



Predictors of global warming risk perceptions among Latino and non-Latino White Americans

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Abstract

Global warming will disproportionately affect people of color (e.g., Latinos). Previous research has found that Latinos in the USA are more engaged with global warming than are non-Latino Whites, in part, because they are more likely to perceive it as a serious risk. It was unclear, however, what factors most strongly explain Latinos' elevated perceptions of risk. This study uses two parallel, nationally representative surveys of Latino and non-Latino White Americans to investigate these different levels of risk perception. Mediation analyses indicate that Latinos' greater risk perceptions may be explained by (in order of magnitude) their stronger pro-climate injunctive social norms and egalitarian worldviews, stronger identification with the Democratic party, more frequent communication with family outside the USA, greater harm from environmental hazards, stronger descriptive norms, and a weaker individualist worldview. These findings help inform strategies for communicating with different subgroups of Americans that have different global warming risk perceptions.

Keywords Climate change · Global warming · Latino · Risk perceptions · Norms · Communication

1 Introduction

Global warming is one of the most serious and far-reaching issues of our time. One of the challenges in communicating about the issue is that many people believe that its effects are

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distant in time and space (Leiserowitz 2006; Leiserowitz et al. 2018). As a result, many people do not perceive global warming as a serious risk to the USA, their local community, or their own well-being.

1.1 Latinos and global warming

Global warming and other environmental hazards have a disproportionate impact on communities of color. For example, Latinos are more likely than non-Latino Whites to live in areas exposed to hazardous waste (Mohai et al. 2009) and high concentrations of air pollution (Clark et al. 2014). Additionally, Latinos have stronger global warming risk perceptions (i.e., beliefs that it will cause harm) than other ethnic/racial groups, on average (Leiserowitz et al. 2017). For example, 34% of non-Latino Americans think global warming is harming people *right now*, whereas 50% of Latino Americans do. Further, a recent nationally representative survey found that Latinos are substantially more likely than non-Latinos to think global warming is happening and human caused (Leiserowitz et al. 2017), and to support pro-climate policies (Leiserowitz and Akerlof 2010). Latinos also top the list of groups most concerned about the environment in general (Pearson et al. 2018).

Because Latinos are the second-largest ethnic group in the USA, are disproportionately affected by environmental issues, and generally have stronger pro-climate attitudes and climate change risk perceptions than other ethnic/racial groups, it is important to understand the factors that explain these differences. Understanding these factors can help practitioners better engage these groups in the issue of global warming and its solutions.

This study focuses on global warming risk perceptions, defined as the extent to which people perceive global warming as likely to cause harm (e.g., to them personally, their family, etc.; see O'Connor et al. 1999). Generally, risk perception is an important predictor of pro-climate attitudes and behaviors (e.g., Leiserowitz 2006). Specific to Latinos, risk perceptions play a strong role in explaining differences between Latinos and non-Latino Whites in political action (i.e., contacting elected officials) on global warming (Ballew et al. 2019). Importantly, risk perceptions better explain Latinos' higher levels of climate activism compared to non-Latino Whites than do other predictors such as egalitarianism and social norms.

Because risk perception has been shown to be a key variable in explaining differences in Latinos' versus non-Latino Whites' climate activism (Ballew et al. 2019), an important follow-up question, then, is: what factors best explain these group differences in risk perception? A wide range of theoretically derived explanations may help account for group differences in risk perception, including worldviews, cultural orientation, social influence, perceived vulnerability, and exposure to environmental hazards. Each of these are explored in the current study.

1.2 Theoretical perspectives

One of the most prominent theoretical perspectives on ethnic/racial differences in environmental risk perception focuses on differences in privileged societal status, which is related to differences in perceived and actual vulnerability to environmental hazards—including climate change. For example, Flynn et al. (1994) explain that Whites, especially White men, have benefited the most from the sociopolitical system in the USA, and therefore see a variety of dangers as less risky than do other demographic groups. Indeed, evidence shows that ethnic/racial differences in concern about environmental hazards are partially accounted for by differences in perceived vulnerability to and awareness of environmental hazards (Satterfield

et al. 2004). Similarly, environmental deprivation theory proposes that ethnic/racial differences in environmental concern are driven by differential *exposure* to environmental hazards such as pollution (e.g., Whittaker et al. 2005). That is, people of color are more likely to be concerned about environmental hazards such as air pollution because they are more likely to be exposed to and suffer negative health consequences from pollution.

Other theoretical perspectives emphasize identity and culture in explaining ethnic/racial differences in environmental concern, especially climate change. For example, measures to mitigate climate change often entail government regulation and restrictions on individual liberty. Thus, members of privileged groups (e.g., non-Latino Whites; Flynn et al. 1994) who tend to identify more strongly with these individualistic values are more likely to doubt the risks of environmental hazards because they are concerned with protecting their privileged social status (Kahan et al. 2007).

Other theoretical perspectives suggest that differences in cultural orientation may explain why some groups are more concerned than others about global warming and other pressing environmental issues. For example, Holloway et al. (2009) argue that ideals of harmony, social acceptance, and social support are central to Latino culture. Across two studies, Latino respondents were significantly more likely than non-Latino White respondents to spontaneously relate these ideals to their self-concepts. In two additional studies, evidence showed that these differences in cultural orientation were apparent in in-person interactions with other respondents. If relational values and ideals are especially important in Latino culture, then this might explain in part why Latinos are especially concerned about, and engaged with, environmental issues that put close others at risk.

In the current study, we use these different theoretical perspectives to investigate why Latinos have higher levels of global warming risk perceptions than do non-Latino Whites. Additionally, we take an exploratory approach to this question by including other potential sources of these differences, including media exposure and several sources of social influence (e.g., norms, social capital). We adopt an approach similar to Ballew et al. (2019) as part of a larger project to investigate Latinos' climate change beliefs, attitudes, policy preferences, and behaviors. We identify a diverse set of predictors that are known or suspected to predict risk perceptions, and test which factors best explain why Latinos have higher risk perceptions than non-Latino Whites.

