	-0.011	0.028	-0.412	0.680	0.012	0.039	0.301	0.764
Env. Science	0.252	0.026	9.633	0.000	0.144	0.031	4.567	0.000	0.108	0.041	2.653	0.008
Medical Science	0.291	0.028	10.339	0.000	0.179	0.030	6.000	0.000	0.113	0.041	2.752	0.006
Physics	0.157	0.028	5.682	0.000	0.108	0.029	3.737	0.000	0.049	0.040	1.229	0.219
Industry	-0.012	0.026	-0.473	0.636	0.018	0.022	0.832	0.405	-0.030	0.034	-0.895	0.371
University	0.086	0.025	3.418	0.001	0.032	0.022	1.468	0.142	0.055	0.033	1.652	0.099

[1] Notes: Standard errors clustered at respondent level. Omitted categories are: Independent, White, Male, Economics, Government.

Table S13. The Main results with Partisanship-adjusted Entropy Weights

	Nonpartisan (n = 2510)				Partisan (n = 2515)				Nonpartisan-Partisan (n = 5025)			
Attribute value	Est.	Std. Error	Statistic	P-Value	Est.	Std. Error	Statistic	P-Value	Est.	Std. Error	Statistic	P-Value
Intercept	0.295	0.025	12.036	0.000	0.461	0.043	10.613	0.000	0.461	0.043	10.619	0.000
Democrat	NA	NA	NA	NA	-0.066	0.031	-2.164	0.030	NA	NA	NA	NA
Republican	NA	NA	NA	NA	-0.193	0.044	-4.384	0.000	NA	NA	NA	NA
Female	0.012	0.016	0.765	0.444	0.021	0.016	1.327	0.184	-0.009	0.022	-0.411	0.681
Asian American	0.033	0.025	1.326	0.185	0.029	0.024	1.222	0.222	0.004	0.034	0.104	0.917
Black	0.013	0.022	0.591	0.554	0.039	0.023	1.732	0.083	-0.026	0.032	-0.829	0.407
Hispanic	-0.014	0.022	-0.630	0.529	-0.011	0.024	-0.481	0.631	-0.002	0.032	-0.068	0.946
Env. Science	0.210	0.024	8.799	0.000	0.148	0.025	5.952	0.000	0.062	0.034	1.800	0.072
Medical Science	0.303	0.025	12.154	0.000	0.181	0.024	7.421	0.000	0.123	0.035	3.520	0.000
Physics	0.163	0.024	6.681	0.000	0.120	0.023	5.244	0.000	0.043	0.033	1.292	0.196
Industry	-0.009	0.022	-0.405	0.686	0.046	0.020	2.320	0.020	-0.055	0.030	-1.852	0.064
University	0.080	0.022	3.736	0.000	0.033	0.021	1.614	0.107	0.047	0.030	1.594	0.111

[1] Notes: Standard errors clustered at respondent level. Omitted categories are: Independent, White, Male, Economics, Government.

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5. Overall conclusion

In this PhD thesis, I examined three subtopics within the research field of public understanding of science, namely focusing on racial disparities in civic scientific literacy, public support for the pro-environmental governmental policies, and public perception of scientists' trustworthiness. In **Chapter 2,** I performed a set of multivariate linear regressions on pooled waves of the General Social Survey to investigate how racial social identity and racial ingroup evaluation shape the science literacy gap between whites and African Americans. In **Chapter 3**, I used the European Social Survey Round 8 data to perform structural equation modelling and disentangle the relationship between public support for the welfare state and public support for the environmental state. Lastly, in **Chapter 4** I carried out a conjoint experiment to study the factors of public perception of scientists' preferability and trustworthiness.

Two main conclusions can be derived from **Chapter 2.** Firstly, the analysis showed that there is little evidence to suggest that the salience of racial self-identification affects science literacy differently among whites and African Americans. Thus, the initial hypothesis about the malevolent image of science being deeply entrenched within the collective memory of African Americans and ultimately affecting their science literacy was not corroborated. Secondly, there is stronger yet still cautious evidence to claim that the salience of ingroup evaluation contributes to science literacy more positively among African Americans compared to whites, and this can be interpreted via the alleviation of the stereotype threat effect that African Americans experience with regard to their uptake of science. Another finding I did not have any prior expectation about is that racial self-identification and ingroup evaluation are negatively related to science literacy among whites, even when the educational attainments and other covariates are accounted for. This fact requires further scrutiny by introducing the dimension of value orientations in the analysis.

