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How Emotion Trumps Logic in Climate Change Risk Perception: Exploring the Affective Heuristic Among Wildlife Science Students

KATHRYN T. STEVENSON, MARCUS A. LASHLEY, M. COLTER CHITWOOD, M. NILS PETERSON, AND CHRISTOPHER E. MOORMAN

Fisheries, Wildlife, and Conservation Biology Program, North Carolina State University, Raleigh, North Carolina, USA

Despite scientific support for the reality of climate change, public opinion remains polarized. Continued skepticism may be partially explained by lack of understanding of climate change science, and worldview and ideology, but factors contributing to risk perceptions also may differ depending on the subject of risk. This article compared how wildlife students in the eastern United States perceive climate change risk to wildlife versus humans. Left-leaning political ideology and acceptance of anthropogenic global warming predicted perceptions of climate change risks to humans. Contrastingly, scientific understanding was the most important predictor of wildlife-related risk perceptions. Students may have used an affective heuristic (i.e., emotions) in assessing climate change risks to society and a cognitive reasoning (i.e., logic and data) when considering climate change risks to wildlife, which suggests that climate change communicators should appeal to these different modes of thinking when considering risks to humans versus wildlife.

Keywords affective heuristic, climate change, human dimensions, risk perception, wildlife

Introduction

Addressing challenges associated with global climate change will require an understanding of how to build widespread concern among citizens. Despite scientific consensus regarding the likely causes and impacts of climate change, skepticism and complacency remain commonplace in much of the American public (IPCC, 2014a; Pew Research Center, 2014). Concern over climate change has been linked to individual (Tobler, Visschers, & Siegrist, 2012) and collective (Alhakami & Slovic, 1994) action, suggesting that understanding the mechanisms of climate change risk perception among diverse groups of citizens is important.

Poor understanding of climate science contributes to widespread complacency and skepticism (Sterman, 2011), and ideological filters make addressing climate literacy deficiencies incredibly difficult. Although anthropogenic climate change is compatible with

Address correspondence to Kathryn T. Stevenson, Fisheries, Wildlife, and Conservation Biology Program, North Carolina State University, 110 Brooks Avenue, Raleigh, NC 27695, USA. E-mail: kathryn_stevenson@ncus.edu

left-leaning political ideology and egalitarian and communitarian worldviews, individuals with right-leaning political ideology and hierarchical and individualistic worldviews tend to be skeptical because it places blame on social elites (e.g., emissions and consumption in industrialized countries) and may support increased environmental regulation (Kahan, 2012; McCright & Dunlap, 2011a). Given that climate change is a complex topic requiring a level of scientific understanding that individuals generally lack (Leiserowitz, Smith, & Marlon, 2011; Sterman, 2011), they turn to ideologically compatible news sources (Hamilton, 2011; McCright & Dunlap, 2011a) and opinions from like-minded peers (Kahan, 2012) when forming risk perceptions of climate change. Even those who are scientifically trained are not immune to these tendencies, as education and scientific literacy levels may polarize their ideologically based climate change risk perceptions (CCRPs) (Hamilton, 2011; Kahan et al., 2012). Although recent studies suggest that education targeting climate-specific topics can avoid ideologically based polarization (Guy, Kashima, Walker, & Neill, 2014; Stevenson, Peterson, Bondell, Moore, & Carrier, 2014), worldviews and ideology still contribute heavily to climate change risk perception, especially among those with low levels of climate science understanding.

Literature on risk suggests that people may ignore scientific consensus over anthropogenic climate change for psychological reasons in addition to ideological ones. Specifically, people tend to rely more on emotion, instinct, and intuition (affect) versus reason as a risk becomes increasingly serious or unknown (Slovic & Peters, 2006), or when it is likely to impact them directly (Van Der Linden, 2015). Climate change fits both of these criteria, as it is relatively unique in terms of complexity and geographic and temporal scales (Van Der Linden, 2015), and although climate change occurs on a scale that individuals may not experience directly (Weber, 2006), exposure to extreme weather events may be linked to increased climate change risk perception (Spence, Poortinga, Butler, & Pidgeon, 2011). The nature of climate change risk may explain why research suggests that messages targeting affective risk perception (e.g., pictures of polar bears on shrinking pieces of ice) are more powerful than those targeting cognitive risk perception (e.g., visualization of warming trends through graphs and tables) (van der linden, 2015). However, targeting affective risk perception may be equally adept at generating doubt about climate change (Smith et al., 2012).