1.3 Worldviews

Worldviews (e.g., individualism, egalitarianism) are beliefs about the ideal structure of society and help people navigate in a complex world. Individualists most value autonomy and resist restrictions on it, particularly government regulations. This inclination makes individualists less inclined to support climate policies (Leiserowitz 2006). Egalitarians, on the other hand, are most concerned with equal distribution of resources and costs, and tend to support climate policies.

The worldviews of individualism and egalitarianism are among the foundations of political ideology and partisanship across cultures. In an analysis of worldviews in 16 countries, Piurko et al. (2011) found that liberals consistently report valuing egalitarianism more than conservatives and conservatives consistently report valuing individualism more than liberals.

Latinos in the USA consistently favor the Democratic party over the Republican party, and substantially more than do non-Latino Whites (Pew Research Center 2018b). Further, people living in countries in Central or South America have stronger egalitarian

values than people living in the USA (Schultz and Zelezny 1999). Thus, it is possible that Latinos' greater climate change risk perceptions are, in part, rooted in stronger egalitarianism, liberalism, and affiliation with the Democratic party, and weaker individualism, conservatism, and affiliation with the Republican party.

1.4 Social influences

Social influence can have powerful effects on people's attitudes and behaviors across a variety of contexts (e.g., Asch 1955; Cialdini et al. 1990; Goldberg et al. 2019, 2020; Rios et al. 2018). Social norms, for example, have been used to reduce littering (Cialdini et al. 1990), increase recycling (Burn 1991), and save resources by increasing reuse of hotel towels (Goldstein et al. 2008; for a meta-analysis, see Abrahamse and Steg 2013).

Norms can be descriptive or injunctive (Cialdini et al. 1990). Descriptive norms are how people behave. For example, observing that most of your neighbors recycle is a descriptive norm that might encourage you to recycle. Injunctive norms are what people believe others ought to be doing. An injunctive norm in favor of recycling is the belief that others think people ought to recycle. Across five studies, Cialdini et al. (1990) showed that both types of norms have strong effects on people's behavior, depending on which norm was salient. For example, researchers gave unknowing participants an opportunity to litter (i.e., a paper advertisement placed on their car's windshield), and manipulated whether the surrounding area was totally clean or heavily littered (i.e., a descriptive norm). Results showed that participants were significantly more likely to litter in a heavily littered than a non-littered environment. In a follow-up study, the researchers manipulated the message on the advertisement and found that participants were significantly less likely to litter when there was an anti-littering injunctive norm message on the advertisement (e.g., "April is Keep Arizona Beautiful Month. Please do not litter"). In the current study, because perceptions of descriptive and injunctive norms play a powerful role in people's beliefs and behavior, we measure participants' perceived descriptive and injunctive norms with regard to global warming, and test whether either or both explain why Latinos perceive global warming as a greater risk than do non-Latino Whites.

People may also learn about the risks of global warming because they hear people in their social networks (e.g., friends, family, co-workers) talking about it. Discussion of political issues has been shown to predict political participation in the form of voting and contacting political candidates (La Due Lake and Huckfeldt 1998; Wyatt et al. 2000). Therefore, it is plausible to expect a similar relationship between hearing conversations about global warming in one's social network and having greater risk perceptions. Thus, we test whether differences in social network effects explain Latino versus non-Latino White differences in global warming risk perceptions. Further, it is possible that being contacted by an organization aiming to help reduce global warming is associated with greater risk perceptions. Thus, we included this variable for exploratory purposes.

Additionally, approximately half of Latino adults are foreign born (Pew Research Center 2017) and are likely to have family outside the USA. Recent research shows that foreign-born Latinos have greater risk perceptions than do Latinos born in the USA (Macias 2016). This may not be surprising considering that people residing in Central and South American countries *are* at greater risk than USA residents to the negative health impacts of climate change (Patz et al. 2005). Thus, we test the extent to which

communication with family outside the USA is linked to risk perceptions for Latinos more so than non-Latino Whites.

We also consider the concept of social capital as potentially important in explaining risk perceptions. Cognitive social capital refers to an individual's perceptions of the support they would receive from their social network in a time of need (e.g., Harpham et al. 2002). Interestingly, some evidence indicates that although greater social capital can help people adapt to and recover from a natural disaster, greater social capital may also have negative effects because it can be associated with *lower* risk perceptions *before* a natural disaster (Babcicky and Seebauer 2017). Because of this potential influence on climate change risk perceptions, we have included a measure of cognitive social capital.

Additionally, concern for future generations is one of the leading reported reasons for wanting to reduce global warming (Leiserowitz et al. 2018). Latinos are more likely than non-Latino White Americans to live in multi-generational households (Pew Research Center 2018a). It is possible that these multi-generational social ties make the impacts of climate change on future generations more salient. We therefore include a measure of living in a multi-generational household as a predictor variable.

1.5 Media exposure

The mass media plays a critical role in shaping public perceptions of climate change (e.g., Feldman et al. 2014; Gustafson et al. 2019; Leiserowitz 2004). Because the media tends to portray climate change as a very serious threat, often using fear appeals (e.g., O'Neill and Nicholson-Cole 2009), we predict that respondents who hear about global warming in the media more often will have higher risk perceptions than those who hear about it less frequently (Zhao et al. 2011).

1.6 Vulnerability and past harm from environmental hazards

Although people can learn about the risks of climate change through media coverage or discussion with social network members, prior research finds that *personal experience* can also affect risk perceptions (e.g., Akerlof et al. 2013; Myers et al. 2013). For instance, one longitudinal study found that three in four Americans' (75%) climate change beliefs were influenced by the experience of environmental hazards (e.g., heat waves; Myers et al. 2013). Accordingly, as proposed by environmental deprivation theory, we explore indicators of environmental vulnerability and personal experience, such as exposure to environmental hazards or extreme weather (Whittaker et al. 2005). Because racial and ethnic minorities in the USA, including Latinos, are more likely than non-Latino Whites to experience environmental threats (e.g., air pollution; Clark et al. 2014), differential exposure to environmental factors may help explain why Latinos have higher climate change risk perceptions than non-Latino Whites (Pearson et al. 2017; Satterfield et al. 2004).

Thus, we expect that self-reported exposure to environmental threats, including *past experience of and harm from environmental hazards* (e.g., heat waves, drought, air pollution), the frequency of *working outdoors*, and engaging in *outdoor leisure activities*, will predict climate change risk perceptions. Moreover, we explore whether self-reported *health issues* (experienced by oneself or someone in the household) also predict risk perceptions.