The main conclusion of **Chapter 3** is that when controlling for the covariates derived from the Value-Belief-Norm theory there is a weak positive relationship between public support for the welfare state and public support for the environmental state. The latter is explained best by the belief in the reality of climate change, with those having a stronger belief in the existence of climate change expressing more support towards the government measures aimed at curbing its societal and economic risks. The weak effect of the welfare state support on the environmental state support suggests that when convincing the public in the necessity of the government-driven anti-climate change measures, the environmental identity argument should be prioritized over the etatist argument. This means that, while pointing to the responsibility of the state to act accordingly in relation to both short-term societal and long-term environmental risks might be effective to some extent in convincing people to support climate change curbing policies, it would be far more effective to approach this through raising public awareness about climate change and fostering public environmental identity.

Finally, the research carried out in **Chapter 4** showed that the topic of public trust in science cannot be scrutinized without acknowledging the notion of the public image of the very scientists in the first place. The main conclusion of the study is that when judging the preferability and trustworthiness of scientists, the general public appears to be very sensitive to their political ideology, favoring those scientists who do not express a strong political leaning and identify themselves as Independent rather than Democrats or Republicans. This finding adds to the ongoing discussion on the politicization of science and provides evidence for political neutrality to be a crucial component of the scientific ethos in the public eyes. Additionally, the research suggested that the public credibility of scientists is loosely related to their sex and race/ethnicity, meaning that the stereotypes surrounding gender and race play an insignificant role in shaping public opinion about scientists and their trustworthiness. Conversely, people tend to put more emphasis on the professional characteristics of scientists, preferring those who come from the hard sciences over social science, and those working for the university over the industry. This finding confirms the tentative notion that when examining public opinion on science, the very concept of science should not be treated as a homogeneous monolithic entity as its perceived characteristics vary substantially along the dimensions of the scientific field and institution responsible for the knowledge production.

Overall, three chapters of the present PhD thesis have touched upon and explored the concepts central to the very field of public understanding of science – science literacy, trust in scientists, and support for scientific policies. However, the overarching question that any research in this field instinctively tries to contribute to revolves around finding approaches to restoring and strengthening public confidence in science. Either through making fierce attempts to educate the public about science in the 1980s, or – how it is being done lately - by making the very process of academic research more transparent and accountable, the scientific institution sends an unambiguous message that its existence and efficiency ultimately depend on whether people express trust in science or not.

We know from the previous literature that civic scientific literacy is hardly related to public appreciation of science and that it is engagement rather than knowledge that can drive improvements in how the public perceives science. While this idea looks promising and more effort should be aimed at making science communication two-way rather than one-way, two-way communication is still subjected to social inequality and stratification. For example, as Dawson (2018) notices, while participatory mechanisms might be open to large fractions of society, low-income ethnic minority groups might still experience alienation from science and perceive it as something distant and unattainable, being beyond their control. For this social group, communication remains one-way, and their level of scientific knowledge could be the critical factor in processing scientific information. As I showed in **Chapter 2** of this thesis, social identity factors play their role in shaping science knowledge, and more research is required to map how various social identities interact with how people perceive science and scientific knowledge.

Exploring public support for climate change policies from the perspective of the welfare state in **Chapter 3,** I cannot help but mention that this is also an issue that is directly linked to the quality of science communication. Would people be less sceptical about the need to tackle climate change if they were more engaged in exploring its aftermaths and being assured that scientists value and demand their experience? The whole situation reminds me of the famous case of studying mad cow disease described by Wynne and colleagues (1996), in which scientists disregarded a whole layer of knowledge that came from local farmers and that was considered redundant and worthless for the investigation. With this type of attitude, however straightforward and unambiguous the communication from science to people could be, it still would not be able to nurture trust. Mutual trust can thrive only in that kind of setting, where both sides respect each other's worldview and are eager to learn from each other, rather than devaluating one epistemic experience, and appraising another one.

Lastly, science-in-society cannot be imagined without direct interaction between scientists and citizens, either in public hearings, open debates, collaborative research, citizen science, or else. This framework inevitably makes the personal characteristics of scientists more salient compared to the times when science was separated from society, not so much on the physical as on the symbolic level. The question that lies on the surface is to what extent stereotyping can impact the credibility of scientists and whether it can potentially corrupt the very process of direct communication. As **Chapter 4** has shown, stereotyping of scientists, if any, occurs along the lines of achieved rather than ascribed statuses, and what people demand most from scientists is not mixing their political and professional identities. This is undoubtedly something that academics can have control of, so being mindful about own political biases and how they might impact research is an essential step towards restoring public confidence in our institution.

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