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Climate change and coastal environmental risk perceptions in Florida

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ABSTRACT

Understanding public perceptions of climate change risks is a prerequisite for effective climate communication and adaptation. Many studies of climate risk perceptions have either analyzed a general operationalization of climate change risk or employed a case-study approach of specific adaptive processes. This study takes a different approach, examining attitudes toward 17 specific, climate-related coastal risks and cognitive, affective, and risk-specific predictors of risk perception. A survey of 558 undergraduates revealed that risks to the physical environment were a greater concern than economic or biological risks. Perceptions of greater physical environment risks were significantly associated with having more pro-environmental attitudes, being female, and being more Democratic-leaning. Perceptions of greater economic risks were significantly associated with having more negative environmental attitudes, being female, and being more Republican-leaning. Perceptions of greater biological risks were significantly associated with more positive environmental attitudes. The findings suggest that focusing on physical environment risks maybe more salient to this audience than communications about general climate change adaptation. The results demonstrate that climate change beliefs and risk perceptions are multifactorial and complex and are shaped by individuals' attitudes and basic beliefs. Climate risk communications need to apply this knowledge to better target cognitive and affective processes of specific audiences, rather than providing simple characterizations of risks.

1. Introduction

Climate change will likely have a dramatic and disproportionate effect on coastal regions, including increased flooding, shoreline erosion, and habitat change, among other effects (IPCC, 2007). Despite the potential impact of climate change and related environmental hazards, climate outreach and communication has been ineffective (Wolf and Moser, 2011). Risk perceptions, defined as the subjective judgments that people make about the threat posed by a hazard, are an important influence of the political context of policymaking (Slovic, 1999; Leiserowitz, 2006); understanding risk perceptions can be a key part of improving risk communication (Slovic, 1987; Keller et al., 2006).

Almost half of Americans say they are "not very" or "not at all" worried about climate change (Leiserowitz et al., 2010). While a lack of accurate knowledge about climate change influences climate risk perceptions (Leiserowitz et al., 2010; Moser and Dilling, 2011), there are other important factors as well. Climate-related risks are perceived as affecting people in the future or those who live far from the United States (Leiserowitz, 2005). Threats that are perceived as long-term or affecting distant people are often undervalued compared to more immediate and salient threats (Stern, 1992; CRED, 2009), which may partially explain why climate change is not a primary concern to many people in the United States.

Many prior studies of climate change risk perception have focused on concern about climate change as a general concept (e.g., O'Connor et al., 1998; Nisbet and Myers, 2007) or a small set of more specific risks (e.g., Leiserowitz, 2006). However, climate change as an abstract concept is difficult to judge based on personal experience (Weber, 2010). Indeed, climate change is not a risk itself as much as a driver and catalyst of other risks that may be more salient to the public than the risk of climate change, generally (Spence et al., 2011; Akerlof et al., 2013).

Coastal communities may be particularly affected by climate change, which is expected to exacerbate sea-level rise, heavy precipitation events (IPCC, 2012), marine fishery declines (Cheung et al., 2009), water pollution, and habitat loss (Tobey et al., 2010). Understanding coastal environmental risk perceptions and what drives those perceptions may offer important insight to risk

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communicators about specific coastal risks while also helping to clarify influences on general climate-related risk perceptions. However, studies of coastal risks have typically used broad definitions of climate change risk (e.g., Brody et al., 2007; Spence et al., 2011), analyzed specific risks such as hurricanes in isolation from other climate-related risks (e.g., Peacock et al., 2005), or used a case-study approach to analyze adaptive processes (e.g., Few et al., 2007). This quantitative study takes a different approach, analyzing perception of specific coastal environmental risks that are likely to be directly affected or exacerbated by climate change. The study is based on a conceptual model of risk perception (Fig. 1) developed from prior research into the determinants of environmental risk perception, described in Section 1.1.