1.7 The current study

This study advances knowledge on global warming¹ attitudes in several important ways. Theoretical tests that attempt to explain group differences are usually employed one at a time. Here, we synthesize several existing theoretical perspectives and assess their relative strength in understanding ethnic/racial differences in global warming risk perceptions. Additionally, non-White ethnic/racial groups, and Latinos in particular, are underrepresented in a large portion of academic research (e.g., Boas et al. 2020). This is due, in part, to difficulties in obtaining high-quality samples. For example, even in a representative sample of the USA population with 1000 participants, there are likely to be only about 180 Latinos (i.e., ~18%; U.S. Census Bureau 2017). Further, because many psychological studies rely on convenience samples (Anderson et al. 2018), it is unlikely there will be a sizeable proportion of Latinos in a typical sample. This study uniquely allows for rigorous analyses of Latinos in comparison to non-Latino Whites because we use large nationally representative samples of each group. Additionally, of practical importance, the current study also provides knowledge that can be used to communicate with key groups in the USA that are often particularly vulnerable to climate impacts as well as the most likely to take action on the issue.

2 Method

Participants were recruited as part of two parallel nationally representative surveys. The survey that included non-Latino White respondents was fielded from May 18 to June 6, 2017 and the survey of Latino respondents was fielded from May 18 to June 8, 2017. Data were collected, respectively, through GfK's KnowledgePanel® and KnowledgePanel Latino®, which use probability sampling methods to draw members of the USA population to take online surveys. Techniques to recruit potential panel members included random digit dial and address-based sampling methods to reach nearly all non-institutional USA residences. Respondents who decided to join the panel but lacked access to the Internet were loaned computers and provided with Internet access to complete surveys. Of those who were invited to complete the surveys, 51% participated in the general USA population survey and 46% participated in the Latino survey.

2.1 Participants

The representative sample of the general USA population consisted of a total of 1266 adults 18+ including 932 non-Latino White respondents. The representative sample of Latinos in the USA initially consisted of 2054 adults 18+, 1571 of whom were USA citizens and considered for our analyses. Additional cases were excluded from the samples due to excessive missing data (see Section 2.2.8).

¹ We use the term “global warming” instead of “climate change” throughout the survey instrument because previous research shows that Americans are substantially more likely to have heard of global warming than climate change (Leiserowitz et al. 2014). Further, using the term global warming makes the current research more of a direct comparison to our previous surveys that use the same question wording. However, we acknowledge that this is a limitation for making inferences regarding perceptions of “climate change” (instead of global warming).

The final samples included 861 non-Latino Whites and 1433 Latino USA citizens. In the non-Latino White sample, 49.6% were men versus 52.5% in the Latino sample. The non-Latino White sample was, on average, slightly older ($M=49.5$ years, $SD=17.6$) compared with the Latino sample ($M=42.9$, $SD=16.4$). Although annual household income was slightly higher among non-Latino Whites than Latinos, the distributions were relatively similar: most earned less than \$75,000 per year (50.6% of non-Latino Whites, 59.0% of Latinos) and the modal group earned \$100,000 or more per year (36.5% of non-Latino Whites, 25.1% of Latinos). Also, there were education differences between non-Latino Whites and Latinos: the largest percentage of non-Latino White respondents had a Bachelor's degree or higher (33.9%), followed by some college (29%), and a high school degree (28.7%), whereas the largest percentage of Latinos had a high school degree (32.5%), followed by some college (30.2%), and a Bachelor's degree or higher (19.2%). Descriptive statistics for all variables are presented in Table 1.

2.2 Measures

2.2.1 Worldviews

We included two measures of worldviews: egalitarianism and individualism, both of which were rated on a scale from 1 (*Strongly disagree*) to 4 (*Strongly agree*) (Leiserowitz 2006; Smith and Leiserowitz 2014). The measure of egalitarianism included four items (e.g., “The world would be a more peaceful place if its wealth were divided more equally among nations”), which were averaged to form an index ($\alpha_{\text{Latino}} = .75$, $\alpha_{\text{Non-Latino White}} = .77$). Individualism was measured with three items (e.g., “If the government spent less time trying to fix

Table 1 Descriptive statistics

Variable	Full sample	Latino	Non-Latino White
<i>M (SD)</i>			
Gender (female)	.47 (.50)	.46 (.50)	.48 (.50)
Age	50.40 (16.69)	47.96 (16.13)	54.45 (16.84)
Education	2.93 (.97)	2.88 (.99)	3.00 (.94)
Income	3.80 (1.83)	3.64 (1.85)	4.07 (1.77)
Party affiliation	3.55 (2.05)	3.18 (1.95)	4.18 (2.06)
Political Ideology	3.01 (1.11)	2.91 (1.07)	3.19 (1.15)
Egalitarianism	2.65 (.84)	2.79 (.81)	2.42 (.82)
Individualism	2.56 (.81)	2.50 (.78)	2.66 (.85)
Descriptive norm	2.53 (1.04)	2.61 (1.05)	2.38 (.99)
Injunctive norm	2.76 (1.18)	2.95 (1.17)	2.44 (1.14)
Media exposure	3.62 (1.21)	3.61 (1.21)	3.63 (1.20)
Social network	2.59 (1.27)	2.67 (1.29)	2.46 (1.23)
Family communication	2.24 (1.83)	2.69 (1.95)	1.48 (1.28)
Social capital	2.36 (1.55)	2.36 (1.53)	2.37 (1.58)
Generations cohab.	1.67 (.72)	1.77 (.74)	1.50 (.66)
Contacted by org	1.40 (.85)	1.39 (.82)	1.41 (.90)
Health Issues	1.43 (1.25)	1.43 (1.26)	1.42 (1.23)
Past harm env. hazards	1.87 (.99)	2.02 (1.07)	1.62 (.79)
Risk perceptions	3.01 (.93)	3.20 (.86)	2.69 (.95)

M mean, *SD* standard deviation, *Cohab.* cohabiting, *Env.* environmental

everyone's problems, we'd all be a lot better off"), which were also averaged to form an index ($\alpha_{\text{Latino}} = .75$, $\alpha_{\text{Non-Latino White}} = .85$).