Studies on affective and cognitive dimensions of risk perception, however, do not address if or how people apply cognitive or affective models differently when considering different subjects of climate change risk (i.e., entities exposed to risk of climate change). This is a critical gap within wildlife conservation scholarship because the entire discipline revolves around a dual, if not dualistic, focus on wildlife and humans (Decker, Riley, & Siemer, 2012; Peterson & Rodriguez, 2011). Literature on risk has established that people assign different levels of risk depending on characteristics of the hazard (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978; Slovic, 1987; Swim et al., 2011). For instance, people are more likely to think hazards that are unobservable or unknown (e.g., microwave ovens) and have high stakes (e.g., nuclear reactor accidents) are riskier than hazards that are more known (e.g., auto accidents) and have lower stakes (e.g., bicycles) (Slovic, 1987). Other studies have established that people assign different levels of risk to the same hazard depending on the subject of the risk. For instance, individuals may be more likely to think that hazards ranging from smoking and traffic accidents are more risky for people in general rather than themselves (Hermand et al., 2003; Sjöberg, 2000), and individuals have reported being more concerned about climate change impacts to non-human nature than to themselves (Leiserowitz, 2006).

Given that individuals attribute different levels of risk to different subjects (Hermand et al., 2003; Leiserowitz, 2006; Sjöberg, 2000), it is possible they are also using different modes of reasoning, but limited research has addressed this possibility. Given that individuals are more likely to use affective heuristics and ignore numbers and probability when risks are highly emotional or personal (Loewenstein, Weber, Hsee, & Welch, 2001; Rottenstreich & Hsee, 2001), people may be more likely to downplay the role of science and logic in assessing risk to humans, but more readily incorporate these factors when assessing risk to the non-human world. If this hypothesis were correct, climate communicators should be able to effectively build concern for the non-human world (e.g., threats to biodiversity) using scientific data, but should rely on emotional appeals and strategic framing to communicate risks posed to society (Fleischer, 2013). Further exploring this hypothesis may help to build an understanding of how to tailor climate communications that best generate widespread concern for both humans and wildlife.

We begin to address this hypothesis with a case study of CCRPs among wildlife science undergraduate students from 22 universities across the eastern United States. We investigated the degree that knowledge about climate change, acceptance of anthropogenic global warming (AGW), and political affiliation predicted CCRPs for both wildlife and for society in general. Although we expected political ideology would mirror influences reported for the American public, with Democrats and Republicans displaying greater and lesser society-related CCRP levels respectively, we expected the influence of ideology to vary depending on the subject of risk (wildlife, society). We wanted to know if knowledge about climate change was positively related to wildlife-related CCRPs because students would use cognitive reasoning when considering risk to wildlife. Also, would personal acceptance of AGW and political affiliation positively associate with society-related CCRPs because students would use an affective heuristic when considering risk to people? In the latter case, application of the affective heuristic would allow political ideology to trump the relationship between knowledge and CCRPs.

Methods

Sampling

Given that we were interested in responses from students with a scientific background and familiarity with a non-human subject (e.g., wildlife), we used a purposive sample of mostly juniors and seniors from universities with curricula specifically designed to meet The Wildlife Society's certification standards. These standards require that students take nine semester hours of physical sciences, nine semester hours of quantitative sciences, and 36 semester hours of biological sciences including ecology and wildlife management and biology (The Wildlife Society, 2014). We chose this population because their training should provide enough background to understand the basics of climate science (e.g., required courses in chemistry, physics, biology, and ecology [The Wildlife Society, 2014]), which may mitigate the possibility of skepticism due to lack of scientific literacy. Furthermore, their familiarity with a non-human subject vulnerable to climate change (e.g., wildlife) provides an opportunity to examine how knowledge and ideology factor into forming CCRPs for relatively salient human versus non-human subjects.

The 2013 Southeastern Wildlife Conclave held in Southern Pines, North Carolina, provided an ideal context for sampling students from this demographic. The meeting drew students from 22 universities in the eastern United States. Attendance at this Conclave requires considerable preparation and travel, signaling a high level of commitment by the students to the field of wildlife conservation. Upon registration, we asked each student to participate in this study by completing a questionnaire. We excluded students from the authors' university because many of these students were involved in pretesting of the questionnaire. Of the 332 eligible students in attendance, 218 completed the questionnaire (65% compliance). The majority of our sample was male (56%) and white (94%) with four students identifying as African American, three as Hispanic, one as Pacific Islander, two as Asian, and three as other. With regards to political affiliation, 37% of these students identified as Republicans, 18% as Democrats, and 46% as Independents/other.

