Abstract: Although global climate change poses a real and looming threat to both human societies and the natural world, large gaps in understanding exist between the general public and the scientific community. One factor contributing to such gaps could be the use of intuitive thinking to understand complex phenomena. In two studies, we explore climate change understanding and engagement through the lens of an intuitive pattern of thinking, human exceptionalism, which refers to the tendency to infer that humans are exceptional to, and separable from, the rest of the natural world. In both studies, undergraduates thought about global climate change in human exceptionalist ways that were orthogonal to accuracy—for example, they correctly think that humans uniquely contribute to climate change compared to other organisms, but incorrectly think that humans will be uniquely immune to the effects of global climate change. Moreover, human exceptionalist thinking has real-world consequences; it was negatively associated with eco-friendly attitudes and behaviors, and negatively predicted individuals’ attribution of damage from recent hurricanes (i.e., hurricanes Michael and Florence) to global climate change. Finally, we demonstrated that increasing the salience of connections between humans and global climate change reduced human exceptionalism. Findings suggest that intuitive thinking in general, and human exceptionalism in particular, make important contributions to how we understand and reason about global climate change, and may be promising targets for interventions aimed at increasing pro-environmental attitudes and behaviors.

Keywords: intuitive thinking; global climate change; human exceptionalism; anthropocentrism

1. Introduction

Industrialized nations are seeing record-high rates of belief in global climate change from their citizens [1,2]. Nevertheless, large gaps in understanding persist between the general public and the scientific community, e.g., in [3,4]. The persistence and ubiquity of incorrect beliefs suggest that they may be shaped in part by our underlying conceptual structures—the way that we spontaneously organize our knowledge about the world. In the current research, we investigated the extent to which young adults’ thinking about climate change aligns with a common pattern of intuitive thinking: human exceptionalism. We examined both the accuracy of different types of human exceptionalist thinking about climate change, and the consequences of such thinking on downstream beliefs and engagement with the phenomenon.

1.1. Intuitive Thinking

From early in development, children actively seek to understand, explain, and predict the world around them. To do so, they develop implicit or explicit intuitive theories (also known as “folk theories”, “commonsense theories”, or “mental models”) that serve as coherent systems of knowledge about psychological, social, physical, and biological phenomena [5–10]. These intuitive conceptual systems help us to understand, explain, and predict the complex world around us. However, they can also present potential roadblocks to achieving more formal scientific understandings [11,12]. Indeed, contradictions between
intuitive and formal understandings are common [9,13–15], and can be thought of as faulty overextensions of otherwise adaptive theories [16].

1.2. Human Exceptionalism and Climate Change Understanding

As in other areas of science [9], people consistently misunderstand key concepts about climate change [17–19]. For example, adults misunderstand the role of humans in causing climate change, e.g., in [4,20], and are unsure how humans will be impacted by global climate change, e.g., in [21,22]. These uncertainties might impede the understanding of how to mitigate global climate change, or whether it is important to do so [23,24].

Although climate literacy is generally improving [25], both children and adults continue to hold misunderstandings about climate science and climate change [26,27]. For example, even educators conflate the greenhouse effect with ozone layer depletion [28,29]. Given that climate literacy is affiliated with climate change concern [30], which, in turn, may bolster pro-environmental behaviors [31], it is critical to understand the factors that may pose a hurdle to understanding climate change. Identifying and predicting the kind of information that is counterintuitive could provide insight to educators about the specific concepts that students might struggle to understand.

Some researchers have posited that global climate change is integrally difficult to understand due to its complexity and the uncertainty of the effects [32]. Others have argued that the difficulty in understanding climate change does not stem solely from the complexity of the phenomenon, but rather can be traced, in part, to conflicts between the basic tenets of climate change and the basic architecture of the cognitive systems we use to understand the natural world, e.g., in [33,34]. In other words, global climate change might contradict informal intuitions about how the world works. We acknowledge that intuitive ways of thinking cannot fully explain the difficulties that individuals have when understanding global climate change; this complex issue is influenced by myriad factors including social pressures, i.e., political influences, [35,36]—for a review, see [37]; cognitive biases, e.g., [38,39]; and motivational factors [40,41]. However, intuitive patterns of thought may be one important piece of this intricate puzzle. Indeed, reliance on intuitive thinking has been shown to influence our understanding of a number of different scientific domains, including physics [42,43], chemistry [44,45], and biology [5,12,15,46–48]. In the current paper, we focus on one type of intuitive thinking—human exceptionalism—and explore the implications of human exceptionalist thinking for understanding climate change.

Human exceptionalism involves seeing humans as ontologically unique and biologically discontinuous with the rest of the living world, e.g., in [49]—as “apart from” rather than “a part of” nature [50]. This can result in the erroneous belief that biological laws do not, or no longer, apply to humans [51–53]. For example, human exceptionalism could manifest as the beliefs that humans are immune from extinction [54], are the “most highly evolved species” [55], or are the inevitable result of evolutionary success [53]. In the context of environmental ethics, human exceptionalist thinking can lead to the establishment of preferential ethical consideration given to humans over nonhuman animals, e.g., in [56,57].