We measured political ideology by asking, "In general, do you think of yourself as..." (1 = *Very liberal*, 5 = *Very conservative*). For political party, participants were asked, "Generally speaking, do you think of yourself as..." with response options of *Republican*, *Democrat*, *Independent*, *Other*, or *No party/not interested in politics*. Participants who chose *Independent* or *Other* were asked if they consider themselves closer to the Republican party, Democratic party, or neither. Participants who chose *Republican* or *Democrat* were asked about whether they were a *strong* or *not a very strong* [*Republican/Democrat*]. These items were used to create a single seven-point measure (1 = *Strong Democrat*, 7 = *Strong Republican*).

2.2.2 Social influence

For questions about the participant's social network, we asked about descriptive and injunctive social norms as well as discussion of global warming. For descriptive norms, we asked one item, "How much of an effort do your family and friends make to reduce global warming?" (1 = *No effort*, 5 = *A great deal of effort*; *Don't know* responses were coded as missing). Injunctive norms were measured with one item, "How important is it to your family and friends that you take action to reduce global warming?" (1 = *Not at all important*, 5 = *Extremely important*; *Don't know* responses were coded as missing). For exposure to discussion about global warming, participants were asked, "About how often do you hear other people you know (your family, friends, co-workers, etc.) talk about global warming?" (1 = *Never*, 5 = *At least once a week*; *Not sure* responses were coded as missing). To measure how many times participants had been contacted by an environmental organization, we asked, "How many times, if ever, have you been contacted (by mail, phone, or in person) by an organization working to reduce global warming?" (1 = *Never*, 2 = *Once*, 3 = *Two or three times*, 4 = *Four or more times*; *Not sure* responses were coded as missing).

To gauge how much participants communicate with family outside the USA, we asked, "How often do you communicate with family members in other countries?" (1 = *Never*, 7 = *Basically every day*). Participants who chose the additional response option, *I do not have family members in other countries*, were coded as *Never*.

Social capital was measured by asking, "If you were in trouble, how many relatives and friends could you count on to help you?" (0 = *None*, 1 = *1–2*, 2 = *3–5*, 3 = *6–10*, 4 = *11–15*, 5 = *16–20*, 6 = *More than 20*).

To gauge the number of familial generations that live in the participant's household, we asked, "Which of the following, if any, live with you in your home at least some of the time?" [A grandchild or grandchildren/A child or children/A parent of parents/A grandparent or grandparents] (0 = *No*, 1 = *Yes*). Responses were summed to form a measure of generations cohabiting.

2.2.3 Media exposure

To gauge how often participants are exposed to media coverage of global warming, we asked "About how often do you hear about global warming in the media (TV, movies, radio, newspapers/news websites, magazines, etc.)?" (1 = *Never*, 5 = *At least once a week*; *Not sure* responses were coded as missing).

2.2.4 Vulnerability

As a proxy measure of physical vulnerability to extreme weather, we asked participants whether they work outdoors, “If you are employed, do you...” (1 = *Work indoors nearly all the time*, 5 = *Work outdoors nearly all the time*), and how much of their leisure time is spent outdoors, “When you participate in leisure activities (either on your own or with others), how much of that time do you spend outdoors versus indoors?” (1 = *Indoors nearly all of the time*, 5 = *Outdoors nearly all of the time*). We measured existing health issues by asking participants which, if any, of six common chronic health problems they or someone in their household have been diagnosed with (coronary heart disease, diabetes, obesity, respiratory illness including asthma, a physical or mental disability, allergies; 0 = *No*, 1 = *Yes*; responses were summed to form an index).

2.2.5 Past harm from environmental hazards

Participants were first asked, “In the past year, have you personally experienced any of the following?” (0 = *No*, 1 = *Yes*). This question included a block of three items: extreme heat wave, drought, and polluted air. For each item endorsed, participants were asked *how much* they were harmed (1 = *Not at all*, 4 = *A great deal*). These three items were averaged to create an index of past harm from environmental extremes ($\alpha_{\text{Latino}} = .73$, $\alpha_{\text{Non-Latino White}} = .62$).

2.2.6 Risk perceptions

To measure participants’ global warming risk perceptions, they were asked, “How much do you think global warming will harm:” for eight different items such as “you personally,” “people in your community,” and “future generations of people” (1 = *Not at all*, 4 = *A great deal*; *Don’t know* responses were coded as missing). Items were averaged to form a risk perception index ($\alpha_{\text{Latino}} = .96$, $\alpha_{\text{Non-Latino White}} = .97$).

2.2.7 Demographics

To measure gender, respondents were asked “Are you...?” with the options of *Male* (0) and *Female* (1). For age, respondents were asked “How old are you?” and were given a text box to type in their age. To measure education, participants were asked “What is the highest level of school you have completed?” and were given seven options ranging from *Some high school or less* to *Professional or Doctorate Degree*. This variable was recoded into four categories ranging from *Less than high school* (1) to *Bachelor’s degree or higher* (4). To measure income, respondents were asked “How much is the combined income of all members of your household for the past 12 months?” (1 = *Below \$50,000*, 2 = *\$50,000 or more*, 3 = *Don’t know*) and were then given the following prompt: “We would like to get a better estimate of your total HOUSEHOLD income in the past 12 months before taxes. Was it...” (1 = *Less than \$5000*, 21 = *\$250,000 or more*). This variable was then recoded into six categories ranging from *Less than \$25,000* (1) to *\$100,000 or more* (6). Respondents reported their ethnicity by answering the question “Are you Spanish, Hispanic, or Latino?” (1 = *No I am not*, 2 = *Yes, Mexican, Mexican - American, Chicano*, 3 = *Yes, Puerto Rican*, 4 = *Yes, Cuban, Cuban American*, 5 = *Yes, other Spanish, Hispanic, or Latino group*). Respondents reported their race by responding to the statement “Please choose one or more race(s) that you consider yourself to be” (1 =

White, 2 = Black or African American, 3 = American Indian or Alaska Native, 4 = Asian, 5 = Native Hawaiian or other Pacific Islander, 6 = Some other race). Respondents reported their religious affiliation by answering the question “What is your religion?”