Instrument Development

Our survey drew on several scales and questions used in previous studies, and also included additional questions that we developed. We measured knowledge about climate change with a scale used by Tobler et al. (2012), which included three categories of knowledge: physical knowledge, knowledge of climate change causes, and knowledge of climate change impacts. We measured acceptance of AGW with two questions—one asking whether students thought global warming was occurring and if they thought global warming was caused by humans. The first question offered nine choices in response to whether global warming was happening, ranging from "No, and I'm extremely sure" to "Yes, and I'm extremely sure." The second question asked whether global warming was caused by humans, with four responses: "caused by mostly human activities," "caused by mostly natural change in the environment," "neither, because global warming isn't happening," and "other." We chose the phrase acceptance of "global warming" over "climate change" purposely. Climate change was suggested as an alternative framing for AGW by political strategists because the public can interpret the phrase in multiple ways, many of which do not implicate humans or imply a global warming trend (Luntz, 2003). The narrower, though emotive, understanding of AGW limits this subjectivity problem, thereby allowing us to capture potential relationships between ideology and acceptance.

We used four questions to measure society-related CCRPs, asking how much students were worried about global warming, and how much they thought it would harm them personally, harm people in the United States, and harm future generations. We designed questions to address both dread and immediacy of the threat, as both dimensions have been shown to predict the level of risk attributed to climate change (Leiserowitz, 2004; Levin, 2014). Given that the item responses for these four questions were on slightly different scales (Table 3), we converted responses to standardized z-scores before summing them to yield a society-related CCRP score. We drew questions for the acceptance of AGW and society-related CCRPs from Leiserowitz, Maibach, Roser-Renouf, and Hmielowski (2012). We constructed a new scale to measure wildlife-related CCRPs because no scales were known to exist. The scale included five questions measuring the degree that students thought climate change would have a significant impact on endangered and non-endangered species, extinction rates, wildlife management decisions, and research. We measured political affiliation with a question asking with which political party students identified. Also, we included demographic questions on race, sex (male, female), and the university where students attended at the time.

Given that we combined scales and questions used in several previous studies, as well as designed new questions, we pretested our instrument before use. We administered a draft questionnaire to 60 undergraduate students enrolled in a Human Dimensions of Wildlife class. We asked respondents to make written notes on any questions that were confusing or hard to answer and elicited oral feedback on the instrument in focus groups. All responses revealed a normal distribution and minimal concerns surfaced, which resulted in only minor revisions to the questionnaire.

Data Analysis

After data collection with the full sample, we tested for reliability and internal validity using Cronbach's alpha measurements and principal component analysis, respectively (Gliem & Gliem, 2003; MacCallum, Widaman, Preacher, & Hong, 2001). We analyzed data using STATA software, version 12.1. We used multiple linear regression to model society-related CCRPs and wildlife-related CCRPs as a function of knowledge about climate change, acceptance of AGW (including acceptance of climate change and its human causes), and political affiliation. We controlled for sex and race in the model because these variables may affect environmental risk perception (Finucane, Slovic, Mertz, Flynn, & Satterfield, 2000). However, race was not a significant predictor of either measure of CCRPs, so we did not include it in the final models. Given that students from the same university may be exposed to similar experiences, we tested for a random effect of university affiliation. This accounted for the likelihood that students from the same university may have similar levels of CCRPs instead of independent random deviations among student responses. Given that random effects were not significant, we excluded them from the final models.

Results

On average, students scored 80% on the physical knowledge scale, 70% on the knowledge of climate change causes scale, and 82% on the climate change impacts scale. Reliability of the combined overall knowledge scale was acceptable (Cronbach's alpha = .71, Table 1) (Gliem & Gliem, 2003). Students were accepting of AGW, with mean acceptance of global warming 6.51 out of 9 (SD = 1.61) and mean acceptance of human causes 2.69 out of 3 (SD = .50). However, 11% of respondents stated they did not think climate change was happening and 34% stated that it was non-anthropogenic (Table 2).