Human exceptionalism thinking about global climate change may lead to correct inferences in some cases, and incorrect inferences in others. On one hand, human exceptionalist thinking may align with beliefs that are consistent with scientific evidence, such as believing that modern, global climate change is uniquely driven by human behavior [58]. On the other hand, exceptionalist thinking may also align with beliefs that are inconsistent with scientific evidence, such as the misconception that humans will be unaffected by climate change compared to other species, perhaps because of our intellect or technologies. In line with such exceptionalist thinking about the effects of climate change on humans, adults rarely spontaneously discuss human-relevant effects of climate change [59–61]; see also [34], Study 2. Thus, human exceptionalism could shape people’s understanding of climate change in complex ways.

Human exceptionalism focuses broadly on how individuals consider the relationship between humans in general and the rest of the natural world. By thinking about the
relationship at this higher level of abstraction (i.e., the population instead of the individual), the construct of human exceptionalism may provide insight into how people generalize from their own individual experiences with, and perceptions of, nature to consider the broader place of the human species in the natural world. This may be particularly important to consider in the context of climate change, as this is a problem that is likely to impact people and places far beyond one’s immediate environment.

1.3. The Current Research

Human exceptionalism is a prevalent, pervasive, and intuitive way of thinking about the world that can describe patterns of inferences across a variety of different domains of thought. We hypothesize that people recruit exceptionalism when thinking about climate change, and that this informal pattern of thinking may influence information processing about global climate change as well as likelihood to engage with the issue. We investigated this in two studies. In Study 1, we used a battery of exceptionalism measures to determine whether climate change understandings reflect human exceptionalist patterns, sampling both undergraduate novices and experts (i.e., graduate students and faculty specializing in environmental science) to estimate the accuracy of these beliefs. In Study 2, we tested a method of intervening upon exceptionalist thinking about climate change: the use of concept maps to increase the salience of connections between humans and global climate change. Moreover, Study 2 also used surveys to examine the place of exceptionalist thinking about climate change and perceptions of real-world environmental disasters: hurricanes Florence and Michael.

2. Study 1

In Study 1, our primary research question was: Do people reason about climate change in ways that are consistent with human exceptionalism? To address this question, we developed a battery of measures to assess the extent to which individuals think about climate change in patterns consistent with human exceptionalism. We sampled both novice undergraduate students and environmental-science experts to explore the effects of domain knowledge. As points of comparison, we also used similar measures to assess human exceptionalist thinking in two other scientific domains: biology and ecology. Because exceptionalist thinking and related constructs (e.g., speciesism) have been consistently discussed, e.g., in [12,62,63], and demonstrated within the domain of biology [49,64,65], this comparison provides a strong test of human exceptionalist thinking surrounding climate change. Similarly, political ecologists have proposed that human exceptionalism is a factor in an individual’s decisions about ecological conservation, e.g., in [56,57]. Ecology will, thus, provide an additional point of reference.

2.1. Method
2.1.1. Participants

We collected two samples of participants that varied in environmental-science expertise: a “novice” sample of undergraduate students and an “expert” sample of environmental science graduate students, postdocs, and professors. For the novice sample, 54 undergraduate students (age range 18–23; 19 males, 35 females) from Northeastern University participated for partial credit towards their Foundations of Psychology course. Four of the students were working towards biology (N = 3) or environmental studies (N = 1). Most participants reported taking at least one college-level biology course (57.4%), while few reported taking at least one college-level environmental science course (20.4%). For the expert sample, we recruited 12 individuals (age range 23–54; 3 males, 9 females) who were either PhD candidates in marine and environmental sciences (N = 8), or who already had earned their PhD and were working as postdoctoral researchers or professors in the field (N = 6). All participants were individually recruited via university email to ensure that they met demographic requirements. Participants endorsed various fields of relevant expertise: environmental science (N = 7), ecology (N = 8), geology (N = 5),
marine biology \((N = 3)\), environmental chemistry \((N = 3)\), sociology/social sciences \((N = 3)\), and biogeochemistry \((N = 1)\). These fields were not mutually exclusive, with the majority of participants \((N = 10)\) endorsing multiple fields of expertise. Experts were remunerated $25 for completion of the task. All participants were fluent English speakers.

2.1.2. Measures

We developed two measures of human exceptionalist thinking, each of which compared exceptionalist thinking in three domains: climate change, biology, and ecology. This included an implicit measure, the Attribution Task, and an explicit measure, the Explicit Exceptionalism task. In addition, we included a measure of demographics. See Supplementary Online Materials for the stimuli for all measures.