2.2.8 Missing data

To mitigate potential biases, hot deck imputation was used to impute missing data (Myers 2011). Several studies demonstrate that hot deck imputation is superior to other commonly used methods of handling missing data such as listwise deletion, pairwise deletion, and mean substitution (e.g., see Hawthorne and Elliott 2005; Roth 1994). We used deck variables that previous research has shown to be predictive of global warming beliefs such as income, education, strength of political party affiliation, and, for Latino participants, the language on which they chose to complete the survey (i.e., English or Spanish).

Participants who had missing data or chose the response “*Don’t know*” for six or more questions in the Risk Perceptions Index and/or refused or responded “*Don’t know*” or “not sure” to five or more items from other variables were excluded from analyses (9% of Latinos, $n = 138$, and 8% of non-Latino Whites, $n = 71$). There were small differences between the excluded and retained sample across both Latinos and non-Latino Whites. For instance, there were more females and political moderates in the excluded sample than the retained sample. Supplementary Table 1 reports the differences between the excluded and retained samples.

3 Results

3.1 Latino versus non-Latino White differences in risk perceptions

An independent samples t test found that Latinos ($M = 3.20$, $SD = .86$) reported significantly higher global warming risk perceptions than did non-Latino Whites ($M = 2.69$, $SD = .95$); $t(2292) = -13.31$, $p < .001$, 95% CI [.60, .44], $d = -.57$.

3.2 Predictors of risk perceptions among Latinos and non-Latino Whites

Next, we entered all relevant variables into a bivariate correlation analysis to determine which variables are related to risk perceptions. Variables significantly correlated with risk perceptions were retained for further analyses (Supplementary Table 2).²

All retained variables were then analyzed using multiple regression, first in separate models with conceptually related variables grouped together, and then in a full model with all variables. Separate models were run for the Latino and non-Latino White samples (Table 2). Then tests of significance for differences between regression coefficients were conducted using z -tests (right column, Table 2; Paternoster et al. 1998).

For Latinos, significant positive predictors of risk perceptions in the full model included gender (i.e., women reporting greater risk perceptions), identifying as Protestant, egalitarianism, descriptive norms, injunctive norms, communication with family outside the USA, health

² Because of demographic differences between Latino and non-Latino White samples, demographics (gender, age, education, income, and religious affiliation) were included as covariates in all regression and mediation models even if they did not significantly correlate with risk perceptions.

Table 2 Predictors of risk perceptions by Latinos and non-Latino Whites

	Separate Models 1–5				Full Model				z-test
	Latinos		Whites		Latinos		Whites		
	β	F (Adj. R2)	β	F (Adj. R2)	β	F (Adj. R2)	β	F (Adj. R2)	
1. Demographics		13.00 (.06)		9.21 (.07)		59.10 (.47)		51.43 (.56)	
Gender	.13***		.14**		.08***		.02		2.00*
Age	.00		.04		-.01		.00		0.26
Education	-.03		.02		.00		-.03		0.98
Income	-.09**		-.02		-.01		.00		0.15
Catholic	.07		.07		.02		.04		0.43
Born Again	-.15***		-.09		-.04		.02		1.40
No religion	.09*		.22***		.04		.08*		0.88
Protestant	.02		.04		.06**		.03		0.79
2. Ideology		175.16 (.33)		135.05 (.38)					
Party affiliation	-.18***		-.11**		-.11***		-.03		1.79
Political ideology	-.03		-.12**		-.01		-.07*		1.53
Egalitarianism	.38***		.32***		.28***		.19***		2.07*
Individualism	-.17***		-.19***		-.13***		-.13***		0.19
3. Social influence		77.74 (.30)		90.42 (.45)					
Descriptive norm	.16***		.23***		.11***		.17***		1.41
Injunctive norm	.37***		.44***		.25***		.32***		1.64
Media exposure	-.01		-.02		.00		.02		0.75
Social network	.08**		.11**		.03		.02		0.07
Fam. Comm.	.12***		.00		.09***		.00		2.44*
Social capital	-.09***		.04		-.06**		.02		2.92**
Gens. cohab.	.04		.01		.03		.00		0.85
Contact by org.	-.02		.04		-.03		-.01		0.51
4. Vulnerability		27.77 (.02)		22.82 (.03)					
Health issues	.14***		.16*		.04*		.05*		0.32
5. Personal experience		67.89 (.05)		52.90 (.06)					
Past harm env. haz.	.21***		.24***		.09***		.06*		0.85

z-test z-score for tests of significance for differences between standardized coefficients of Latinos and non-Latino Whites in the Full Model, *Fam. Comm.* family communication, *Gens. Cohab.* generations cohabiting, *Contact by Org.* contacted by organization, *Past Harm Env. Haz.* past harm from environmental hazards. All coefficients are standardized

*** $p < .001$; ** $p < .01$; * $p < .05$

issues, and experience of past harm from environmental hazards. Significant negative predictors included party affiliation (i.e., higher = stronger identification with the Republican Party), individualism, and greater social capital.

For non-Latino Whites, significant positive predictors in the full model were “No Religion” identification, egalitarianism, descriptive norms, injunctive norms, health issues, and past harm from environmental hazards. Significant negative predictors were political ideology (i.e., higher = more conservative) and individualism.

Next, we tested whether there were significant differences in the strength of each predictor in the full model for Latinos and non-Latino Whites (Table 2). The results show that gender was a significantly stronger predictor for Latinos than non-Latino Whites. That is, women had higher global warming risk perceptions than men for both Latinos and non-Latino Whites, but this difference was significantly larger for Latinos. Likewise, egalitarianism was a strong predictor of risk perceptions for both groups, but was a significantly stronger predictor for Latinos. For the variable measuring communication with family outside the U.S., the coefficient was again stronger for Latinos. Importantly, this variable had no association with risk perceptions for Whites but was a robust positive predictor for Latinos. Similarly, there was a significant difference in the predictive strength of social capital: it had no association with risk perceptions for Whites but had a significantly negative relationship with risk perceptions for Latinos.