1.1. Determinants of risk perception

Early research on risk perception largely focused on rational-choice models of risk, which presumed that individuals considered risks in an analytical manner, mentally calculating the odds and desirability of different risk outcomes and using those calculations as the basis for their risk perception (Lowenstein et al., 2001; Slovic et al., 2002; Leiserowitz, 2006). Rational-choice models imply that people make logical, deliberate judgments about risks using their brain's analytic processing system (Epstein, 1994; Lowenstein et al., 2001; Leiserowitz, 2006). However, there is ample evidence that rational-choice does not explain people's risk perceptions (Slovic et al., 2002), as laypeople tend to have little understanding of the drivers, probabilities, and consequences required to rationally assess risks (e.g., Bostrom et al., 1994; Read et al., 1994).

Instead of analytical, rational processing of risk, laypeople often process risks using their experiential processing system, which is affective and holistic and tends to encode information in terms of metaphors, stories, and images. Experiential processing is typically non-rational, leading to emotion-, value-, and affect-driven decisions and attitudes (Epstein, 1994; Lowenstein et al., 2001; Slovic et al., 2002). As a result, experts and laypeople tend to think of risks in entirely different ways, which may be a significant challenge for risk communication about complex topics like climate change (Moser and Dilling, 2011).

Experiential risk processing implies that layperson risk perception is primarily a function of the cognitive and affective characteristics of the individuals perceiving the risks and only secondarily a function of the characteristics of the risks themselves (Sjöberg, 2000; Slimak and Dietz, 2006). Additionally, the risk-specific factors that influence risk perception, such as the voluntariness of the risk, the public's familiarity with the risk, perception of risk control, and the morality of the risk, tend to do so by influencing the public's sense of "outrage" over a risk, rather than influencing calculations of the probabilities and consequences of a risk (Sandman, 1987).

While the precise drivers of risk perception may vary by system, there are several cognitive, affective, and demographic characteristics that often have been found to be important components of risk perception, including social trust, environmental attitudes, and risk salience. Factors highlighted in this study are described below.

1.1.1. Social trust

Social trust is a measure of the trust that an individual has in government agencies to manage a risk (Siegrist et al., 2000) and is a