Scores on the society-related and wildlife-related CCRPs scales averaged 70% (11.8 out of 17 maximum, SD = 3.53) and 82% (20.3 out of 25 maximum, SD = 3.60), respectively. Both scales had acceptable reliability (Cronbach's alpha = .73 and.82, respectively). A post-hoc principal components analysis supported internal validity, as each scale was associated with a single factor and individual items were highly correlated with the factor (factor loadings >.65 for all items). We converted individual societal-related and wildlife-related CCRPs raw scores to percentages of the maximum score, and the difference between the averages of these converted scores was significant ($p < .001$). Within the society-related CCRPs scale, respondents were least worried about global warming harming them personally and most worried about harm to future generations (Table 3). Within the wildlife-related CCRPs scale, respondents were most in agreement that climate change would have significant effects on endangered species, followed by non-endangered species, extinction rates, wildlife management decisions, and wildlife research (Table 4).

Results demonstrated support for the hypothesis associated with wildlife-related CCRPs. Knowledge about climate change was positively related to wildlife-related CCRPs and was the strongest predictor (Table 5). Neither acceptance of global warming nor its human causes were related to wildlife-related CCRPs. Democratic political affiliation (compared with Independents/others) was positively related to wildlife-related CCRPs, but

Table 1
Climate change knowledge scale ($n = 218$)[a]

Topic	Item wording	% correct	*SD*	Alpha if deleted
Climate change physical science	Burning oil, among other things, produces carbon dioxide (CO_2).	97	.17	.70
	Carbon dioxide (CO_2) is a greenhouse gas.	97	.21	.70
	Greenhouse gases partly retain the Earth's heat radiation.	88	.32	.70
	Carbon dioxide (CO_2) is harmful to plants.	78	.41	.71
	The ozone hole is the main cause of the greenhouse effect.	66	.47	.70
	At the same quantity, carbon dioxide (CO_2) is more harmful to the climate than methane.[a]	57	.50	.73
Climate change causes	The global carbon dioxide (CO_2) concentration in the atmosphere has increased during the past 250 years.	89	.32	.70
	The increase of greenhouse gasses is mainly caused by human activities.	79	.41	.69
	With a high probability, the increase of carbon dioxide (CO_2) is the main cause of climate change.	57	.59	.68
	Climate change is mainly caused by natural variations (such as changes in solar radiation intensity and volcanic eruptions).	60	.49	.69
	The last century's global increase in temperature was the largest during the past 1,000 years.	69	.47	.68
Climate change impacts	For the next few decades, the majority of climate scientists expect . . .			
	. . . an increase in extreme events, such as droughts, floods, and storms.	98	.15	.71
	. . . a warmer climate to increase the melting of polar ice, which will lead to an overall rise of the sea level.	93	.25	.69
	. . . a cooling-down of the climate.	80	.40	.68

(*Continued*)

Table 1
(Continued)

Topic	Item wording	% correct	*SD*	Alpha if deleted
	. . . a warmer climate to increase water evaporation, which will lead to an overall decrease of the sea level.	76	.43	.68
	. . . the climate to change evenly all over the world.	75	.43	.68
	. . . a precipitation increase in every region worldwide.	71	.46	.68

[a]We drew these questions from Tobler et al. (2012). Percentage correct represents the percentage of respondents whose answers reflect current scientific understanding. Scale reflected acceptable reliability (Cronbach's alpha $\alpha = .71$).
[b]Retaining item reduced alpha by .02 but facilitates direct comparison across studies.

Table 2
Acceptance of anthropogenic global warming items ($n = 218$)

Question	Mean	*SD*	Mode
Recently you may have noticed that global warming has been getting some attention in the news. Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world's climate may change as a result. What do you think? Do you think that global warming is happening?[a]	6.51	1.61	7
Assuming global warming is happening, do you think it is . . .[b]	2.69	.50	3

Items were analyzed as separate variables (acceptance of global warming and acceptance of human causes).
[a]Coding as follows: No . . . 1 = *and I'm extremely sure*, 2 = *and I'm very sure*, 3 = *and I'm somewhat sure*, 4 = *but I'm not at all sure*; Yes . . . 9 = *and I'm extremely sure*, 8 = *and I'm very sure*, 7 = *and I'm somewhat sure*, 6 *but I'm not at all sure*; Or 5 = *I don't know*.
[b]Coding as follows: 3 = *caused mostly by human activities*, 2 = *caused mostly by natural changes in the environment*, 1 = none *of the above because global warming isn't happening*.

was a less important predictor than knowledge of climate change. Sex had no relationship with wildlife-related CCRPs.