3.3 Explaining Latino versus non-Latino White differences in risk perceptions

Mediation analyses were used to determine which variables best explain why Latinos have significantly higher global warming risk perceptions compared to non-Latino Whites. We used the PROCESS macro Model 4 (Hayes 2013) with dataset (0 = *Latinos*, 1 = *Non-Latino Whites*) entered as the independent (X) variable, explanatory variables entered as mediators (M), and the risk perception index entered as the dependent variable (Y). All models included demographic covariates including gender, age, education, income, and religious affiliation (using dummy variables), although inclusion of these covariates did not influence any of the results.

First, we tested for indirect effects with variables grouped into blocks with conceptually related variables to determine the contribution of each variable to the model. Seven significant indirect effects emerged. The tests of indirect effects show that, compared with non-Latino Whites, Latinos' elevated risk perceptions are explained, in part, by stronger identification with the Democratic Party, stronger egalitarianism, weaker individualism, greater pro-climate descriptive and injunctive social norms, more communication with family members in other countries, and personal experience of harm from environmental hazards (via extreme heat waves, drought, and polluted air; see Supplementary Tables 3A-3D). Next, the significant mediators from each block were entered into a single model simultaneously. In this combined model, all seven indirect effects remained significant (see Table 3). However, the direct effect (the Latino vs. non-Latino White difference in risk perceptions while controlling for all mediators) remained significant $\beta = -.15$, 95% CI $[-.21, -.08]$. For coefficients of all paths in the model, see Fig. 1.

3.4 Testing for the strongest mediators

In this combined model of significant mediators, we used pairwise comparisons (automatically computed by the PROCESS macro) to test whether some mediators were significantly stronger than others (Table 4). We found that injunctive norms and egalitarianism best explained Latino versus non-Latino White differences in risk perceptions, but were similar to each other in strength. Both injunctive norms and egalitarianism were significantly stronger mediators than all other variables in the model: party affiliation, family communication, prior experience, descriptive norms, and individualism. There were no significant differences among these five remaining mediators.

Table 3 Mediators of the relationship between group (Latino vs. non-Latino White) and risk perceptions

Mediator	Standardized indirect effects (95% CI)
Injunctive norm	-.10 (-.13, -.07)
Egalitarianism	-.09 (-.11, -.06)
Party affiliation	-.04 (-.06, -.02)
Family communication	-.04 (-.05, -.02)
Past harm env. haz.	-.03 (-.05, -.02)
Descriptive norm	-.03 (-.05, -.02)
Individualism	-.02 (-.04, -.01)

X = Group (0 = Latino, 1 = non-Latino White); Y = risk perceptions index. Covariates = gender, age, education, income, and four dummy variables for each religious affiliation (Catholic, Born Again, No Religion, and non-Evangelical Protestant). Env. Haz. = environmental hazards. Significance was tested using bias-corrected bootstrap confidence intervals with 5000 resamples. All indirect effects in this table are significant, as confidence intervals do not cross zero

4 Discussion

Recent research indicates that heightened risk perceptions among Latinos is the strongest predictor of higher levels of political action (i.e., contacting elected officials) among Latinos compared with non-Latinos Whites (Ballew et al. 2019). The current results identify several variables that predict global warming risk perceptions among Latinos and non-Latino Whites, but also variables that might explain *why* Latinos, more than non-Latino Whites, perceive global warming as a serious risk.

4.1 Differences in predictor strength

In the full regression model, several variables were stronger predictors of risk perceptions for Latinos than for non-Latino Whites, including gender, egalitarianism, communication with family outside the USA, and social capital.

The finding that women have higher global warming risk perceptions than men was larger for Latinos than non-Latino Whites. Interestingly, gender differences were equivalent for each group when examining the regression model with only demographic variables, but was stronger for Latinos in the full model, suggesting that gender has more unique explanatory power for Latinos than for non-Latino Whites.

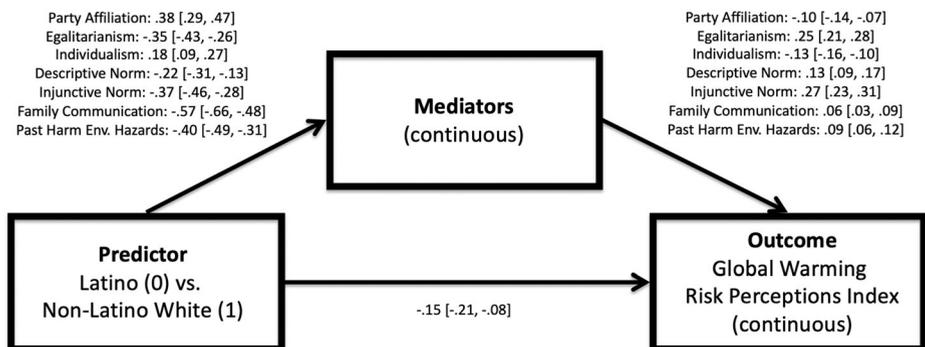


Fig. 1 Mediation models accounting for group differences in risk perceptions

Table 4 Pairwise comparisons of indirect effects

Comparison variable	Variable	Contrast of indirect effects (95% CI)
Injunctive norm	Egalitarianism	-.01 (-.05, .02)
	Party Affiliation*	-.06 (-.09, -.03)
	Family Communication*	-.06 (-.10, -.03)
	Past Harm Env. Hazards *	-.07 (-.10, -.04)
	Descriptive Norm*	-.07 (-.10, -.04)
Egalitarianism	Individualism*	-.08 (-.11, -.05)
	Party affiliation*	-.05 (-.08, -.02)
	Family communication*	-.05 (-.08, -.02)
	Past harm env. hazards *	-.05 (-.08, -.02)
	Descriptive norm*	-.06 (-.08, -.03)
Party affiliation	Individualism*	-.06 (-.09, -.04)
	Family communication	.00 (-.03, .02)
	Past harm env. hazards	-.01 (-.03, .02)
	Descriptive norm	-.01 (-.03, .01)
	Individualism	-.02 (-.04, .00)
Family communication	Past harm env. hazards	.00 (-.03, .02)
	Descriptive norm	-.01 (-.03, .02)
	Individualism	-.01 (-.03, .01)
Past harm env. hazards	Descriptive norm	-.01 (-.02, .02)
	Individualism	-.01 (-.03, .01)
Descriptive norm	Individualism	-.01 (-.02, .01)

* Significant difference for comparison variable minus variable. Y = risk perceptions index. Variables listed in order of the size of the indirect effect. Covariates = gender, age, education, income, religious services, and four dummy variables for each religious affiliation (Catholic, Born Again, No Religion, and non-Evangelical Protestant). Env. = environmental. Significance was tested using bias-corrected bootstrap confidence intervals with 5000 resamples. Party affiliation and Individualism variables were reverse-scored to have the same sign as other variables in the model to enable significance tests for differences between specific indirect effects (Hayes 2013)

Importantly, although egalitarianism was a top predictor for both groups, it was significantly stronger for Latinos. One explanation for this is that Latinos may be more likely to see global warming as an environmental justice issue (e.g., Satterfield et al. 2004) that concerns the welfare of others or an issue of social justice. Further research is needed in order to explore this explanation.