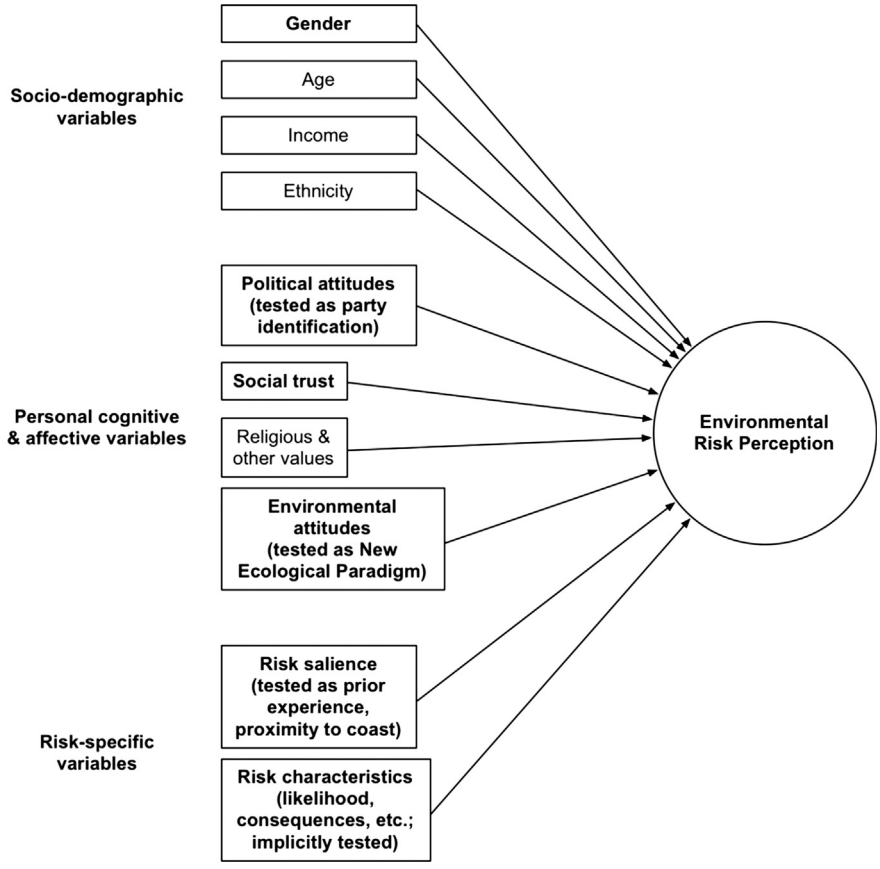

Fig. 1. Conceptual model of coastal environmental risk perception. Items in bold were tested in the regression analysis.

primary influence on environmental risk perception. Individuals with higher levels of social trust may perceive less risk than do individuals with lower levels of social trust. For example, trust has been shown to be a primary factor in public risk perception of Superfund and nuclear waste sites (Bord and O'Connor, 1992; Flynn et al., 1992), pesticide use, nuclear power, artificial sweetener (Siegrist et al., 2000), wildlife disease transmission (Vaske et al., 2004), and prescribed burning (Vaske et al., 2007).

1.1.2. Environmental attitudes

Environmental attitudes have been shown to affect environmental risk perceptions. The New Ecological Paradigm (NEP; Dunlap and Van Liere, 1978; Dunlap et al., 2000) scale is the most commonly used measures of environmental attitudes (Hawcroft and Milfont, 2010). Several studies have shown that higher levels of environmental concern as rated by the NEP are associated with greater risk perceptions across a variety of ecological risks (Stern and Dietz, 1994; Slimak and Dietz, 2006), including climate change (Kellstedt et al., 2008).

1.1.3. Risk salience

Another set of factors that can influence environmental risk perceptions can be loosely termed risk salience. Generally, risk salience is made up of two components: *relevant prior experience* and *proximity to the risk*.

Relevant prior experience has been shown to directly influence environmental risk perceptions related to the Chernobyl disaster (Drottz-Sjöberg and Sjöberg, 1990), air pollution (Whitmarsh, 2008), and hurricane Katrina (Boykoff, 2007). One study found that experience with flooding contributed to climate change concern (Spence et al., 2011). Prior experience may influence risk perceptions by engaging the availability heuristic: people who have suffered from an environmental disaster may be more likely to recall that event when considering related environmental risks, increasing their risk perception (Keller et al., 2006).

Similarly, actual or perceived (Giordano et al., 2010) proximity to a potential risk has been shown to affect risk perception, although this finding is not universal. Closeness to potential terrorist targets was associated with risk perceptions in a study in Michigan (Woods et al., 2008). However, proximity to a major 1998 wildfire event in Florida did not change beliefs about prescribed burning (Jacobson et al., 2001). The effects of proximity on risk perception may differ by demographic group (Fischoff et al., 2003) and may be mediated by perceived benefits associated with the risk (Kunreuther et al., 1990; Heath et al., 1998).

1.1.4. Demographic factors

Researchers have found several potential demographic influences of environmental risk perception. Of specific interest to this study of undergraduate students are political affiliation, which may amplify or attenuate risk perceptions (Slovic, 1999; Leiserowitz, 2006) and gender, a factor in dozens of studies (reviewed in Slovic, 1999) that have shown that females tend to perceive greater risks as greater than males do.

1.2. Objective and research questions

The objective of this study is to analyze climate-related coastal environmental risk perceptions among undergraduates at The University of Florida to: (1) further our understanding of what drives climate risk perception by focusing on a specific system, and (2) make suggestions that might improve future climate outreach and communication. To achieve these objectives, this study addresses the following research questions:

Table 1
Climate-related risk perceptions divided into scales based on a factor analysis.