**Attribution Task.** For this task, participants rated the likelihood that a number of living things (including humans) have a series of properties \([5, 66]\). The properties varied by domain; biological properties included “breathes” and “has a heart”, ecological properties included “competes with other organisms” and “gets energy from other organisms”, and climate change properties included two causes (“contributes to global climate change” and “emits greenhouse gases”) and two effects (“will experience habitat loss due to climate change” and “will face extinction due to climate change”). The living organisms included humans, two nonhuman mammals (polar bear and wolf), two reptiles (alligator and painted turtle), two birds (dove and hummingbird), two fish (anchovy and salmon), two invertebrates (deep sea red crab and coral), and two plants (magnolia tree and algae). Likelihood ratings were made on a scale from 1 (extremely unlikely) to 7 (extremely likely). Novices completed attribution tasks for all three domains, whereas experts only completed the attribution task for climate change to reduce the survey time for experts; the attribution task was particularly time-consuming for this sample because they thoughtfully and deliberately considered their knowledge of each organism when making their ratings.

For each participant, we computed average property projections to each of the sampled taxonomic groups: humans, nonhuman mammals, reptiles, birds, fish, invertebrates, and plants. We averaged attribution scores across both members of each taxonomic group. Scores could range from 1–7, with higher scores representing stronger property attribution.

**Explicit Exceptionalism.** For this task, participants rated their agreement with 15 statements that overtly claim that humans are unique or separate from other species. Within this measure, we created parallel statements across biology, ecology, and climate change. For example, from the base statement “humans have many genes and enzymes that are extremely different from other species” (biology), we created “human ecosystems are extremely different from other species’ ecosystems” (ecology) and “humans will be impacted by climate change very differently than other species” (global climate change). Participants rated agreement with statements on a scale ranging from 1 (strongly disagree) to 7 (strongly agree).

We reverse-scored 3 statements (i.e., one per domain) that describe humans in a non-exceptionalist way as “just another organism” and averaged participants’ agreements with all 5 statements affiliated with each domain type. Higher scores on this aggregate score represented more human-exceptionalist thinking.

2.1.3. Design and Procedure

After providing consent, participants completed a self-paced, Qualtrics-hosted survey \([67]\) including all exceptionalist measures of ecology, biology, and climate change initially, followed by the demographics. For novice participants, questions were completed alongside other measures of intuitive thinking about climate change as part of a larger dissertation survey (see \([34]\), Study 1 for details of all included measures) with the implicit measures early in the survey and Explicit Exceptionalism as the last measure in the survey before demographics. Expert participants only completed the measures described here. The order of the questions within each task was randomized. The full task took approximately 45 minutes for novices to complete and 15 minutes for experts.
2.2. Results

We addressed our primary research question—*Do people reason about climate change in ways that are consistent with human exceptionalism?*—using implicit and explicit tasks. For both, we compared the novice sample’s human exceptionalism thinking about global climate change to human exceptionalism thinking about the related domains of biology and ecology and compared novice and expert ratings of human exceptionalism measures about climate change.

2.2.1. Do Patterns of Property Attribution Reveal Human Exceptionalist Reasoning?

To explore human exceptionalist attribution patterns for biological and ecological, we computed one-way ANOVAs to compare the mean likelihood of attributions to humans with attributions to the six other taxonomic target groups (*nonhuman mammals, reptiles, birds, fish, invertebrates, plants*) for each property. We take the differential attribution of properties to humans versus other organisms as evidence of human exceptionalist thinking. For attributions about global climate change, some properties were hypothetical; for these, we compared novice attribution patterns to those for experts.

**Biological Properties.** ANOVA revealed no evidence of exceptionalist reasoning about the biological properties we queried. Attribution patterns were similar for “breathes” (Figure 1a) and “has a heart” (Figure 1b); participants did not differentiate humans from nonhuman mammals, reptiles, and birds in their perceived likelihood to have these properties ($F(6, 318) = 50.88, p < 0.001, \eta^2 = 0.41$, and $F(6, 318) = 454.28, p < 0.001, \eta^2 = 0.87$, respectively; see Figure 1). In contrast, fish and invertebrates were significantly less likely to be attributed biological properties. For plants, responses demonstrated uncertainty over whether plants breathe, but the correct denial that plants have hearts.

![Figure 1. Attribution of “breathes” (a) and “has a heart” (b) plotted by target category. The x-axis is organized by decreasing taxonomic distance from humans (far left). Error bars represent 95% confidence intervals. Asterisks indicate significant difference from attribution to humans by Bonferroni comparison, ***$p < 0.001$.](image)

**Ecological Properties.** Like biological properties, ANOVA revealed no evidence of exceptionalist reasoning about the ecological properties we queried. Attributions of “competes with other organisms” (Figure 2a) did not differ for any taxonomic groups save plants ($F(6, 318) = 17.51, p < 0.001, \eta^2 = 0.17$), whereas for “gets energy from other organisms”
attributions to humans did not differ from nonhuman mammals, reptiles, and birds ($F(6, 318) = 126.31, p < 0.001, \eta^2 = 0.63$). In contrast, plants were seen as less likely to complete, and fish and invertebrates were seen as less likely to get energy from other organisms ($p < 0.01$). Responses demonstrated the correct denial that plants get energy from other organisms.

