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# Global Warming Risk Perceptions in India

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Few studies have focused on global warming risk perceptions among people in poor and developing countries, who are disproportionately impacted by climate change. This analysis conducts a comprehensive assessment of global warming risk perceptions in India using a national sample survey. Consistent with cultural theory, egalitarianism was positively associated with global warming risk perceptions. In addition, perceived vulnerability and resilience to extreme weather events were also two of the strongest factors associated with global warming risk perceptions. While worry was positively associated with risk perceptions, it accounted for only a small proportion of the variance, unlike studies in developed countries. Finally, the study also collected global warming affective images. The most common responses were "don't know" or "can't say" (25%), followed by "pollution" (21%), "heat" (20%), and "nature" (16%). The study finds that the predictors of global warming risk perceptions among the Indian public are both similar and different than those in developed countries, which has important implications for climate change communication in India.

**KEY WORDS:** Affective imagery; cultural worldviews; India; perceived vulnerability and resilience; risk perceptions

## 1. INTRODUCTION

Without ambitious action to mitigate greenhouse gases (GHGs), climate change[1] is likely to have major negative impacts on economies, livelihoods, and public health through intensification of disasters such as hurricanes, floods, heat waves, and wildfires (IPCC, 2018). While climate change is global, its impacts will be disproportionately experienced by people in poor and developing countries (IPCC, 2018). India is considered one of the most vulnerable countries to global warming because of the sensitivity of its population and economy to the consequences of climate change. About half of India's population is engaged in agriculture and other climate-sensitive industries, with over 300 million Indians still without access to electricity (Economic Survey, 2018). While India is one of the fastest growing economies and is the third largest contributor of annual emissions in the world, energy and income inequality are widespread.

Public perceptions of global warming risks are an important driver of public engagement (Leiserowitz, 2006; Leiserowitz, 2005; O'Connor, Bord, & Fisher, 1999; Semenza et al., 2008; Smith & Leiserowitz, 2012, 2014; Spence, Poortinga, Butler, & Pidgeon, 2011). Risk perception is defined as subjective judgments about potential harm (e.g., Kahan et al., 2012; Leiserowitz, 2005; Slovic, 1987; van der Linden, 2017). While multiple studies have

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[1]While 'climate change' is a more scientifically accurate term, we interchangeably use it with 'global warming' as the latter is more popularly used in media and public discourse.

found a strong association between risk perceptions and public support for climate policies and willingness to engage in climate-activist behaviors (e.g., Smith & Leiserowitz, 2012, 2014; van der Linden, 2017), these have been mostly conducted in developed countries, predominantly the United States. Only few studies have evaluated how people in poor and developing countries perceive global warming risks (e.g., Shi, Visschers, Siegrist, & Arvai, 2016; Xue, Marks, Hine, Phillips, & Zhao, 2018). For example, global surveys show that a majority of the public in poor and developing countries are not aware of the term "global warming" or "climate change" (e.g., Capstick, Whitmarsh, Poortinga, Pidgeon, & Upham, 2015; Lee, Markowitz, Howe, Ko, & Leiserowitz, 2015; Leiserowitz & Thaker, 2012; Ray, & Pugliese, 2010).

Human decision making about risks is said to be driven by two different processing systems (e.g., Kahneman, 2011). The "risk as analysis" system focuses on the role of cognitive deliberation in how people process and assess risk, and decision making is typically analytic, labor intensive, and slow. In contrast, the "risk as feelings" system refers to the role of affect and other emotional cues when making decisions about risks (e.g., Finucane, Alhakami, Slovic, & Johnson, 2000; Slovic & Peters, 2006). This thinking is typically described as intuitive, experiential, and fast, and research has focused on how "affect," the emotional quality of "good" or "bad," greatly influences decision-making processes (e.g., Slovic et al., 2002). As affect is typically processed automatically and efficiently, it helps individuals make daily decisions without requiring much cognitive effort. This "affect heuristic" has received wide empirical support and many studies have used it to understand how publics perceive and process risk across a wide range of issues (e.g., Finucane et al., 2000), including global warming (e.g., Leiserowitz, 2006; Leiserowitz & Smith, 2017; Smith & Leiserowitz, 2012).

Risk, moreover, "does not exist independent of our minds and culture" (Slovic, 1992, p. 690). A number of studies in the United States, for example, demonstrate the powerful influence of cultural worldviews and values on how public process information about global warming (e.g., Kahan et al., 2012; Kahan, Braman, Gastil, Slovic, & Mertz, 2007; Leiserowitz, 2006; van der Linden, 2015). Equally important are values that shape how the public interprets the environment relative to other issues, such as economic development (Dietz, Kalof, & Stern, 2002; Drews, Antal, & van den Bergh, 2018; Steg, Groot, Dreijerink, Abrahamse, & Siero, 2011; Stern, Dietz, & Kalof, 1993).

In addition, people's perceptions of global warming are likely to be driven by their previous experiences with related risks and their perceptions about their resilience to recover from negative impacts (e.g., Akerlof, Maibach, Fitzgerald, Cedeno, & Neuman, 2013; Brody, Zahran, Vedlitz, & Grover, 2008; Spence et al., 2011). This is likely the case with people living in poor and developing countries who may have little familiarity or knowledge about the scientific terms "global warming" or "climate change." When people are exposed to novel risks, they are likely to process information based on their existing perceptions and experiences. While most studies have focused on affective reactions and cultural worldviews, as mentioned above, few studies have evaluated how perceptions related to vulnerability and resilience impact how the public assesses global warming risks. In this exploratory study, we respond to calls for a comprehensive risk perception model (e.g., van der Linden, 2014, 2015) by integrating theories of affective imagery, cultural worldviews, values, and perceived vulnerability and resilience, in addition to socio-demographic factors, to understand Indian perceptions of global warming risks.

## 2. LITERATURE REVIEW

### 2.1. Affective Imagery

Affective images are defined as the "sights, sounds, smells, ideas, and words, to which positive and negative affect or feeling states have become attached through learning and experience" (Slovic, MacGregor, & Peters, 1998, p. 3). Affective images are mental representations or cognitive content and can contain both perceptual and symbolic aspects (Damasio, 1999). Utilizing affective imagery analysis, a methodological approach that taps into the affect heuristic, researchers have investigated the affective aspects of public global warming risk perceptions. These are accessed using a structured form of free association to identify how people spontaneously represent particular risks and hazards (Szalay & Deese, 1978). Typically, open-ended survey questions are used to elicit free associative content, which combines the benefits of qualitative and quantitative research methodologies.