Risk item	Mean	SD	Factor loading
Physical environment risks	*7.17*	*1.79*	*a = 0.89*
Drinking water loss	7.81	2.20	0.78
Drought	7.21	2.03	0.82
Climate change	7.12	2.20	0.87
Extreme temperature patterns	6.92	2.12	0.83
Sea-level rise	6.83	2.17	0.74
Economic risks	*6.66*	*1.55*	*a = 0.71*
Beach loss	7.41	2.02	0.48
Property damage from hurricanes	7.34	2.17	0.57
Property insurance increases	6.72	2.16	0.85
Property value declines	6.48	2.30	0.88
Tourism declines	5.36	2.54	0.50
Biological risks	*5.98*	*1.88*	*a = 0.86*
Fish population declines	6.72	2.11	0.65
Land plant population declines	5.91	2.20	0.91
Aquatic plant population declines	5.77	2.26	0.92
Spread of invasive plant species	5.54	2.34	0.75
Risks dropped from analysis due to improper loading			
Contamination from septic tanks	7.31	2.08	
Storm surge	6.98	2.05	
Coastal erosion	6.76	1.99	

Note: Overall mean was 6.75. Sample size varied by question from 545–558.

- RQ1: How do University of Florida students perceive climate change-related coastal risks?
- RQ2: What factors influence perceptions of risk?

2. Methods

The survey population consisted of 762 undergraduate students in two large, introductory classes at the University of Florida. The classes were general education classes, consisting of students from approximately 88 different majors across all of the colleges at the University. The measurement and analysis of the variables is described below.

2.1. Risk perceptions

Respondents were asked to rate their level of concern about 17 coastal environmental risks (Table 1). The risks were selected based on a multi-stage process involving statewide extension specialists at Florida Sea Grant and a series of in-depth key informant interviews with policymakers and technical staff in the coastal community of Crystal River, Florida. Two of the risks (sea-level rise and coastal erosion) were chosen because of their general applicability to coastal areas, and the remaining 15 risks were the most commonly mentioned during interviews (Carlton, 2012).

Respondents rated the risk items using the most-least rating method, a technique that has been found to efficiently avoid end-piling when rating lists of items (McCarty and Shrum, 2000). Respondents were first presented with the list of risks and were asked to choose which of the items is of most concern to them and which item is of least concern to them. Respondents were then asked to rate each of the items on a 10-point rating scale. The endpoints of the scale were labeled, with 1 meaning “not at all concerned” and 10 meaning “strongly concerned”. A factor analysis (extraction method: principal components analysis) with varimax rotation was performed on the risk questions to reduce the variables into interpretable factors. Factor scores were obtained using the regression method and were retained for analysis. Retaining factor scores is superior to simply averaging the variables for each factor because factor scores optimally weight the observed variables for analysis (Stevens, 1986).

2.2. Social trust

Social trust was measured using several questions based on Vaske et al. (2007). The questions were designed to assess respondents' trust of "Florida government officials" to effectively manage coastal environmental risks. Respondents were asked, "I trust Florida government officials to: (1) effectively manage coastal environmental risks, (2) provide the best available information on coastal environmental risks, (3) provide me with enough information to decide what actions I should take regarding coastal environmental risks, (4) provide me with truthful information about coastal environmental risks, (5) provide me with timely information about coastal environmental risks." Responses were given on a 5-point Likert scale. As an additional indicator of social trust, respondents were asked, "taking everything into consideration, how would you grade Florida government officials for handling coastal environmental risks?" Responses were given as a grade ranging from A to F.

2.3. Environmental attitudes

The 15-question New Ecological Paradigm scale (Dunlap et al., 2000) was used to measure environmental attitudes. A principal component analysis was performed to ensure the NEP could be used as a unidimensional scale of environmental concern in the regression model (e.g., Shephard et al., 2009; Amburgey and Thoman, 2012; Wu, 2012).

2.4. Risk salience

The 2004 hurricane season, in which 4 hurricanes (Charlie, Frances, Ivan, and Jeanne) made landfall in Florida, was used as a key prior coastal environmental risk event. Respondents were asked whether they lived in Florida during the 2004 hurricane season and the extent to which they were affected by the 2004 hurricanes, measured on a 1–10 scale from "not at all affected" to "extremely negatively affected." Respondents who were not Florida residents in 2004 were assigned a score of 1. To assess general proximity to the coast, respondents were asked how far their permanent residence was from the coast: 1 mile or closer, 2–5 miles, 6–10 miles, 11–25 miles, or 26+ miles.