Causes of Global Climate Change. In contrast, we see clear evidence of exceptionalist thinking about causes of global climate change. Both novices ($F(6, 318) = 104.57, p < 0.001, \eta^2 = 0.38$) and experts ($F(6, 66) = 31.02, p < 0.001, \eta^2 = 0.65$) rated humans as much more likely to contribute to climate change than any other category of organism (see Figure 3a). Thus, novices agreed with experts that humans uniquely contribute to climate change, providing evidence for exceptionalist thinking that aligns with expert understanding. However, novices also perceived greenhouse-gas emission through an exceptionalist lens ($F(6, 318) = 43.61, p < 0.001, \eta^2 = 0.23$, see Figure 3b); attributions to humans were significantly higher than attributions to all nonhuman organisms. In contrast, experts showed no exceptionalist thinking, and no differences in attribution of greenhouse-gas emission ($F(6, 66) = 1.62, p = 0.157, \eta^2 = 0.08$). Thus, novices incorrectly perceived humans to be unique in terms of their greenhouse-gas emissions, providing evidence for a type of exceptionalist thinking that contrasts with expert understanding.

Effects of Global Climate Change. We also observed clear evidence of exceptionalist thinking about the effects of global climate change among novices. Novices rated humans as much less likely to experience habitat loss ($F(6, 318) = 17.38, p < 0.001, \eta^2 = 0.12$, Figure 4a) than any other category of organism. In contrast, experts did not think humans were less likely to experience habitat loss than any other organism. Rather, they thought that humans were more likely to experience habitat loss than birds and plants ($F(6, 66) = 13.53, p < 0.001, \eta^2 = 0.50$; Figure 4a). Novices also rated humans as much less likely to face extinction due to global climate change than any other species ($F(6, 318) = 29.76, p < 0.001, \eta^2 = 0.17$, Figure 4b). In contrast, although experts thought nonhuman mammals, reptiles, and invertebrates were more likely to face extinction than humans, they also believed that...
humans, birds, fish, and plants faced extinction to equal degrees ($F(6, 66) = 15.32, p < 0.001$, $\eta^2 = 0.42$; Figure 4b). Thus, novices differed markedly from experts in their perceptions that humans are unique in terms of being protected from some of the negative effects of climate change, such as facing extinction or experiencing habitat loss.

**a. Contributes to climate change.**

**b. Emits greenhouse gases.**

*Figure 3.* Novice and expert attributions of “contributes to climate change” (a) and “emits greenhouse gases” (b). The x-axis is organized by decreasing taxonomic distance from humans (far left). Error bars represent 95% confidence intervals. Asterisks indicate significant difference from attribution to humans by Bonferroni comparison, ** $p < 0.01$, *** $p < 0.001$. 

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**Figure 4.** Novice and expert attributions of the likelihood that target species will “experience habitat loss” (a) and “face extinction” (b). The x-axis is organized by decreasing taxonomic distance from humans (far left). Error bars represent 95% confidence intervals. Asterisks indicate significant difference from attribution to humans by Bonferroni comparison, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

**2.2.2. Does Agreement with Explicit Statements Demonstrate Human Exceptionalist Reasoning?**

We computed a mixed-effects ANOVA on agreement with explicit human exceptionalist statements with domain (biology, ecology, and climate change) as a within-subject variable and expertise (novice and expert) as a between-subjects variable. Overall, novices agreed with explicit exceptionalist statements more than experts ($F(1, 64) = 27.09, \ p < 0.001, \ \eta^2 = 0.21$). Likewise, agreement with exceptionalist statements about climate change was higher than agreement with exceptionalist statements about biology or ecology ($F(2, 128) = 11.26, \ p < 0.001 \ \eta^2 = 0.04$, Bonferroni $p < 0.013$). For novices, mean agreement
with explicit exceptionalist statements about global climate change exceeded the midpoint of the scale ($t(53) = 2.89, p = 0.006, d = 0.39$), whereas means for biology and ecology did not differ from the midpoint ($p \geq 0.259$). In contrast, for experts, mean agreement with explicit exceptionalist statements in all three domains was significantly below the midpoint of the scale ($t(11) \geq 2.61, p \leq 0.024, \text{Cohen’s } d \geq 0.75$ (see Figure 5)). There was no significant interaction between domain and expertise. In other words, novices agreed with explicit human exceptionalist statements in both relative and absolute terms.