Additionally, communication with family outside the USA was a stronger predictor for Latinos than non-Latino Whites. Because approximately half of Latino Americans are foreign born (Pew Research Center 2017), they likely have family members who live outside the USA and reside in places that are at greater risk of global warming impacts (Patz et al. 2005). The variable included in our study only measured communication with such family members, but its relationship with global warming risk perceptions suggests that it might have overlap with other related variables, such as how long they have lived in the USA or social identification with their native country. One plausible explanation for the relationship between communication with family members abroad and risk perceptions is that information exchanged with family members outside the USA about experiencing impacts of climate change increases Latinos' risk perceptions. Further research is needed, however, to understand the interplay between familial ties with people outside the USA, information exchanged in conversation, and risk perceptions about environmental hazards.

Perhaps the more counterintuitive finding is the negative relationship between social capital (i.e., number of people you can count on for support in a time of need) and risk perceptions for

Latinos, but a near-zero relationship with risk perceptions for non-Latino Whites. Most Latinos have relatively high risk perceptions, so it is possible that those who have many people they can count on for support have relatively lower risk perceptions because they feel protected by supportive social ties. This finding has been observed in research on responses to flood risk (Babcicky and Seebauer 2017). Importantly, research shows that social capital can be a double-edged sword: it is negatively associated with risk perceptions before an event (i.e., flooding), but is positively associated with efficacy for responding to the event. Although social capital was a significant predictor for Latinos in the current study, it is important to note that its strength was much smaller in magnitude than other key variables in the model (e.g., egalitarianism, injunctive norms).

It is also worth examining the predictors that, although of high theoretical relevance, did not predict risk perceptions for Latinos or non-Latino Whites. For example, considering the well-known importance of media exposure in shaping climate change beliefs and attitudes (e.g., Feldman et al. 2014; Gustafson et al. 2019; Leiserowitz 2004), it is surprising that it did not predict risk perceptions. One explanation for this is that, while important, media exposure did not contain any information beyond the other variables included in the analyses. Another plausible explanation is that our measure of media exposure was non-specific. That is, it measured respondents' self-report of *how often* they hear about global warming in the media, but did not measure the *content* of that exposure, thereby reducing the variable's predictive strength if some respondents hear information that increases their risk perceptions while others hear information that reduces them. Thus, based on the results of the current study, it is unclear whether differences in media exposure plays a key role in explaining Latino versus non-Latino White differences in global warming risk perceptions.

4.2 Accounting for differences in risk perceptions

Mediation analyses allowed for testing of whether Latino versus non-Latino White differences in risk perceptions could be accounted for by group differences on other theoretically relevant variables. In order of magnitude, Latinos' greater risk perceptions can be explained, in part, by stronger injunctive norms and egalitarian worldviews, followed by stronger identification with the Democratic party, more frequent communication with family outside the USA, more experience with harm from environmental hazards, stronger descriptive norms, and lower levels of individualism.

The findings from the current study bolster and extend upon previous research identifying the importance of social norms in the formation of beliefs and attitudes (Cialdini et al. 1990; Goldstein et al. 2008). Importantly, our results indicate that the type of norm matters. Previous research shows that both descriptive and injunctive norms can be influential, as observed here, but the influence of the particular norm depends on its salience (Cialdini et al. 1990). In this study, injunctive norms were significantly better than descriptive norms at explaining differences in risk perceptions. This is likely because the injunctive norm was more salient; it focused on friends' and family's expectations specifically *for the individual*. Put simply, an individual's perception that their close social network wants *them* to take action is more influential than an individual's perception of their social group's objective behavior. Because communicating injunctive norms has been shown to have causal effects on pro-environmental behaviors (e.g., Cialdini et al. 1990), the current research suggests that this would be a useful strategy for communication campaigns that aim to engage groups with the issue of climate change that currently have relatively lower levels of engagement (e.g., non-Latino Whites).

Also confirming and extending previous research (Leiserowitz 2006), egalitarianism is a similarly strong predictor of differences in risk perceptions between Latinos and non-Latino Whites. Because egalitarians are highly concerned with inequities in the distribution of benefits and harms, it makes sense that they are especially attuned to the risks of climate change and environmental issues more generally, particularly because environmental problems disproportionately affect vulnerable populations (Clark et al. 2014; Mohai et al. 2009). Importantly, egalitarianism was an influential variable for explaining group differences in risk perceptions in two ways: egalitarianism was a stronger predictor of risk perceptions among Latinos than among non-Latino Whites (regression results), but also Latinos were themselves higher in egalitarianism ($X \rightarrow M$ relationship in the mediation results).

The current findings suggest that communication campaigns might be enhanced by applying a cultural lens to understanding who to identify for messaging. For example, Latinos have been shown to have a highly relational cultural orientation (Holloway et al. 2009) and thus may be more responsive to appeals to pro-environmental social norms, as our results suggest (see also Pearson et al. 2018). Further, it would be useful for advocacy groups to use egalitarian values as a trait on which to identify people who are likely to be willing to join a campaign to mitigate climate change. For example, advocacy organizations could couple other social justice campaigns (e.g., those focusing on racial, gender, and socioeconomic inequality) with climate change to engage those who already demonstrate an interest and willingness to contribute to causes that align with their egalitarian worldviews. If notable portions of such audiences remain untapped, this presents a promising communication opportunity for policy makers and advocates.