Results also supported the hypothesis associated with society-related CCRPs. Knowledge about climate change had no relationship with society-related CCRPs, but acceptance of global warming and human causes, and political affiliation (Democrat) were positively related to society-related CCRPs (Table 6). Acceptance of global warming was the strongest predictor, followed by political affiliation with Democrats more likely to perceive climate change as a risk to society than Independents/others. Acceptance of human

Table 3
Society-related climate change risk perception scale ($n = 218$)

Question	Mean	*SD*	Alpha if deleted
How worried are you about global warming?[a]	2.88	.83	.61
How much do you think global warming will harm you personally?[b]	2.47	1.13	.66
When do you think global warming will start to harm people in the United States?[c]	3.44	1.62	.64
How much do you think global warming will harm future generations of people?[d]	3.04	1.16	.62

Cronbach's alpha measures revealed acceptable reliability (standardized $\alpha = .73$).
[a]Coding as follows: 4 = *very worried*, 3 = *somewhat worried*, 2 = *not very worried*, and 1 = *not at all worried*.
[b]Coding as follows: 1 = *not at all*, 2 = *only a little*, 3 = *a moderate amount*, 4 = *a great deal,* 0 = *don't know*.
[c]Coding as follows: 5 = *they are being harmed no*w, 4 = *in 10 years*, 3 = *in 25 years*, 2 = *in 50 years*, 1 = *in 100 years*, 0 = *don't know*.
[d]Coding as follows: 1 = *not at all,* 2 = *only a little*, 3 = *a moderate amount*, 4 = *a great deal*, 0 = *don't know*.

Table 4
Wildlife-related climate change risk perception scale ($n = 218$)[a]

Question	Mean	*SD*	Alpha if deleted
Climate change will have significant effects on ENDANGERED species	4.43	.74	.78
Climate change will have significant effects on NON-ENDANGERED species	4.20	.94	.80
Climate change will have significant effects on wildlife extinction rates	4.09	.92	.75
Climate change will have significant effects on wildlife management decisions	3.91	1.08	.75
Climate change should guide wildlife research	3.75	1.04	.81

[a]Answer choices were on a five-point scale ranging from 5 = *strongly agree* to 1 = *strongly disagree*. Cronbach's alpha measures revealed acceptable reliability ($\alpha = .82$).

causes was the weakest significant predictor of society-related CCRPs. Society-related CCRPs was similar between Republican political affiliates and Independents/others. Sex was not related to society-related CCRPs, but the relatively low p-value ($p = .054$) indicated that a relationship may be detectable with larger sample sizes, with female students perceiving climate change as a greater societal risk than male students.

Table 5
Predictors of wildlife-related climate change risk perception among wildlife undergraduate students ($n = 218$)

Variable	*B*	*β*	*SE B*	*p*
Knowledge about climate change	.226**	.230	.066	.001
Acceptance of global warming	.122	.092	.088	.168
Acceptance of human causes	.189	.072	.171	.269
Republican[a]	−.285	−.064	.306	.351
Democrat[a]	.811*	.145	.396	.042
Sex[b]	.0260	.006	.282	.928
Constant	8.408		1.040	.000

Adjusted $R^2 = .163$. Included are both the unstandardized (*B*) and standardized (*β*) coefficients.
$^{*}p < .05$, $^{**}p < .01$.
[a]Reference category is Independent/other political affiliation.
[b]Coded 0 = male, 1 = female.

Table 6
Predictors of society-related change risk perception among wildlife undergraduate students ($n = 218$)

Variable	*B*	*β*	*SE B*	*p*
Knowledge about climate change	.130	.095	.084	.122
Acceptance of global warming	.597***	.325	.112	.000
Acceptance of human causes	.434*	.120	.217	.047
Republican[a]	−.638	−.102	.388	.101
Democrat[a]	1.255**	.162	.503	.013
Sex[b]	.693	.115	.358	.054
Constant	−7.002		1.320	< .001

Adjusted $R^2 = .268$. Included are both the unstandardized (*B*) and standardized (*β*) coefficients.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.
[a]Reference category is Independent/other political affiliation.
[b]Coded 0 = male, 1 = female.