![Figure 5. Novice and expert agreement (ranging from 1 “strongly disagree” to 7 “strongly agree”) with explicit exceptionalist statements about biology, ecology, and climate change. Error bars represent 95% confidence intervals. Solid dots represent means that differ significantly from the midpoint of the scale (4) via one-group $t$-test $p < 0.05$.](image)

To examine the five global-climate-change explicit-human-exceptionalism items more closely, we conducted independent samples $t$-tests comparing mean agreement scores for experts and novices on each item. On four of the five items, novices agreed more with explicit exceptionalist statements than experts ($t(64) \geq 3.08, p \leq 0.003, \text{Cohen’s } d \geq 0.98$ (see Figure 6)). On the fifth item, “Humans have unique attributes that will influence how they are impacted by climate change”, experts and novices did not differ in agreement.

2.3. Discussion

The results clearly demonstrate human exceptionalist thinking about global climate change among environmental science novices. Novices strictly differentiated between humans and all other species—and did not differentiate among nonhuman species—in terms of both the causes and effects of global climate change. These patterns were observed using both implicit (i.e., Attribution Task) and explicit (i.e., Explicit Exceptionalism) measures. Novices were also more likely to agree with explicit human exceptionalist statements regarding global climate change than regarding biology or ecology.

It is critical to emphasize that although human exceptionalist thinking can contribute to misconceptions, it can also be consistent with scientific knowledge. For example, humans do have some exceptional qualities (to our knowledge, no other species builds highways, writes papers on intuitive thinking, or can enact environmental policies). Indeed, systems of intuitive thinking that were antithetical to reality would not be particularly useful. To determine what aspects of observed novice thinking about global climate change represent exceptionalist misconceptions, we compared novice responses to those of experts. With respect to the causes of global climate change, novice exceptionalist beliefs were consistent with expert beliefs that humans contribute more to climate change, representing an accurate
understanding of the role of humans in global climate change. Regarding the ability to emit greenhouse gases, novices again showed a strongly exceptionalist attribution pattern where experts did not. We interpret this finding with caution, however, because experts may have differed in whether they interpreted the items as “emits greenhouse gases at all” (in which case, all living things emit CO₂) versus “emits disproportionate amounts of greenhouse gases” (in which case, humans are guilty as charged).

Figure 6. Novice and expert agreement (ranging from 1 “strongly disagree” to 7 “strongly agree”) with individual explicit exceptionalism items relevant to global climate change (a–e). Asterisks indication significant differences via t-test, **p < 0.01; ***p < 0.001.

In terms of the effects of global climate change, novice exceptionalism clearly contradicted expert beliefs. This was clearest in terms of habitat loss, where novices rated humans as less likely to experience habitat loss than any other species, whereas experts rated them as more likely to experience habitat loss than birds or plant. Likewise, for “likely to suffer extinction,” novices again made judgments consistent with human exceptionalism, rating humans as less likely to face extinction than all other organisms. Although experts thought that humans were less likely to face extinction than a few other organism types (mammals, reptiles, and invertebrates), they did not differentiate humans from all other species. Instead, expert responses appeared to be more tailored to the unique survival of individual species (as evidenced by ratings of individual organisms; see Supplementary Materials). Similarly, novice agreement with explicit exceptionalist statements clearly differed from expert responses. The sole exception was the question about humans having unique attributes relevant to their survival of climate change, with which both groups agreed. Interestingly, this represents an explicit statement of human exceptionalism, and suggests that experts acknowledge that humans are exceptional in some ways, but do not generalize that exceptionalism to all aspects of global climate change, as novices do.
In sum, comparison with expert responses suggests that novice conceptions of global climate change were strongly influenced by human exceptionalist beliefs. This contrasts markedly with patterns of attribution of biological and ecological properties, which showed no such stark differentiation between humans and other organisms. Novices attributed biological and ecological properties to nonhuman mammals, reptiles, and birds at the same level as to humans. We did, however, observe some evidence of anthropocentric reasoning (i.e., failure to correctly attribute biological properties to organisms that are dissimilar to humans). Specifically, fish and invertebrates were seen as less likely to breathe or have a heart, plants were seen as less likely to compete, and fish and invertebrates were seen as less likely to get energy from other organisms. Importantly, this type of human-based reasoning is meaningfully distinct from human exceptionalism [68,69]. Thus, while individuals might be using human-similarity-based reasoning to guide inferences about biology and ecology of highly dissimilar species, we uniquely saw consistent human exceptionalist thinking about global climate change.

3. Study 2

Study 1 demonstrated that novices think about climate change in human exceptionalist ways. Specifically, novices believe (like experts) that humans are disproportionately responsible for climate change, and (unlike experts) that humans are disproportionately immune to the consequences of climate change, among other human exceptionalist misconceptions. In Study 2, we investigated two possible downstream consequences of human exceptionalist thinking by asking whether exceptionalist thinking is related to how people perceive recent real-world extreme weather and whether human exceptionalism predicts attitudes and behaviors consistent with climate change mitigation. We also provide a preliminary test of an intervention to reduce exceptionalist thinking about climate change.