It is worth attempting to understand why injunctive norms and egalitarianism seem to outweigh other theoretically relevant variables in explaining group differences in risk perceptions. One explanation is that these variables provide the most unique information for predicting risk perceptions, considering they were the strongest predictors even while holding the other variables in the mediation model constant. Injunctive norms and egalitarianism might provide the most unique information for predicting risk perceptions because they capture a wider range of information that is known to be crucial for beliefs and perceptions about climate change: the beliefs of close others in one's social network (Goldberg et al. 2019a, b) and people's core values about inequality and social justice (Leiserowitz 2006). Although there were larger *group* differences (Latinos vs. non-Latino Whites) on other mediating variables (e.g., past harm from environmental hazards, communication with family outside the USA), these variables were much weaker than injunctive norms and egalitarianism in predicting global warming risk perceptions. Thus, the stronger role that injunctive norms and egalitarianism played in explaining Latino versus non-Latino White differences in risk perceptions is based on the *combination* of robust group differences *as well as* their greater predictive strength of global warming risk perceptions.

Interestingly, the variables of frequency of communication with family outside the USA, Democratic party affiliation, experience with harm from environmental extremes, descriptive norms, and individualism each explained Latino versus non-Latino White differences in risk perceptions to a similar degree. Although party affiliation, worldviews, and social norms are well-understood predictors of climate change beliefs, these data also highlight the importance of prior experience with harm from environmental extremes and close connections to people outside the USA.

These findings are important for science communicators because they may be actionable. That is, it is difficult to change individuals' worldviews or party affiliation.

However, informing the public about the connection between environmental extremes and climate change and the vulnerability of relatives in developing countries are both actionable communication insights. However, practitioners should employ this strategy with caution because high levels of risk perception without accompanying efficacy to mitigate the threat can lead people to avoid taking action to reduce the threat (Witte 1994). Thus, because Latinos already have high risk perceptions, the current findings suggest that bolstering efficacy among some subgroups of Latinos may be a useful strategy for increasing climate action, whereas increasing risk perceptions might be a better strategy for some subgroups of non-Latino Whites. The current findings provide a useful roadmap for communicating with subgroups within each of these large groups of the USA population.

Although the mediating variables accounted for most of the difference in risk perceptions between Latinos and non-Latino Whites, a significant direct effect remained. That is, even when holding the mediators constant, there were still significant group differences in risk perceptions. This suggests that there are likely additional mediators that can further explain group differences in risk perceptions (Zhao et al. 2010). Future research should explore other factors that can be used in combination with those identified here in order to fully account for the observed group differences.

4.3 Limitations

There are limitations to this study that should be noted. First, this study uses observational data, which means that further research is needed to establish causal relationships. Although it is not possible to manipulate racial or ethnic differences in a real-world context, it is plausible to manipulate variables identified in this study to determine the causal effects on risk perceptions. For example, descriptive and injunctive norms have been shown to be very influential for increasing pro-environmental behavior (Cialdini et al. 1990) and thus might translate to interventions aiming to increase risk perceptions. Additional research should test this question, as well as whether there is a causal role of other key variables we have identified, such as the effect of crafting messages that emphasize egalitarian values (e.g., climate change as a social justice issue).

An additional limitation is that we only compared two ethnic/racial groups: Latinos and non-Latino Whites. In the nationally representative survey that provided the data on non-Latino White Americans, the sample sizes of other racial groups (e.g., African-Americans, Asian-Americans, Native Americans) were too small to facilitate robust comparisons. It is unknown whether the primary factors identified here also explain differences between other racial or ethnic groups, and would therefore be an important question for future research to investigate.

Measuring race and ethnicity—especially for Latinos—has complexities that should be noted. Although we measure race and ethnicity as does the USA Census (i.e., as separate constructs), many Latinos see their ethnicity as *part* of their racial identity (Pew Research Center 2015). In fact, a majority of Latinos report that their racial identity is both Hispanic and White. Because of this overlap in self-identification of race and ethnicity for Latinos but not for non-Latino Whites, it makes categorization and analysis less clear. Moreover, Latinos with different nationalities may hold disparate values based on the various historical, social, and cultural contexts in their (or their families') countries of origin. Further research should examine the role of each of these important factors.

Another limitation is that, although self-reported past harm from environmental hazards was a significant factor in explaining Latino versus non-Latino White differences, we did not evaluate the *objective* risk of global warming impacts to participants (e.g., based on geographic area). Although we did not measure objective risk of exposure to environmental hazards, research shows that personal experience may be shaped by people's existing beliefs (e.g., connecting climate impacts to global warming when one is already certain that global warming is happening; Myers et al. 2013). This suggests that, in some situations, *perceived* harm from environmental hazards might be a better predictor of global warming risk perceptions than actual harm. Future research could investigate the interplay between subjective and objective risks of global warming, and how they differentially shape perceptions of other key predictors, such as injunctive and descriptive norms.

Finally, the use of mediation analysis to understand group differences is not without limitations. Any proposed variable that is correlated with both the independent variable (Latino vs. non-Latino White) and dependent variable (risk perceptions) could statistically serve as a mediator (Fiedler et al. 2011). Thus, decisions about which factors serve as mediators should be guided primarily by theory, as opposed to statistics. Although we have used existing theoretical perspectives to guide variable selection and analysis here, it is important to understand that there may be additional variables that explain the group differences in risk perception observed in this study.

4.4 Conclusion

This study identifies several opportunities to communicate with, engage, and mobilize key subgroups of Americans on the issue of climate change. We identify relatively enduring aspects of the Latino community that predict their greater risk perceptions, such as a relatively more egalitarian worldview. Importantly, however, we also identify factors that can inform climate change communication campaigns, like communicating pro-climate injunctive norms. Finally, these findings help explain why Latinos are more likely to perceive global warming as a serious risk, which in turn predicts why they are also more likely to take political action.

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Author contributions AL, SAR, and MJC developed the materials, design, and scope of the study. SAR managed the data and participant recruitment. MHG and AG conducted the statistical analyses with input from MTB. MHG drafted the first draft of the manuscript with input from AG and MTB. All authors contributed to the final version of the manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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