2.5. Demographic variables

Respondents were asked to identify their political affiliation on a 7-point scale from "Strong Democrat" to "Strong Republican", with "Independent" as the middle value. Respondents also were asked their gender and age, although age was omitted from the analysis because nearly all (94%) respondents were between 18 and 22 years old.

2.6. Regression analysis

Each of the risk factor components was used as a dependent variable in a multiple regression analysis with the following independent variables: social trust, the New Ecological Paradigm (NEP) scale, the extent to which respondents were affected by the 2004 hurricanes, the distance of respondents' permanent residence from the coast, respondents' political affiliation, and respondents' gender. Residual plots were visually inspected for a normal variance structure.

2.7. Survey administration

Prior to administration, a pilot test was performed to refine the instrument. Twenty-three University of Florida undergraduates of similar demographics to the target population and 6 adults took the survey during the pilot test. Their feedback was incorporated prior to administrating the survey, resulting in clarification in the wording on the social trust questions and several of the risk perception questions.

The survey was administered electronically via Survey Monkey in the Spring of 2012. Respondents were given electronic pre-notification and several in-class reminders to complete the survey.

3. Results

3.1. Response rate and demographics

A total of 558 completed surveys were received for a 73.2% response rate. A nonresponse check showed that the gender ratio of respondents was similar to the gender ratio of nonrespondents. Additionally, the gender ratio and political affiliations were similar between the two classes surveyed. As a result, no post-hoc weighting was applied. The majority of respondents (58.6%) were female. The average respondent identified as politically independent, rating themselves 3.98 (SD = 1.62) on the 7-point political affiliation scale. Most (93%) respondents have lived in Florida for at least the last 5 years.

3.2. Research question 1: climate-related risk perceptions

The scores for each risk item are presented in Table 1.The overall mean score for the risk items was 6.75 on a scale of 1–10. Respondents were most concerned about drinking water loss ($M = 7.81$, SD = 2.20), beach loss ($M = 7.40$, SD = 2.03), property damage from hurricanes ($M = 7.34$, SD = 2.17), and water contamination from septic tanks ($M = 7.31$, SD = 2.08). Respondents were least concerned about land plant loss ($M = 5.91$, SD = 2.20), aquatic plant loss ($M = 5.77$, SD = 2.26), invasive plants ($M = 5.54$, SD = 2.34), and tourism declines ($M = 5.36$, SD = 2.54).

For the risk data, three factors explaining 65.3% of the variance were retained based on both the Kaiser 1 rule (i.e., all factors with eigenvalues over 1) and evaluation of a scree plot (Ferguson and Cox, 1993). The factors were reviewed and interpreted as physical environment risks ($M = 7.17$, SD = 1.79), economic risks ($M = 6.66$, SD = 1.55), and biological risks ($M = 5.98$, SD = 1.88). All three components had acceptable internal consistency (Table 1). Three variables loaded highly on two or more factors and were therefore dropped from the analysis (Stevens, 1986).

3.3. Research question 2: factors influencing risk perceptions

The social trust indicators had high internal consistency (alpha = 0.81) and were averaged into a social trust index. The average social trust index score was 3.09 (SD = 0.78) out of 5. The 15-item New Ecological Paradigm (NEP) scale also had strong internal consistency (alpha = 0.80). Thirteen of the 15 questions loaded highly ($\geq$0.40) on the first unrotated factor, which is sufficient for treating the NEP as a unidimensional scale (Dunlap et al., 2000). The average NEP score was 3.44 (SD = 0.55) on a 5-point scale, indicating low-to-moderate pro-environmental attitudes among respondents.

3.4. Regression models

All three regression models (physical environment risks, economic risks, and biological risks) were significant at the $p < 0.001$ level. The adjusted r^2 values ranged from 0.20–0.22. The full regression results are described in Table 2.

Table 2
Multiple regression models by risk category with risk perception as the dependent variable. The dependent variables are the retained risk factor scores from the principal component analysis.