Discussion

Our results build on the idea that individuals see climate change as riskier for non-humans than for humans (Leiserowitz, 2006) by demonstrating that differing levels of risk may be attributed partially to different modes of risk assessment employed when considering risk to humans versus wildlife. Wildlife students who participated in this study may have applied their scientific knowledge when assessing climate change risk to wildlife, but probably did not employ similar reasoning when considering climate change risk to society. The difference in approaches suggests that in the case of climate change, individuals still tend to rely on affective responses when determining risks that are personal (Slovic & Peters, 2006). The students' apparent reliance on affective heuristics (personal beliefs, political ideology) in assessing society-related CCRPs supports the need for techniques such as strategic framing that incorporate emotional appeals to build widespread climate change concern for humans (Kahan, 2012; Nisbet & Mooney, 2007). However, the students' apparent use of cognitive reasoning (i.e., knowledge about climate change) in assessing wildlife-related CCRPs indicates that communicators may be able to rely on scientific facts to build concern for non-humans (e.g., ecosystems, wildlife). Especially among groups with an interest in reducing risks to non-humans (e.g., hunters, outdoor enthusiasts, wildlife watchers), scientific facts and reasoning may be persuasive in building concern and inspiring action on behalf of wildlife.

The apparent reliance on an affective heuristic to assess risk to society in this case may help explain why even the most scientifically literate fall prey to the same biases that drive polarization among the general public. Slovic and Peters' (2006) research suggested that affectively approaching risk makes individuals less likely to rely on probability rules and data, instead assessing risk by "how it feels." In the context of climate change, a potential reliance on an affective heuristic to assess risk helps explain why large portions of the population remain skeptical and complacent over potential societal impacts from climate change, despite mounting evidence suggesting widespread and serious consequences if action is not taken quickly (IPCC, 2014b; Pew Research Center, 2014). Knowledge probably did not factor into society-related CCRPs, indicating that both those who accept climate change and those who are skeptical were not relying on facts to form their perception, despite the relatively high level of scientific training among this sample of students. These results are congruent with other studies that assert strategic framing segmented for differing worldviews and political ideologies, and appealing to emotion is necessary to inspire widespread climate change action in a diverse society, even among scientifically trained audiences (Hamilton, 2011; Kahan et al., 2012; McCright & Dunlap, 2011b; Nisbet & Mooney, 2007).

Use of cognitive reasoning over affective heuristics in the case of wildlife may be related to the less personal nature of the risk (Slovic & Peters, 2006) and the greater actual climate change risk posed to non-humans compared to humans. Although current projections suggest that climate change will have serious economic, political, and social impacts on humans (e.g., sea-level rise, distribution, and availability of fresh water) (IPCC, 2014a), the adaptive capacity of humans is generally greater than that of wildlife. For instance, unchecked declines in sea ice will likely eliminate several species (e.g., polar bears) (Thomas et al., 2004), but humans can emigrate to other locations or change livelihood strategies (e.g., seal harvesting to growing hay) (Adger, 2009; Moss et al., 2010). These changes may be disruptive and painful for humans, but they are usually not options for wildlife.

Most research addressing CCRPs advocacy has focused on how strategic framing and affective messaging may overcome ideological barriers to education (Leiserowitz, 2006; Nisbet & Mooney, 2007; Scannell & Gifford, 2011; Smith et al., 2012), and these efforts would benefit from considering our results that roles of ideology and knowledge shift when the subject of risk being considered shifts. Thus, our approach is complementary to previous research examining questions about whether taking an affect-based approach to messaging (Leiserowitz, 2006), or an adaptation rather than mitigation approach to AGW (Arbuckle, Morton, & Hobbs, 2013; Evans, Milfont, & Lawrence, 2014), can allow people to respond positively to calls to participate in addressing climate change problems. Specifically, our research suggests that answers to those questions may vary depending on the subject of climate change risk being considered, and that wildlife may be a subject that evokes more rational responses and thus less need for affective messaging or framing focused on adaptation rather than mitigation. However, this result raises secondary concerns about climate change education among wildlife professionals. For instance, does the dual approach to risk where wildlife students employ cognitive reasoning when considering wildlife, but affective heuristics when considering society, portend wildlife managers struggling with cognitive dissonance over responding to climate change? Similarly, will the dual focus narrow wildlife management considerations to those primarily related to wildlife that ignore crucial coupled human–natural systems?

As our sample included individuals whose scientific literacy is likely greater than the general population, future research should investigate whether non-science students or the general public employ similar cognitive reasoning when assessing risks to wildlife. In addition, these studies could explore the use of cognitive reasoning to assess risk to non-humans to which individuals may feel either less or more personally connected (e.g., pets, charismatic wildlife, non-charismatic wildlife), and further evaluate and refine the scales used in this study. Understanding precisely when individuals employ cognitive reasoning in assessing climate change risk will further equip communicators with the tools needed to build widespread concern for and subsequent action on climate change.

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