Leiserowitz (2005) first used affective imagery analysis to examine American global warming risk

perceptions, policy preferences, and behaviors in a nationally representative survey. Respondents were asked to free associate the "first thought or image" that comes to mind when hearing the words global warming. Using content analysis to categorize the associations, images of "melting ice" were the most frequently provided (e.g., melting polar ice caps, Antarctica melting), followed by general references to rising temperatures (e.g., temperatures increasing), and impacts on nonhuman nature (e.g., upset ecological balance). A subsequent study found that image categories were a better predictor of public global warming risk perceptions and policy preferences than other variables including sociodemographics, such as party affiliation and political ideology (Leiserowitz, 2006). These results demonstrated that the connotative meaning of global warming plays an important role in how Americans respond to the issue.

More recently, Smith and Leiserowitz (2012) performed a time-series analysis to understand how an American's affective image associations have changed over time. From data collected via four nationally representative surveys (completed in 2003, 2007, 2008, and 2010), results revealed a sharp rise in the number of Americans who freely provided a naysayer association to global warming (e.g., "hoax") while also revealing decreases in other associations such as melting ice, heat, and the ozone hole. The study also replicated the results of Leiserowitz (2006), whereby images and the affect they provoke explained more variance in global warming risk perceptions than a range of other predictors including the cultural worldviews of egalitarianism and individualism and political ideology. In an additional study focusing on the links between affect and emotion (Smith & Leiserowitz, 2014), a series of regression analyses further found support for the importance of affective images as predictors of global warming policy preferences. Despite discrete emotions (including fear, anger, worry, and hope) being the most powerful predictors, affective images accounted for more variance than political party identification and political ideology.

Most recently, Leiserowitz and Smith (2017) analyzed changes in affective imagery over a 14-year period in nationally representative samples of the American public between 2002 and 2016. Of particular interest was the increase in associations of global warming with "weather," which more than quadrupled between 2007 and 2016. In addition, these associations correlated relatively strongly with changes in the seasonal Climate Extremes Index, implying that American interpretations of global warming were influenced by extreme weather events.

While the studies reviewed identify the important role affective imagery can plan in public risk perceptions, they were all based on nationally representative samples of the American public. Few studies utilizing affective image analysis have been conducted outside of the United States, the United Kingdom (e.g., Lorenzoni, Leiserowitz, Doria, Poortinga, & Pidgeon, 2006), or Australia (Leviston, Price, & Bishop, 2014). Much less is known about the role of affective imagery in public risk perceptions among citizens of less developed and non–English-speaking countries, with different cultural, socioeconomic, and geographic contexts. Moreover, as the extremes of a changing climate are being felt globally, more research is needed to ascertain how citizens in the developing world are engaging with this issue.

**Research Question 1**: What affective images about global warming are prevalent in India?

**Research Question 2**: Is affective imagery a significant predictor of global warming risk perceptions among Indians?

### 2.2. Cultural Worldviews

Cultural theorists argue that individuals respond to risks in congruence with their cultural worldviews or values about the role of society and government in shaping an individual's life (e.g., Dake, 1992; Kahan et al., 2007; Wildavsky & Dake, 1990). Scholars have identified four worldviews, in a grid-group system, that shape how individuals interpret and respond to risks. They are "egalitarianism," "individualism," "hierarchism," and "fatalism" (e.g., Leiserowitz, 2006; Peters & Slovic, 1996). Each of these archetypes "represents a different 'rationality;' a set of presuppositions about the ideal nature of society which leads each group to perceive different risks and prefer different policy responses" (Leiserowitz, 2006, p. 49). Scholars argue that egalitarians are predisposed to perceive social risks as greater when they result in an unequal distribution of benefits and costs. Individualists, however, tend to downplay social risks as they fear increased social control will lead to a loss of individual freedom and choice. Fatalists are predisposed to believe that life is capricious and show little interest in trying to solve social problems. According

to Dake (1992), "As in the Hindu 'veil of maya,' in which space, time, and causation form the three elements of delusion, fatalists are thought to view life as a lottery in which no particularly risk management strategy is best" (p. 30). Few individuals are expected to hold these ideal types exclusively, however.

Previous research supports these hypotheses. Leiserowitz (2006) found that individuals who hold egalitarian ideals perceive climate change as a greater risk, whereas those who hold individualist ideals perceive climate change as a low or nonexistent risk. In addition, Kahan et al. (2012) found scientific literacy and numeracy—capacities that should help individuals with more information and skill reach conclusions aligned with the scientific consensus that human-caused global warming is happening—decreased global warming concern among individualists, while increasing concern slightly among egalitarians. In other words, higher literacy and numeracy were associated with greater cultural polarization. As cultural theory worldviews tend to be one of the strongest factors explaining risk perceptions in the United States, it is important to test these findings in the Indian context. Only one recent study has tested the role of cultural theory worldviews in India, and found that individualistic worldviews were negatively and egalitarian positively associated with general environmental concern (Pandey & Jain, 2017). To our knowledge, no study has yet evaluated the role of cultural theory worldviews on global warming risk perceptions among Indians. The following hypothesis are proposed:

**Hypothesis 1**: Egalitarianism will be positively associated with global warming risk perceptions

**Hypothesis 2**: Individualism will be negatively associated with global warming risk perceptions

**Hypothesis 3**: Fatalism will be negatively associated with global warming risk perceptions

### 2.3. Environmental Protection Values

While worldviews are considered general orienting mechanisms, values are specific, guiding principles in an individual's life (e.g., Schwartz, 1992; van der Linden, 2014, 2017). Values may correlate with cultural worldviews, where an egoistic value orientation correlates with an individualistic worldview and social values with an egalitarian worldview (e.g., Stern, 2000; van der Linden, 2014). Importantly, previous research shows that values are more predictive of personal norms, policy acceptability, and intentions about environmental activism than general environmental concerns and ecological worldviews (e.g., Steg et al., 2011). Generally, in environmental domains, scholars focus on assessing individual values toward the self (egotistic values), caring of others (socioaltruistic values), and caring for nonhuman nature and biosphere (biospheric values) (e.g., Stern et al., 1993; van der Linden, 2015). Previous studies show that biospheric values are strongly correlated with global warming and nuclear energy risk perceptions (e.g., de Groot, Steg, & Poortinga, 2013), and explained 12% of variance in global warming risk perceptions (e.g., van der Linden, 2015). van der Linden (2015) found that while biospheric values were significantly associated with both perceived societal and personal risk, egotistic values were moderately associated with personal risk, but not societal risk. In this study, we extend these previous studies to specifically focus on environmental protection values relative to economic growth and jobs.