Independent variable	Model 1: physical environment risk (ß)	Model 2: economic risk (ß)	Model 3: biological risk (ß)
Social trust	0.06	0.12	−0.1
New ecological paradigm[a]	0.57***	−0.20*	0.37***
2004 Hurricane effects[b]	0.03	0.01	−0.01
Proximity of home to the coast	0.01	−0.04	−0.06
Political affiliation[c]	−0.13***	0.12***	0.04
Gender[d]	0.20*	0.26*	−0.074
Adjusted r^2	0.22	0.20	0.21
$N = 491$			

Note: Asterisks indicate statistical significance: * = $p < 0.05$, *** = $p < 0.001$.
[a] Higher scores: higher pro-environmental attitudes.
[b] Higher scores: greater perceived effects of the 2004 hurricanes.
[c] Higher scores: more Republican-leaning.
[d] Dichotomous categorical variable, Male = 0, Female = 1.

The NEP score was the strongest predictor of physical environment risk perception ($B = 0.57$, $p < 0.001$), with respondents expressing greater environmental concern also perceiving greater risk. Gender also was a significant predictor of physical environment risk perception ($B = 0.20$, $p < 0.05$), with females perceiving greater risk than males. Political affiliation significantly predicted physical environment risk perception ($B = -0.13$, $p < 0.001$), with more Democratic-leaning respondents perceiving greater risk.

Gender was the strongest predictor of economic risk perception ($B = 0.26$, $p < 0.05$), with females again perceiving greater risk than males. NEP score was also a significant predictor ($B = -0.20$, $p < 0.05$): people who expressed less ecological concern perceived greater economic risk. Political affiliation also predicted economic risk perception ($B = 0.12$, $p < 0.001$), with more Republican respondents perceiving greater economic risk.

NEP score was the only significant predictor of biological risk perception ($B = 0.37$, $p < 0.001$): those who had higher environmental concern perceived greater biological risk.

4. Discussion

Individuals' cognitive and affective characteristics often influence their environmental risk perceptions as much as or more than the characteristics of the risks themselves (Slimak and Dietz, 2006). This study analyzed climate change-related risk perceptions in undergraduates at the University of Florida and found that, although many proposed cognitive and affective variables did not influence risk perceptions, respondents' risk perceptions were strongly influenced by attitudinal factors such as environmental attitudes and political affiliation.

4.1. Research question 1: risk perceptions

The first research question identified specific risk perceptions. In general, respondents were concerned about all 17 risks: each item's average rating was above the midpoint on the concern scale. Many of the highest concerns—half of those rated above 7 on the 10-point scale—were related to water: drinking water loss, water contamination, and drought. The public concern for water quality and quantity is unsurprising in a coastal state like Florida, and has been reported consistently in public opinion polls (e.g., Borisova et al., 2013).

There are apparent similarities among some of the most highly rated risks. Both the water risks and property damage from hurricanes, which together are four of the six hazards that rated over 7, might be considered more immediate, personal threats to the respondents, especially compared to the items of least concern, such astourism declines, spread of invasive species, and aquatic and terrestrial plant population declines. The primacy of immediate, personal threats is also found in the general categories of risk identified by the factor analysis: respondents were more concerned about risks related to the physical environment and property than they were risks to the local flora and fauna. The ordering of concern for the different risk categories, and roughly the individual risk items, reflects prior research that individuals perceive salient, local, and more immediate risks of more concern than risks that are less personal (Stern, 1992; CRED, 2009). The broad risk of climate change, generally considered by Americans to be a long-term risk that will affect others (CRED, 2009), was the sixth-highest rated risk, averaging 7.12 on the 10-point scale. This finding reflects prior nationwide surveys in which 55% of Americans indicated they are "somewhat" or "very" concerned about climate change (Leiserowitz et al., 2010).

4.2. Research question 2: influences on risk perception

The second research question identified factors that influenced risk perception. The regression models revealed that risk perceptions were most influenced by respondents' environmental attitudes measured by the New Ecological Paradigm, their gender, and their political affiliation. The cognitive, affective, and demographic nature of these significant predictors further underscores the importance of individual characteristics in determining risk perception.