3.1. Introduction

3.1.1. Consequences of Human Exceptionalist Thinking

One goal of Study 2 was to investigate the consequences of human exceptionalist thinking about climate change. To do so, we examined the impacts of exceptionalist thinking on real-world outcomes, including judgments about real-world environmental disasters, mitigating attitudes, and behaviors. Individuals often attribute relatively innocuous weather-related events, such as milder winters [70] or increased temperatures [71], to climate change. Thus, people draw connections between climate change and weather events. Moreover, these perceived 'personal experiences' predict climate change engagement [37,71,72], and might be necessary to encourage collective action through pro-environmental policies [73]. Attributing weather events to climate change also increases likelihood to prepare for extreme weather [74,75]. For these reasons, attributing extreme weather events to climate change could be a catalyst of climate change engagement.

Two hurricanes hit the East Coast of the United States in 2018, providing the unfortunate opportunity to test how human exceptionalism influences perceptions of actual, proximate extreme weather events. Hurricanes Florence and Michael hit North Carolina and Florida, respectively, causing damage to property, economic losses [76], and human casualties [77]. Because climate change is increasing the frequency and severity of weather events such as hurricanes, e.g., as shown in [78], these storms represent ways in which United States residents are currently impacted by climate change. In Study 2, we examined perceptions that damage from hurricanes Florence and Michael stemmed from global climate change, human exceptionalism, and pro-environmental attitudes and behaviors.

3.1.2. Reducing Human Exceptionalist Thinking

Not only does human exceptionalism lead to misconceptions about the potential effects of climate change, as shown in Study 1, but exceptionalist thinking has also been shown to predict decreased investment of time and money in environmental remediation [79]. More generally, human exceptionalism places humans into a position of being separate
and distinct from the rest of the natural world, disconnected and psychologically distant from the ecosystems upon which we depend. Connectedness to nature [80–82] has been repeatedly linked to pro-environmental attitudes and behaviors, e.g., in [83–89]. Likewise, the psychological distance [90,91] that people perceive between themselves and people or regions impacted by climate change has been linked to climate change concern as well as pro-environmental behaviors, e.g., in [61,92–95].

Prima facie, human exceptionalism implies reduced connectedness to nature and increased psychological distance between humans and climate change. Thus, we should be able to reduce such exceptionalist thinking by priming people to think about how humans are connected to climate change. One potential way to alter individuals’ beliefs about the relationship between humans and the environment is through fuzzy concept mapping (FCM). FCMs are two-dimensional visual representations of an individual’s knowledge structures surrounding a topic, depicting the underlying concepts or ideas as nodes, and the relational links between them, represented by arrows indicating causal direction or lines indicating general relatedness [96–99]. While some investigators use FCMs to depict knowledge conveyed by an interviewee, e.g., in [100–102], participants may also be instructed to draw FCMs themselves in order to visualize their own knowledge structure, highlighting important links therein, e.g., in [103,104]. Drawing one’s own FCM serves as a reflective, metacognitive act that can be used to help activate prior knowledge or relationships [105] and/or misconceptions [106]. Moreover, characteristics of mental models as revealed through FCMs have been shown to predict the likelihood of sustainable behaviors, e.g., in [75,107]. Because individuals are drawing out explicit connections between concepts, FCMs can prime people to remember relationships or notice novel relationships that may not otherwise have been salient. In the context of considering how to alter human exceptionalist beliefs, it may be useful to instruct students to draw a FCM that is likely to depict relationships between humans and the rest of the natural world, thereby rendering such relationships salient. In Study 2, we attempted to reduce exceptionalist thinking by increasing the salience of the relationship between humans and climate change.

3.1.3. Current Study

Thus, we addressed three sets of questions in Study 2. First, does exceptionalist thinking predict perceptions of a recent environmental disaster? To address this, we investigated linkages between exceptionalist thinking and perceptions of two hurricanes that impacted people living along the East Coast of the United States shortly before this study was run: hurricanes Florence and Michael. We predicted that human exceptionalist thinking would be negatively related to attribution of damage of hurricanes to climate change, feelings of closeness to hurricane victims, and being personally impacted by the hurricanes. Second, does exceptionalist thinking predict mitigating attitudes and behaviors? To address this, we examined the relationship between human exceptionalist thinking and pro-environmental attitudes and behaviors supportive of climate change mitigation. We also predicted a negative relationship between human exceptionalist thinking and mitigating attitudes and behaviors. Third, does increasing the salience of the relationship between humans and climate change reduce exceptionalist thinking? To test this, we developed an FCM intervention designed to prime awareness of the connections between humans and climate change and investigated the impact of this intervention on exceptionalist thinking about climate change.