Often, the environment and economic development are framed in opposition to each other, such that protecting and promoting one will necessarily and negatively impact the other (e.g., Drews et al., 2018). However, environmental protection can often grow the economy and provide new jobs (e.g., clean energy, forest restoration). In the United States, Leiserowitz et al. (2015) found that Americans were most likely to say that environmental protection "improves economic growth and creates new jobs" (60%). Fewer said it "reduces growth and costs jobs" (15%), or "has no effect on growth or jobs" (22%). While such questions have been asked in several surveys (see Drews et al., 2018), these perceptions of the tradeoffs between the environment and economy have not been evaluated in relation to global warming risk perceptions. We propose to test the following hypothesis:

**Hypothesis 4**: Environmental protection values will be positively associated with global warming risk perceptions

### 2.4. Perceived Vulnerability and Resilience

Apart from worldviews and values, perceived vulnerability is likely to shape public perceptions about global warming risks (Bord & O'Connor, 1997;

Satterfield, Mertz, & Slovic, 2004). Perceived vulnerability can be defined as heightened sensitivity to risks (Bord & O'Connor, 1997) and is shaped by previous direct or vicarious experiences to risks as well as socioeconomic factors (Satterfield et al., 2004). For example, Bord and O'Connor (1997) argued that the persistent gender gap in environmental concern, with women showing higher concern than men, is an artifact of perceived vulnerability, not necessarily a result of differences in ecological values. Lazo, Bostrom, Morss, Demuth, and Lazrus (2015) found that viewing one's home as vulnerable to hurricanes predicts increased evacuation intentions among respondents in two coastal regions in the United States. Further, physical vulnerability, measured as proximity to coastline, is positively correlated with climate change risk perceptions in the United States (Brody et al., 2008), perhaps due to sea-level rise, a prominent image in the American mind about climate change. Nevertheless, few studies evaluating risk perceptions have focused explicitly on the relationship between perceived vulnerability and risk perceptions (Satterfield et al., 2004).

We expect that perceived vulnerability or individuals' perceptions of the potential impacts from extreme weather events such as flooding and drought on their food supply, drinking water supply, income, health, and community will have a large influence on their global warming risk perceptions. This reasoning is in line with empirical evidence that perception of local temperature changes is the strongest predictor of global warming risk perceptions in many Asian and African countries (Lee et al., 2015).

Just as important as perceived vulnerability is perceived resilience, or perceptions about one's ability to recover from the negative impacts resulting from global warming. Similar to perceived vulnerability, few studies have documented the impact of perceived resilience on risk perceptions (Adger, Barnett, Brown, Marshall, & O'Brien, 2013; Béné et al., 2016; Grothmann & Patt, 2005). For example, it is possible that individuals who feel that they can easily recover from an extreme weather event may have lower risk perceptions. Alternatively, individuals with low perceived resilience are likely to show higher risk perceptions, indicating their inability to recover from negative impacts. Due to lack of exposure and awareness about global warming, Indians are likely to transpose their perceptions of existing vulnerabilities and resilience onto new but related risks such as global warming. Based on these studies, we hypothesize the following:

**Hypothesis 5**: High perceived vulnerability will be positively associated with higher global warming risk perceptions

**Hypothesis 6**: Low perceived resilience will be positively associated with higher global warming risk perceptions

### 2.5. Worry

Worry is as an emotional reaction (Sjöberg, 1997; van der Linden, 2015, 2017) and has been found to be a strong predictor of risk perceptions and behavior. While concern refers to negative perceptions toward a common issue "and can be expressed without any particular motivational or emotional content" (van der Linden, 2017, p. 24), personal worry can be a strong emotion that shapes risk perceptions. Previous studies show that worry is positively associated with risk perceptions. For example, Sundblad, Biel, and Gärling (2007), using a Swedish sample, found that worry, measured as degree of worry about the negative consequences of global warming in three countries, across three time horizons (5, 50, 100 years), was positively associated with risk perceptions. They concluded that anticipatory emotions like worry trigger an action call, can act as a shortcut to behavior, and are likely to drive environmental activism and private-sphere behavior. Smith and Leiserowitz (2014) found that worry about climate change is one of the strongest predictors of global warming policy support, such as regulating $CO_2$ emissions, signing international treaties, and increasing taxes on gasoline. Following these studies, it is hypothesized that Indians most worried about global warming are likely to have higher risk perceptions:

**Hypothesis 7**: Worry will be positively associated with global warming risk perceptions

Based on previous studies (e.g., Akerlof et al., 2013, Brody et al., 2008; Smith & Leiserowitz, 2012; van der Linden, 2015), a large number of demographic variables were also analyzed such as gender, age, and socioeconomic indicators such as caste, monthly income, educational levels, religiosity, geographic location, membership in community groups, engagement with agriculture sector, living in a rented house, and the time needed to collect water. Mixed results have been found about the association between demographic factors in shaping risk perceptions in developed countries, with political ideology

consistently one of the strongest factors (see van der Linden, 2017).

## 3. METHOD

The measures used in this study were drawn from a nationally representative survey of Indians' climate change awareness, risk perceptions, policy support, and behavior conducted in 2011 using four stages of stratified sampling. (1) Parliamentary constituencies or national-level electoral units served as primary sampling units and were randomly selected with probability proportional to population size. (2) Assembly constituencies cluster to form the federal-level parliamentary constituencies. In the second stage, assembly constituencies were randomly selected. (3) In the third stage, polling locations (or polling stations) within an assembly constituency were randomly selected. (4) In the final stage, from each of the randomly selected polling stations, the first respondent was randomly selected, followed by every 10th respondent on the list provided by the Election Commission. Of the 30 selected respondents, a maximum of 10 interviews per polling station were conducted, without replacement for those respondents who were not present at home or who refused to participate in the survey. The electoral rolls provided by the Election Commission were used.

To increase the size of the nonurban sample, a separate random sample of 1,000 rural respondents was surveyed, composed of people residing in rural areas in all major states of India, similar to the stratified sampling mentioned above. In all, the survey included 138 urban and rural communities in 21 of the 35 states and union territories in India, covering 98% of the geographical area where Indian adult population lives. Respondents were selected from four types of communities: 2,094 were interviewed in Tier 1 mega-cities (e.g., Delhi and Mumbai), 459 respondents in Tier 2 cities (e.g., Lucknow, Jaipur, and Kochi), 517 in Tier 3 cities (e.g., Johrat, Tirupur, and Udhampur), and 961 rural respondents. Face-to-face interviews were conducted in November and December 2011 by two survey companies in India (C-Voter and Markelytics). The questionnaire was translated into 12 major Indian languages including Hindi, Bengali, Tamil, Urdu, and others. The survey took approximately 45 minutes to complete. Using the above sampling plan, 10,153 respondents were contacted, of which 4,031 respondents completed the survey, resulting in a response rate of 39.7%, with a 1.54% margin of error at the 95% confidence interval. The final data were weighted to match the age, gender, religious, and regional distribution of the target population, using 2001 Census parameters, the most recent Census available at the time of the survey. Only 1,999 respondents answered the open-ended affective imagery question, therefore the final sample for the current analysis was $N = 1{,}999$.