Environmental attitudes were, in aggregate, the largest determinant of risk perception. Pro-environmental attitudes (i.e., higher NEP scores) were positively associated with greater physical environment and biological risk perception and were negatively associated with greater economic risk perception. These findings affirm prior research showing that environmental risk perception is related to environmental attitudes (Slimak and Dietz, 2006; Kellstedt et al., 2008). Additionally, these findings expand on prior research into climate risk perception: while there have been studies analyzing specific aspects of climate change risk perception (e.g., Leiserowitz, 2006), this is the first study that we are aware of that analyzes climate change risk perception using a number of specific environment-related risks.

The relatively strong negative relationship between environmental values and economic risks is noteworthy, because the highest-loading economic risk factors (i.e., property value declines and property insurance increases) were not explicitly environmental. This finding implies that the tension between economic and environmental concerns extends to risk perception, as well.

Political affiliation also was an important driver of risk perception. More Democratic-leaning respondents perceived greater physical environment and biological risks and more Republican-leaning respondents perceived greater economic risks. Prior research has shown that Republican-leaning individuals tend to perceive climate risks as lower (Leiserowitz, 2005). These findings add nuance by showing that while Republican affiliation is negatively associated with the perception of risk of climate change to the physical environment, Republican affiliation is associated with greater concern for property- and economy-related risks of climate change.

The importance of political and environmental values in determining climate change risk perceptions clarifies the challenge of climate outreach and communication. If people's climate-related

attitudes are largely a reflection of more deeply held, difficult-to-change beliefs (e.g., Decker et al., 2001; Jacobson et al., 2006), then effective outreach and communication is difficult. However, the fact that the categories of risk were influenced differently by environmental attitudes reveals the potential to use the wide-ranging effects of climate change to improve climate change communication. Even those who are not environmentally concerned may be concerned about some climate-related hazards. These findings suggest an opportunity for climate outreach personnel to find common ground with those who might not heed a climate change message, providing a starting point for the background and audience research that's a critical part of any communication campaign (Jacobson, 2009). Future research could test this hypothesis, comparing the efficacy of different outreach framing techniques with different audiences.

4.2.1. Nonpredictive variables

Social trust and risk salience were both nonpredictive of risk perception. Social trust's lack of predictive power contrasts with prior research about the influence of social trust on risk perceptions related to a variety of risks (e.g., Bord and O'Connor, 1992; Flynn et al., 1992; Siegrist et al., 2000; Vaske et al., 2007). The discrepancy may be a result of the system being studied. The prior studies were in conditions with a direct, obvious connection between the risk and the government agency responsible for managing the risk. Since climate change is a broad risk likely to have effects on diverse parts of the environment and economy (IPCC, 2007), climate-related coastal environmental risks do not necessarily have such a clear connection. For example, it might not be obvious to laypeople which agency at which level of government is responsible for managing problems associated with drought, sea-level rise, or other broad impacts. To be influential, social trust might require a specific link between a risk item and a government agency: an earlier study found that nuclear waste risk perception in Sweden was not influenced by general trust in politicians (Sjöberg, 1999).

Social trust may be difficult to define and study in the context of climate change. As Siegrist et al. (2000: 259) states, "the explanation power of trust depends on how it is operationalized. An unspecified measure of social trust (e.g., general social trust in government in all situations) might well explain much less variance." This study, after pilot testing, referred to specific definitions of trust (i.e., government management of coastal risks, government provision of information about coastal risks, etc.) and a relatively general definition of government ("Florida government officials"). This illustrates a difficulty in relating social trust to climate risk perception. Climate-related risks differ from risks related to, for example, prescribed burning or artificial sweeteners in that climate-related risks are inherently multifactorial and are not clearly the responsibility of any particular local or federal government agency. Given this fact, it is possible that no specific operationalization of social trust would explain the variance in risk perception across the diversity of climate-related risks.