3.2. Method

3.2.1. Participants

Participants were 101 (27 males, 73 females, age $M = 18.73, SD = 0.89$) undergraduates from Northeastern University’s Foundations of Psychology participant pool. All participants were fluent English speakers and received partial course credit for participation. To increase variability in climate change knowledge in the sample, half of the recruited participants...
were environmental-science novices (i.e., non-majors; N = 50, and half of participants were environmental-science or related majors (e.g., marine biology, geological sciences; N = 51).

3.2.2. Measures

Explicit Essentialism. The Explicit Exceptionalism measure was identical to Study 1, including scoring.

Attribution Task. In Study 2, we replaced ‘polar bear’ with ‘white-tailed deer’. We also simplified the scoring of the Attribution Task by creating a single index of Differential Attribution. For each of the four climate change properties, we computed the absolute difference between the average attribution score to all nonhuman organisms and the attribution score to human such that higher scores represent greater differences in the likelihood of attributions to humans versus nonhuman organisms. Scores could range from 0 (i.e., no differences in attributions between humans and nonhumans) to 6, with higher scores representing more exceptionalist attributions.

FCM Manipulation. Participants were instructed to draw a fuzzy concept map (FCM) depicting their understanding of the causes and consequences of climate change. First, researchers gave an oral description of concept maps to participants, along with a handout and example of a concept map for photosynthesis. The instructions read,

“The concept map that you will be completing today will be on the topic of causes and effects of global climate change. Here are a few concepts to get you started with your map: greenhouse effect, fossil fuels, sea level rise, melting glaciers."

Participants were not required to include the given concepts in their map. They were encouraged to spend as much time as they wanted to draw their concept map using paper and a pencil. Half of the given target concepts (“fossil fuels” and “sea level rise”) were meant to encourage participants to make conceptual links to humans without explicitly mentioning humans. Through in-depth interviews, we have previously found that participants often made conceptual connections between humans and fossil fuels as well as between sea level rise and damage to coastal cities/homes (see [34], Study 2), so these concepts were likely to encourage individuals to draw connections between humans and both climate change causes and effects.

Mitigating Attitudes. This measure from [108] included nine questions about perceptions of the importance of mitigating behaviors, e.g., “I don’t believe that my behaviors and everyday lifestyle contribute to climate change” or “It is not worth doing things to help the environment if others don’t do the same”. Participants rated their agreement with each statement on a six-point scale ranging from “Not at All” to “Fully”. Seven responses were reverse-coded and then responses were averaged and z-standardized so that higher scores represent more positive attitudes towards mitigating behaviors.

Self-Reported Mitigating Behaviors. This measure of self-reported engagement from [108] in mitigating behaviors first asked participants to rate how environmentally friendly their lifestyle is on a six-point scale ranging from “I really don’t do anything that is environmentally friendly” to “I’m environmentally friendly in everything I do” and, thereafter, asked participants to indicate the frequency with which they engage in eco-friendly behaviors such as reading “books or magazines about the environment” or considering “the environ-
mental impact before purchasing products. Frequency of engagement for these behaviors was rated on a seven-point scale ranging from “Never” to “At Every Opportunity”. Responses to each item were averaged and z-standardized so that higher scores represented more reported engagement in mitigating behaviors.

**Concern about Climate Change.** Participants reported how concerned they were about “climate change in general” on a five-point scale ranging from “Extremely Unconcerned” to “Extremely Concerned”, with higher scores representing more climate change concern. We included a sixth response option (i.e., “Have Not Thought About This Before/Don’t Know Enough About It”), although no participants selected this response.

**Hurricane Questionnaires.** Participants were asked a series of questions about hurricanes Florence and Michael. At the time these data were collected (late Fall, 2018), both hurricanes had recently struck the East Coast of the United States. For each hurricane, participants first indicated how much they were personally impacted on a seven-point scale ranging from “Not at All” to “Extremely Impacted”. Additionally, for each hurricane, participants indicated how close they felt to the people impacted by the hurricane on a seven-point scale ranging from “Not Close at All” to “Extremely Close.” Finally, for each hurricane, participants indicated how much of the damage could be attributed to climate change on a seven-point scale ranging from “None of the Damage” to “All of the Damage”.

Note that there were three additional measures that we included in Study 2 but are not discussed in the manuscript because no clear relationships of interest emerged: the Gaia measure [109], a measure of perceived climate change cause and effects, and a measure of climate change knowledge. For a discussion of these measures, see [34], Study 4.

### 3.2.3. Design

Participants were randomly assigned to one of two conditions which determined when they drew concept maps. Half of the participants (N = 51) drew concept maps before any other measures, while the other half (N = 50) drew concept maps after completing all other measures. The goal of the concept map manipulation was to increase the salience of conceptual connections between humans and global climate change in the interest of reducing climate change exceptionalism. Apart from this between-subjects manipulation, all participants completed the remaining measures in the following order: Attribution Task, Explicit Exceptionalism task, measures of Mitigating Behaviors and Mitigating Attitudes, Questionnaires about Hurricanes, and, finally, the demographics survey.