Finally, missing values (5%–15% of cases) for key variables in the study were imputed using hot-deck imputation (Myers, 2011) by borrowing from a respondent with similar sex, religion, and geographical location. Hot-deck imputation was preferred as it is used widely and has several advantages compared to other methods, including realistic values as they are based on observed values in the data set, and that imputations are within the range of possible values (see Myers, 2011).

### 3.1. Measures

#### *3.1.1. Dependent Variable: Risk Perceptions*

Multiple measures were used to assess global warming risk perceptions, as listed in Table I, derived from previous studies (e.g., Leiserowitz, 2006). The first measure was an index of perceived harm, including how much global warming will harm respondents personally, their family, their community, people in India, future generations of people, and plant and animal species (1, *not at all* to 4, *a great deal*, $\alpha = 0.83$, *M*average $= 3.14$, $SD = 0.91$). The second measure was a single item that asked respondents how soon global warming would start to harm people in the India (1, *never*; 2, *in 100 years*; 3, *in 50 years*; 4, *in 25 years*; 5, *in 10 years*; 6, *they are being harmed now*; $M = 4.15$, $SD = 1.47$). The third measure was an index of questions that asked respondents whether global warming would cause more or less of the following in India over the next 20 years, if nothing was done to address it: severe cyclones, extinctions of plant and animal species, famines and food shortages, droughts and water shortages, severe heat waves, disease epidemics, and severe floods (1, *many less* to 5, *many more*; $\alpha = 0.84$, *M*average $= 3.88$, $SD = 0.94$). The 13 items were moderately to strongly correlated (*r*s ranged from 0.15 to 0.65, all *p*s $< 0.001$). Average scores of these individual items were used in data analysis to index overall risk perceptions (*M*average $= 3.66$, $SD = 0.75$, $\alpha = 0.87$).

#### *3.1.2. Affective Reactions*

Following previous studies, respondents were asked an open-ended question: "When I say 'global

**Table I.** Risk Perceptions Index

| | Mean | SD | Alpha if Item Deleted | Alpha |
|---|---|---|---|---|
| Risk perceptions index | 3.66 | 0.75 | | 0.87 |
| How much do you think global warming will harm | | | | |
| (1) You and your family | 2.91 | 0.93 | 0.86 | |
| (2) People in your community | 3.02 | 0.92 | 0.86 | |
| (3) People in India | 3.18 | 0.91 | 0.86 | |
| (4) Future generations of people | 3.33 | 0.87 | 0.86 | |
| (5) Plant and animal species | 3.27 | 0.94 | 0.86 | |
| (6) Would you say people in India are being harmed now by global warming or people in India will start to be harmed by global warming in 10 years, in 25 years, in 50 years, in 100 years, or never? | 4.15 | 1.47 | 0.87 | |
| In India, over the next 20 years, please tell me if you think global warming will cause more or less of the following, if nothing is done to address it | | | | |
| (7) Severe cyclones | 3.47 | 1.43 | 0.86 | |
| (8) Extinctions of plant and animal species | 4.05 | 1.31 | 0.86 | |
| (9) Famines and food shortages | 4.00 | 1.31 | 0.86 | |
| (10) Droughts and water shortages | 4.03 | 1.26 | 0.85 | |
| (11) Severe heat waves | 4.02 | 1.25 | 0.86 | |
| (12) Disease epidemics | 3.99 | 1.27 | 0.86 | |
| (13) Severe floods | 3.63 | 1.39 | 0.87 | |

*Note:* $N = 1{,}999$. The first six items were measured on a four-point scale, from 1 (*not at all*) to 4 (*a great deal*). Item 6 was measured on a six-point scale, 1 (*never*) to 6 (*they are being harmed right now*). Items 7–13 were measured on a five-point scale, from 1 (*many less*) to 5 (*many more*).

**Table II.** Egalitarianism Index

| | Mean | *SD* | Alpha if Item Deleted | Alpha |
|---|---|---|---|---|
| Egalitarianism index | 3.13 | 0.60 | | 0.59 |
| The world would be a more peaceful place if its wealth were divided more equally among nations. | 3.06 | 0.92 | 0.51 | |
| In my ideal society, all basic needs (food, housing, health care, education) would be guaranteed by the government for everyone. | 3.30 | 0.87 | 0.50 | |
| I support government programs to get rid of poverty. | 3.14 | 0.91 | 0.51 | |
| Discrimination against minorities is still a very serious problem in our society. | 3.05 | 0.89 | 0.56 | |

*Note:* $N = 1{,}999$. Scales range from 1 (*strongly disagree*) to 4 (*strongly agree*).

warming,' what is the first word or phrase that comes to your mind?" Survey participants provided either single word associations (e.g., "pollution") or short narrative statements (e.g., "destruction of life on earth"). The final data set contained 1,999 respondent affective imagery responses. Similar to previous studies (e.g., Leiserowitz, 2006), an inductive content analysis was performed to reduce the responses to 18 categories. The categories were not mutually exclusive; for example, "polluted environment" was coded both for "pollution" and "nature." A second coder analyzed 10% of the sample (200 responses) independently, and Cohen's kappa was very high, ranging from 0.80 to 0.95 for different image categories, indicating high reliability.

### *3.1.3. Cultural Worldviews*

Values derived from cultural theory were operationalized based on previous surveys (e.g., Leiserowitz, 2006). Four items, on a four-point scale (1, *strongly disagree* to 4 *strongly agree*), measured egalitarianism. These items are listed in Table II and indicated a moderate level of reliability ($\alpha = 0.59$). The

**Table III.** Individualism Index

| | Mean | *SD* | Alpha if Item Deleted | Alpha |
|---|---|---|---|---|
| Individualism index | 2.85 | 0.60 | | 0.61 |
| If the government spent less time trying to fix everyone's problems, we'd all be a lot better off. | 3.12 | 0.86 | 0.58 | |
| Our government tries to do too many things for too many people. We should just let people take care of themselves. | 2.87 | 0.93 | 0.55 | |
| The government interferes too much in our everyday lives. | 2.78 | 0.96 | 0.53 | |
| Government regulation of business usually does more harm than good. | 3.00 | 0.92 | 0.57 | |
| People should be allowed to make as much money as they can, even if it means some make millions while others live in poverty. | 2.51 | 1.12 | 0.56 | |

*Note:* $N = 1{,}999$. Scales range from 1 (*strongly disagree*) to 4 (*strongly agree*).

mean of the four items was used to compute egalitarianism index ($M$average $= 3.13$, $SD = 0.60$). Similarly, five items tapped individualism as listed in Table III.

These items indicated a moderate level of reliability and were computed to form individualism index ($M$average $= 2.85$, $SD = 0.60$, $\alpha = 0.61$). A single item measured fatalism: Respondents were asked if they felt individuals make their own destiny or everything in life was the result of fate. The options were recoded as follows: "individuals can make their own destiny" (coded as 1, 41%), "both" (2, 18%), and "everything in life is the result of fate" (3, 41%) ($M = 2.98$, $SD = 1.06$). This measure was treated as a continuous variable for ease of interpretation.