Neither prior experience with hurricanes nor distance of residence from the coast were significant predictors of risk perception in any of the three categories. The lack of predictive power for respondents' experience with risks, in this case the 2004 hurricanes, contrasts with some previous work (e.g., nuclear power studied by Drottz-Sjöberg and Sjöberg, 1990; air pollution studied by Whitmarsh, 2008; flooding and climate change risk by Spence et al., 2011), but not all (e.g., flood experience studied by Whitmarsh, 2008). There are several possible explanations for this discrepancy. One is that the 2004 hurricanes might not be an appropriate prior event, either because hurricanes are such a concern throughout Florida that even those who were not affected by the 2004 hurricanes are still worried about hurricanes generally, reducing the predictive power of the 2004 events. Similarly, enough time may have elapsed that the 2004 hurricanes are no longer cognitively available (Keller et al., 2006) to trigger climate-related risk perceptions. Finally, climate change encompasses many types of risk, so hurricanes might not cause an availability heuristic effect beyond hurricane-related risks.

The irrelevance of proximity as a determinant of risk perception is surprising given that several recent studies found proximity to be important (Woods et al., 2008; Giordano et al., 2010). One potential explanation is that the coast may be similarly salient for residents throughout the state of Florida, given the state's famed beaches and ocean destinations. A similar study of coastal environmental risk perceptions in a state with less coastline might yield different results.

5. Implications

This study confirms prior findings in the risk analysis literature that risk perception is influenced by cognitive and affective processes and that risk characteristics alone (likelihood of occurring, consequences, etc.) are insufficient to explain risk perception. These findings suggest 3 primary implications for climate change outreach and communication: (1) people use experiential processing when perceiving climate-related risks, (2) climate risks and risk perceptions contain a diversity of views, and (3) focusing on specific risks may increase message salience. These implications are discussed below.

The fact that cognitive and affective variables influenced risk perceptions implies that people use experiential processing when perceiving risks. Since experiential processing is affective and relies on metaphors, stories, and images (Epstein, 1994; Lowenstein et al., 2001; Slovic et al., 2002), outreach and communications personnel should consider emotions, metaphors, stories, and images when discussing the risks of climate change. Dry presentations of analytical facts are less likely to appeal to people who are processing information experientially. The challenge for communicators is to appeal to experiential processors while maintaining credibility and trustworthiness.

The second implication of this study is that "climate change" is not a single risk and that people perceiving climate change risks are not a monolithic audience. The risks identified in this study are all climate change-related, but are diverse in character and in how they were perceived by the respondents. Additionally, the cognitive and affective factors that influence risk perception varied by risk. One outreach strategy suggested by these results is to focus on multiple, specific risks, framing the discussion in different ways to capture the interest of the diverse audience. Even though Republican party identification is typically associated with lower levels of climate concern (Leiserowitz et al., 2010), this study suggests that there are still specific risks that concern Republican-identifying people. Focusing on those risks might increase message reception.

Finally, the results of this study suggest specific ways to make climate communication more salient for coastal audiences. Coastal areas offer a number of climate-related risks that audiences might have experience with. In this study, physical environment risks and economic risks were of the most concern to respondents. Risk managers and communicators might be able to design more effective communications by focusing on salient, understandable risks instead of the potentially controversial, temporally and geographically distant effects of predicted general climate change impacts.

6. Limitations of study

There are several limitations to the study. First, the respondents were college students, so findings may not generalize

to the broader population. However, as prior studies have argued (e.g., Siegrist and Cvetkovich, 2000), there is no difference in the psychological processes underlying risk perception in undergraduate students and the population at large, limiting the concerns about using a convenience sample. However, the use of college students prevented us from comparing differences across age groups, a potentially significant driver of risk perception. Second, although the identified risks are believed to be generally applicable across Florida communities, a small portion of respondents might have come from other states and found the risks to be irrelevant or confusing, affecting their responses. Additionally, this study was performed in an American context and the results may not apply internationally, especially in developing countries. Finally, the regression models each explained ~20% of the variance, indicating that there are other factors that influence risk perception.

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