In addition, two items measured respondents' attitudes related to economic growth versus environmental protection. Respondents were asked which of the following statements best represented their views: protecting the environment reduces economic growth and costs jobs (30%), has no effect on economic growth or jobs (22%), or improves economic growth and provides new jobs (48%) ($M = 2.17$, $SD = 0.86$). Similarly, respondents were asked, "When there is a conflict between environmental protection and economic growth, which do you think is more important?" The response option, "economic growth, even if it leads to environmental problems" (36%) was coded as reference category (0) compared to "protecting the environment, even if it reduces economic growth" (1, 64%).

### 3.1.4. *Perceived Vulnerability to Extreme Weather Events*

Multiple measures were used to assess current perceived vulnerability to extreme weather events. Based on a four-point scale (1, *no impact at all*, to 4, *large impact*), respondents were asked about the potential impact of a one-year-long severe drought in their local area on their household's food supply, drinking water supply, income, health, house, and community (see Table IV). Similarly, respondents were asked about the potential impact of a severe flood in their local area on their household's food supply, drinking water supply, income, health, house, and community. The mean of the 12 items was computed as a perceived vulnerability to extreme weather events scale ($M$average $= 2.89$, $SD = 0.76$, $\alpha = 0.93$).

### 3.1.5. *Perceived Resilience to Extreme Weather Events*

Two items measured perceived resilience: Based on a four-point scale (1, *a month* to 4, *several years*), respondents stated the time it would take for their household to recover from a severe flood ($M = 2.56$, $SD = 1.05$) and severe drought ($M = 2.61$, $SD = 1.05$). The mean of the two items were computed as an indicator of perceived resilience, with higher scores indicating low perceived resilience ($M = 2.58$, $SD = 0.95$, $r = 0.64$, $p < 0.001$, $\alpha = 0.78$).

### 3.1.6. *Worry*

On a four-point scale (1, *not at all worried*, to 4, *very worried*), respondents were asked how worried they were about global warming ($M = 2.84$, $SD = 0.82$).

### 3.1.7. *Demographic Variables*

Demographic variables included sex (*male*, 1, 58%) and age (recoded, 18–24 years [1, 10%], 25–34

**Table IV.** Perceived Vulnerability to Extreme Weather Events

| | Mean | *SD* | Alpha if Item Deleted | Alpha |
|---|---|---|---|---|
| Perceived vulnerability index | 2.89 | 0.76 | | 0.93 |
| If a one-year-long severe drought happened in your local area, how big of an impact would it have on each of the following? Your household's | | | | |
| Food supply | 2.83 | 1.04 | 0.92 | |
| Drinking water supply | 2.98 | 1.06 | 0.92 | |
| Income | 2.82 | 1.03 | 0.92 | |
| Health | 2.95 | 0.99 | 0.92 | |
| House | 2.73 | 1.06 | 0.92 | |
| Community | 2.87 | 1.01 | 0.92 | |
| If a severe flood happened in your local area, how big of an impact would it have on each of the following? Your household's | | | | |
| Food supply | 2.91 | 1.02 | 0.92 | |
| Drinking water supply | 3.02 | 1.03 | 0.92 | |
| Income | 2.89 | 1.02 | 0.92 | |
| Health | 3.03 | 0.99 | 0.92 | |
| House | 2.8 | 1.04 | 0.92 | |
| Community | 2.87 | 1.02 | 0.92 | |

*Note:* $N = 1{,}999$. Scales range from 1 (*no impact at all*) to 4 (*large impact*).

[2, 26%], 35–44 [3, 25%], 45–54 [4, 19%], 55–64 [5, 12%], 65 years and above [6, 8%]). Education was coded as per Indian standards: illiterate (1, 5%), literate without formal schooling (2, 2%), literate but below primary (3, 2%), primary (4, 7%), middle school (5, 13%), secondary (6, 19%), higher secondary (7, 19%), diploma/certificate (8, 6%), graduate (9, 19%), postgraduate and above (10, 8%). Monthly income was recoded to refer to up to 2,000 rupees (about 30 USD) a month (1, 8%), 2,001–4,000 rupees (2, 7%), 4,001–5,000 rupees (3, 9%), 5,001–10,000 rupees (4, 30%), 10,001–20,000 rupees (5, 22%), and above 20,000 rupees (6, 23%). Caste, measured according to Indian government categories, were dummy coded with reference to "other castes" (upper or forward castes): Scheduled Tribe (ST) (8%), Scheduled Caste (SC) (16%), and Other Backward Castes (OBC) (32%). Geographic location was dummy coded comparing urban respondents (1, 63%) living in big Indian cities such as New Delhi, Mumbai, Chennai, Kolkata, compared to others (0, 37%).

For religious affiliation, *Hindu* (1, 77%) was dummy coded versus all others. Religiosity was computed as the mean of five variables. On a four-point scale (1, *never* to 4, *daily* or *frequently*), respondents were asked how often they pray (*puja*, *namaz*, etc.) ($M = 3.09$, $SD = 1.06$), visit a temple, mosque, church, gurudwara ($M = 2.66$, $SD = 1.02$), participate in *kathas*, *sangat bhajan*, *jalsas*, church services, etc. ($M = 2.38$, $SD = 0.99$), give donations for religious activities ($M = 2.52$, $SD = 1.01$), and fast, *rozas*, etc. ($M = 2.35$, $SD = 1.02$). The religiosity index has a high reliability ($\alpha = 0.77$) ($M = 2.59$, $SD = 0.73$).

Membership in community organizations was measured with an index of four dichotomously measured items ($M = 0.16$, $SD = 0.25$): membership in a block committee (14.5%), club or association (17%), economic group or co-operative (16%), or political organization or party (16%).

Agricultural workers were identified using a dummy variable distinguishing respondents who are self-employed in agriculture or casual agriculture labor (10%) compared to all others. A dummy variable distinguished respondents who own the property they live in (18%) versus those who rent. Finally, respondents were asked how much time they spend each day collecting and storing water for household purposes using 10 categories (1, *less than half an hour a day*, to 10, *I don't spend any time at all*), which was recoded as the following categories: Do not spend any time (0, 3%), less than half an hour (1, 29%), half an hour (2, 28%), one to two hours (3, 19%), two to three hours (4, 10%), three to four hours (5, 6%), four or more hours (6, 5%).

## 4. RESULTS

Content analysis identified a total of 18 categories of affective images, but only the top six categories included at least 10% of the total responses, which were used in the analysis (see Fig. 1). These six categories accounted for 88% of respondents.

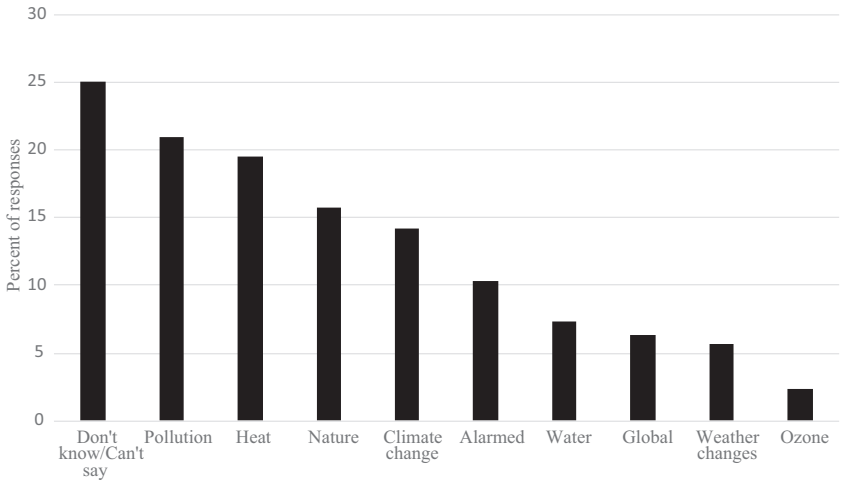


**Fig 1.** Top 10 categories of affective imagery among Indian respondents.

The most frequent category was "Don't know" or "Can't say" (25%), which included all references where respondents explicitly mentioned either of the two phrases. The second most frequent category was "pollution" (21%), which referenced all mentions of pollution, such as "air pollution," "water pollution," "nature is being polluted," "environmental pollution," "pollution due to use of plastic."

The third most frequently coded category "heat" (20%) included all references to increasing temperatures, such as "increasing temperature," "rise in temperature of earth," "overheat," "excess heat," "hot summers as sun is nearing earth," "high temperature," "extended summers," and others. The category "nature" (16%) included all references to nonhuman entities, including general references to the environment, and more specific references to flora, fauna, or specific species. Examples include "environment," "environmental change," "changes in environment," "harmful effect on animals," "animals disappearing," "soil damage." Another separate category of "trees/forests" (2%) (e.g., "deforestation", "save trees") was subsumed within the category of "nature."

The category of "climate" (14%) referenced changing climate or seasons, such as "climate change," "sudden change in climate," "abnormal climate," as well references to unpredictability in climatic change patterns such as, "increase in difficulty as climate patterns are changing," "raining before time." The category of "alarmed" (10%) included references to major negative impacts due to global warming, such as "earth is endangered," "destruction of nature," "animals are disappearing," "food crisis," "planet is in danger," among others. A small subset within the "alarmed category" included references to less severe visions such as "problems in rainy season," "adverse effect on nature," "damage to Environment," as well as codes that reflected imbalance: "uncontrolled balance of nature," "day by day earth is losing its balance," "disturbed ecological balance," "nature system imbalance."

Some of the minor categories included water (7%, "scarcity of water, life endangered"), global impacts (6%, "affecting world"), weather changes (6%) ("weather changes," "weather"), including nondirectional changes in temperature patterns ("changing temperature," "temperature") and seasonal changes ("too cold in winter," "hot winters"). Only a minority of responses mentioned ozone (2%, e.g., "ozone layer depletion"), action (1%, "should do more plantation and save the earth"), or industry/economy (1%) (e.g., "industry"). Other very minor categories included references to "earthquakes" (0.8%), health (0.3%), future generations (0.3), positive impressions (0.2%), poverty (0.05%), and information sources (0.05%).

Correlations between risk perceptions and other key variables are listed in Table V. A series of regression models were constructed to test the association between several factors and risk perceptions, but only the final model is reported below. The first model sought to answer Research Question 2 and found that affective images explained only 1% of variation in global warming risk perceptions, and among the affective images, only "pollution" ($\beta = 0.11$, $p < 0.001$) and "nature" ($\beta = 0.06$, $p < 0.05$) were significantly associated with global warming risk perceptions ($F(6, 1{,}992) = 4.83, p < 0.001$). When accounting for other variables, only "pollution" was

**Table V.** Correlations between Risk Perceptions and Other Key Variables

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Risk perceptions | 1 | | | | | | | | |
| Egalitarianism | 0.35*** | 1 | | | | | | | |
| Individualism | 0.15*** | 0.48*** | 1 | | | | | | |
| Fatalism | −0.04 | 0.01 | 0.09*** | 1 | | | | | |
| Environment vs. jobs | 0.09*** | 0.05* | −0.02 | −0.01 | 1 | | | | |
| Environment vs. economy | 0.19*** | 0.08*** | −0.04 | −0.04 | −0.02 | 1 | | | |
| Perceived vulnerability | 0.56*** | 0.34*** | 0.16*** | −0.05* | 0.04* | 0.15*** | 1 | | |
| Perceived resilience | 0.37*** | 0.20*** | 0.07** | −0.09*** | 0.06** | 0.10*** | 0.47*** | 1 | |
| Worry | 0.18*** | 0.11*** | 0.10*** | 0.05* | −0.05* | 0.10*** | 0.10*** | 0.03 | 1 |

*Note:* $N = 1999$.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

significantly associated with risk perceptions. None of the other affective images was significantly associated with risk perceptions (see Table VI).

Support was found for Hypothesis 1. Egalitarian values were significantly associated with risk perceptions. No support was found for Hypotheses 2 and 3 as nonsignificant associations were found between individualism ($\beta = -0.01$, $p = 0.70$) and fatalism ($\beta = -0.03$, $p = 0.12$) with risk perceptions, respectively. Supporting Hypothesis 4, the variables of environment versus jobs and environment versus economy were significantly and positively associated with risk perceptions. The block of cultural values, overall, explained, 16% of variance in risk perceptions ($F(5, 1{,}993) = 74.98$, $p < 0.001$).

Supporting Hypotheses 5 and 6, high degree of perceived vulnerability and low degree of perceived resilience were strongly associated with risk perceptions and accounted for 33% of variance in risk perceptions. Support was also found for Hypothesis 7; worry was significantly and positively associated with risk perceptions but accounted for only 3% of the variance in risk perceptions. Among demographic variables, males (compared to females), higher monthly incomes, more religious, Hinduism (compared to other religions), and those who spent more time to collect water had higher risk perceptions. Respondents in urban locations, those belonging to lower castes compared to upper castes, and those affiliated with community organizations, however, all tended to perceive global warming as a less severe risk. The full sociodemographic model significantly predicted global warming risk perception and explained 15% of the variance ($F(14, 1{,}984) = 25.31$, $p < 0.001$).

Finally, the five models were combined to determine which variables were the strongest predictors of global warming risk perceptions controlling for other factors. Perceived vulnerability ($\beta = 0.38$, $p < .001$) was the single most powerful predictor of risk perceptions among the variables considered in the model. Egalitarianism was the second most powerful factor ($\beta = 0.18$, $p < .001$), followed by worry ($\beta = 0.11$, $p < 0.001$), and perceived resilience ($\beta = 0.10$, $p < 0.001$). The full model significantly predicted global warming risk perception and explained 41% of the variance ($F(28, 1{,}970) = 49.52$, $p < 0.001$).

## 5. DISCUSSION

This is the first study to test a comprehensive model evaluating global warming risk perceptions among Indians. Previous studies conducted in the United States, and similar studies in the United Kingdom and Australia, found that global warming was associated with images about impacts that are "psychologically distant in time and space" (Leiserowitz & Smith, 2017, p. 20; Leviston et al., 2014; Lorenzoni et al., 2006), such as melting ice and impacts on nonhuman species. In contrast, a unique finding of this study is that the top three associations with global warming among Indian respondents were "don't know," "pollution," and "heat." "Nature," "climate change," and "alarmed" images were other prominent images associated with global warming in the Indian mind.

A quarter of the respondents said they "don't know" or "can't say" when asked about global warming, consistent with findings from previous studies that Indians are largely unaware of "global warming" or "climate change" (Capstick et al., 2015; Lee et al., 2015; Leiserowitz & Thaker, 2012; Ray & Pugliese, 2010). This lack of awareness may help

**Table VI.** Regression Analysis of Global Warming Risk Perceptions

| | | *B* | *SE B* | *β* |
|---|---|---|---|---|
| (Constant) Images | | 1.02*** | .14 | |
| | Climate | 0.08 | 0.04 | 0.04 |
| | Alarmed | −0.02 | 0.05 | −0.01 |
| | Heat | 0.08 | 0.04 | 0.04 |
| | Don't know/Can't say | 0.09 | 0.04 | 0.05 |
| | Pollution | 0.09 | 0.04 | 0.05* |
| | Nature | −0.02 | 0.04 | −0.01 |
| Values and worldviews | | | | |
| | Egalitarianism | 0.22 | 0.03 | 0.18*** |
| | Individualism | −0.04 | 0.03 | −0.03 |
| | Fatalism | −0.01 | 0.02 | −0.01 |
| | Environment vs. jobs | 0.04 | 0.02 | 0.05** |
| | Environment vs. economy | 0.13 | 0.03 | 0.08*** |
| Vulnerability and resilience | | | | |
| | Perceived vulnerability | 0.38 | 0.02 | 0.38*** |
| | Perceived resilience | 0.08 | 0.02 | 0.10*** |
| Worry | | | | |
| | Perceived worry | 0.10 | 0.02 | 0.11*** |
| Demographics | | | | |
| | Male | 0.01 | 0.03 | 0.01 |
| | Age | 0.01 | 0.01 | 0.02 |
| | Education | −0.01 | 0.01 | −0.02 |
| | Monthly income | 0.02 | 0.01 | 0.03 |
| | Scheduled Tribe (ST) | −0.03 | 0.05 | −0.01 |
| | Scheduled Caste (SC) | −0.03 | 0.04 | −0.02 |
| | Other Backward Castes (OBC) | −0.08 | 0.03 | −0.05* |
| | Religiosity | 0.06 | 0.02 | 0.06** |
| | Urban | −0.14 | 0.03 | −0.09*** |
| | Hindu | 0.03 | 0.03 | 0.02 |
| | Member community group | −0.20 | 0.05 | −0.07*** |
| | Agriculture | 0.04 | 0.05 | 0.02 |
| | Rent | −0.03 | 0.04 | −0.02 |
| | Time to collect water | 0.03 | 0.01 | 0.06** |

Note: $N = 1{,}999$, $R^2 = 0.41$, $F(28, 1{,}970) = 49.52$. Male was dummy coded with reference to females. The three caste categories (ST, SC, and OBC) were dummy coded with reference "the other caste" category, respectively. Urban was dummy coded with reference to other geographic locations (semiurban, rural). *Hindu* was dummy coded with reference to other religions. Agricultural workers were identified using a dummy variable distinguishing respondents from other occupations. Time to collect water was recoded from 10 to 7 categories measuring average hours the respondents said they spend each day collecting and storing water.
***$p < 0.0001$; **$p < 0.01$; *$p < 0.05$.

explain why affective imagery accounts for relatively low variance in global warming risk perceptions in contrast to previous studies conducted in the developed world. For example, in the United States, where public awareness of the issue of climate change is high, Leiserowitz (2006) found affective imagery explained 24% of variance in risk perceptions, higher than other predictors, including cultural worldviews, political ideology, and other sociodemographic variables. A similar finding was also reported by Smith and Leiserowitz (2012), who found that image associations explained 34% variance in U.S. risk perceptions. Nevertheless, in contrast to studies in the United States, where global warming was associated with "perception of danger to geographically distant people, places and non-human nature" (Leiserowitz, 2006, p. 62), Indian respondents are more likely to see global warming through the lens of local concerns about existing environmental issues such as pollution, heat, and impacts on nature. Fourteen of the world's most polluted 20 cities are in India according to World Health Organization, and air pollution was responsible for about 1.1 million deaths in 2015, with mortality disproportionally (75%) higher in rural areas (Irfan, 2018). Further, the average temperature in India has increased significantly between 1°C

and 2°C, beginning in the 1970s and accelerating in the 2000s and 2010s in some regions (Ross, Krishnamurti, Pattnaik, & Pai, 2018). Heat waves were responsible for 20% of mortality caused due to extreme weather events between 2001 and 2014, with 2,000 deaths attributed to heat waves in 2015 alone (Padhiar & Menon, 2018).

Only "pollution" was significantly associated with global warming risk perceptions. Similar to findings in China, respondents were probably using a mental model of local pollution to interpret global warming (Lee et al., 2015). Importantly, unlike results from the United States (e.g., Smith & Leiserowitz, 2012), we did not find any "naysayer" images, which aligns with the lack of climate denial in the Indian media (e.g., Painter & Ashe, 2012; Thaker, 2017) and public opinion (Leiserowitz & Thaker, 2012). However, there is also a lack of "health" images, indicating that similar to respondents in developed countries, very few Indians connect the dots between climate change and human health (e.g., Leiserowitz, 2006).

Consistent with the predictions of cultural theory, egalitarianism was positively associated with global warming risk perceptions among Indian respondents. Egalitarian values were one of the strongest predictors of risk perceptions in the model (e.g., Kahan et al., 2012; Leiserowitz, 2006; Smith & Leiserowitz, 2012). However, inconsistent with prior studies, there were no significant associations between individualism and fatalism with risk perceptions. Similarly, Kim and Kim (2019) found that while egalitarianism was positively associated with personal risks to particulate air pollution in South Korea, individualism and fatalism were not. They argued for the development of more culturally appropriate measurement of worldview dimensions. Pandey and Jain (2017) also found nonsignificant relationships between fatalism and general environmental concern among a sample of urban Indians, reasoning that fatalists, who conceive of nature as unpredictable, fail to perceive the seriousness of environmental problems. It is possible that activation of egalitarian values is more salient in the context of environmental problems and that individualism and fatalism may not account for additional variance after accounting for egalitarianism (van der Linden, 2015), particularly if there is a lack of opinion polarization about such issues (van der Linden, 2017) or in countries without a strong culture of individualism. We also found that the preference for environmental protection over economic growth was strongly associated with global warming risk perceptions. This suggests that communicators and policy advocates should emphasize the values associated with general environmental protection as means to support public engagement with climate change.

Perceived vulnerability and resilience to extreme weather events were two of the strongest factors associated with global warming risk perceptions. These findings are consistent with previous studies that identify perceived vulnerability as a significant factor associated with environmental risk perceptions (Bord & O'Connor, 1997; Satterfield et al., 2004). Global warming is likely to increase the magnitude and frequency of extreme weather events (IPCC, 2018). Communicating how individuals and communities are vulnerable to climate change–associated extreme events may be one of the most powerful ways to engage the Indian public on the issue. Resilience refers not only to tangible assets, as it is often measured in terms of income, resources, and social capital (e.g., Grothmann & Patt, 2005). It also includes people's perception about their own ability to handle adverse events that in turn affects their response choices: "Resilience, like vulnerability, is socially constructed, endogenous to individual and groups (households, communities), and hence contingent on knowledge, attitudes to risk, culture and subjectivity" (Béné et al., 2016, p. 166). The positive association between low perceived resilience and global warming risk perceptions indicates that respondents assess future risks through the lens of their current abilities to recover from environmental shocks. Gardezi and Arbuckle (2019) found a weak correlation between subjective perceptions and objective attributes of adaptive capacity, indicating the need to integrate people's perceptions in vulnerability frameworks. Fostering positive subjective resilience is important for proactive and beneficial adaptation. For example, a study of coastal communities in Fiji, Ghana, Sri Lanka, and Vietnam showed that perceived resilience is positively associated with beneficial long-term adaptation actions (Béné et al., 2016). This suggests that government and other agencies that seek to help Indians mitigate and adapt to global warming should increase the salience of global warming by spotlighting existing vulnerabilities to extreme weather events. For example, between 2001 and 2014, extreme weather events accounted for 25% of all accidental deaths in India, led by lightning (40%), extreme precipitation (24%), heat waves (20%), and cold waves (15%) (Padhiar & Menon, 2018).

While worry was positively associated with risk perceptions, in contrast to previous studies in developed countries, it explained only a small proportion of the variance in risk perceptions (e.g., Smith & Leiserowitz, 2014; Sundblad et al., 2007; van der Linden, 2015). This finding indicates the need to study risk perceptions in poor and developing countries where a different set of factors may shape how the public perceives risks. It is possible that the low public awareness and understanding of the issue in India, in contrast to publics in developed countries, means that few Indians have developed strong emotional reactions to the issue. It is thus likely that the association between worry and risk perceptions is contingent on greater awareness and knowledge of the issue. Future studies need to test this finding in other developing countries.

While prior studies have only focused on gender, age, education, income, and political affiliation, we also examined India-specific demographic variables and found that geographic location, membership in community groups, caste group, and time spent to collect drinking water, play important roles in shaping risk perceptions. Indian respondents in rural areas had higher risk perceptions than urban respondents, perhaps due to greater dependence on, and increased sensitivity toward, changes in weather patterns. Respondents who are part of local organizations also have lower risk perceptions, perhaps because they feel they have more social capital and support to manage climate impacts. Religiosity in India is positively associated with greater risk perceptions, in contrast to studies in the United States (e.g., McCright & Dunlap, 2011; Schultz, Zelezny, & Dalrymple, 2000). Asian religions and traditions, particularly Hinduism, may evoke a different nature–human relationship (e.g., Duara, 2015). The caste system is a unique social structure in South Asia, and caste is an important social factor that helps explain, for example, health, income, and education inequalities (e.g., Drèze & Sen, 2013). This study shows that caste differences are associated with differential risk perceptions as well. Further, in contrast to previous studies that find relatively low variance explained due to sociodemographic factors, we find that sociodemographic factors explained 15% of the variance in climate change risk perceptions in India. For example, van der Linden (2015) found that sociodemographic variables accounted for only 2% of variance in risk perceptions in the United Kingdom, while Shi, Visschers, and Siegrist (2015) found that sociodemographic variables explained only 1% variance in concern in a Swiss sample. Taken together, these findings indicate that Indians interpret global warming risks primarily based on their everyday lived experiences.

### 5.1. Limitations

There are several limitations to this exploratory study that future research can help address. First, a cross-section study limits claims of causality, with experimental and longitudinal analysis required to determine the causal effects of the factors analyzed in this study. Second, other affective imagery studies also measure holistic affective ratings of global warming, as a goodness or badness evaluation, which this research did not include. Third, while we measured the choice between economic growth and environmental protection as a dichotomous or forced choice, future researchers can pay attention to question wording and format to better understand environmental protection values, recognizing that many people do not see these as a zero-sum tradeoff (see Drews et al., 2018). Fourth, while the sample was generally representative of India's demographic profile, there is an urban bias in the data. Further, the analysis presented here was restricted to only respondents who answered the affective imagery question. There is an urgent need to further understand public affective images among different demographics in India to help understand how location, caste, and other socioeconomic factors shape affective images and risk perceptions. While the data were collected in 2011, it is still relevant because other surveys, using online convenient samples (Smith, 2019) or using only a few measures such as PEW surveys, confirm two central findings of this article: While a quarter of Indian respondents say they "Don't Know" or "Refused"—the highest among the PEW surveyed countries—about half of the Indian sample consistently rank global warming as a major threat (53% in 2013, 53% 2016, 47% 2017; Poushter & Manevich, 2017). Importantly, this is first comprehensive study of Indians risk perceptions using a national sample survey. Finally, while we attempted to provide a comprehensive analysis of key sociopsychological factors that likely shape risk perceptions, there is a need to understand how other important factors such as trust (e.g., Malka, Krosnick, & Langer, 2009), media use (e.g., Zhao, Leiserowitz, Maibach, & Roser-Renouf, 2011), and objective assessments of vulnerability and resilience (Grothmann & Patt, 2005) shape affective images, perceived vulnerabilities, and risk perceptions.

This study integrated affective, cognitive, experiential, and sociocultural factors in an analysis that explained 41% of the variance in global warming risk perceptions among Indians. Understanding how people in poor and developing countries perceive climate change risks will help governments and other nongovernmental organizations better engage them to successfully mitigate, prepare for, and adapt to one of the most serious and urgent threats of the 21st century.

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