### 3.2.4. Procedure

Participants were tested individually in the laboratory. Prior to drawing concept maps, participants were given written and oral instructions from a trained researcher. The FCM intervention was completed using paper and pencil. The remainder of the survey was completed individually on an online survey platform (Qualtrics) and was self-paced. The study took approximately 60 min to complete.

### 3.3. Results

#### 3.3.1. Scoring

**Explicit Exceptionalism.** To index explicit exceptionalism, we averaged responses to all five explicit-exceptionalism statements. Higher scores indicate more explicit acceptance of human exceptionalism.

**Implicit Exceptionalism.** To index implicit exceptionalism, we averaged absolute human–nonhuman differences in attribution for climate change causes (contributes to climate change, emits greenhouse gasses) and effects (habitat loss, faces extinction). We also averaged all four to compute an overall implicit exceptionalism score. Higher scores indicate larger differences in attributing global-climate-change causes and effects to humans versus nonhumans.

**Hurricane Perceptions.** To index perceptions of extreme weather, we averaged responses for Hurricane Florence and Hurricane Michael on each question (linking hurricane
damage to climate change, feeling close to victims, being personally impacted), yielding three measures.

3.3.2. Does Exceptionalist Thinking Predict Perceptions of a Recent Environmental Disaster?

To explore the relationships between exceptionalism and perceptions of hurricanes Florence and Michael, we computed a set of Spearman’s bivariate correlations between Explicit and Implicit exceptionalism, and the three measures of hurricane perceptions (linking hurricane damage to climate change, feeling close to hurricane victims, and being personally impacted by Florence or Michael). The results are depicted in Table 1. In line with predictions, participants who agreed more with explicit exceptionalism statements were less likely to attribute hurricane damage to climate change and less likely to feel close to hurricane victims. Implicit exceptionalism was also negatively related to feeling closer to hurricane victims, but unrelated to beliefs about hurricane damage.

Table 1. Correlations (Pearson’s r) between human exceptionalism measures, hurricane perceptions, climate change concern, and mitigating attitude and behaviors.

|                                 | Explicit Exceptionalism | Implicit Exceptionalism |
|---------------------------------|-------------------------|-------------------------|
| Linking hurricane damage to climate change | −0.331 ***             | −0.004                  |
| Feeling close to hurricane victims | −0.261 **              | −0.202 *                |
| Being personally impacted by hurricanes Florence or Michael | −0.112         | −0.053                  |
| Climate change concern          | −0.101                  | −0.028                  |
| Mitigating attitudes            | −0.290 **               | −0.094                  |
| Mitigating behaviors            | −0.236 *                | −0.071                  |

Note: * p < 0.05, ** p < 0.01. *** p < 0.001.

3.3.3. Does Exceptionalist Thinking Predict Mitigating Attitudes and Behaviors?

We explored relations between exceptionalist thinking and mitigating attitudes and behaviors in two ways. First, we conducted first-order correlations between implicit and explicit measures of exceptionalist thinking and self-reported mitigating attitudes and behaviors (see Table 1). The results revealed significant negative associations between explicit exceptionalism and mitigating attitudes (p = 0.003) and self-reported mitigating behaviors (p = 0.017). Implicit exceptionalism was unrelated to mitigating attitudes or behaviors.

Second, we tested two multivariate regression models: one for mitigating attitudes and one for mitigating behaviors. Predictor variables included measures of hurricane perceptions (linking hurricane damage to climate change, feeling close to hurricane victims, and personal impact), climate change concern, implicit exceptionalism, and explicit exceptionalism. All predictor variables were z-standardized. For mitigating attitudes, the model fit the data (R² = 0.35, p < 0.001); participants who were more likely to link hurricane damage to climate change and express climate change concern reported stronger mitigating attitudes (see Table 2). For mitigating behaviors, the model again fit the data (R² = 0.22, p < 0.001); participants who were more likely to link hurricane damage to climate change reported stronger mitigating behaviors (see Table 2).

The fact that explicit exceptionalism was related to both linking hurricane damage to global climate change and mitigating attitudes and behaviors via first-order correlations (Table 1), but not to mitigating attitudes and behaviors via multiple regressions (Table 2), raises the possibility of a mediation relationship [110,111] whereby linking hurricane damage to climate change may act as a mediator between explicit exceptionalism and mediating attitudes and behaviors. To explore this possibility, we computed two mediation models in which explicit exceptionalism predicted mitigating attitudes (Figure 7a) and mitigating behaviors (Figure 7b) with attribution of damage to climate change as a mediator. This interpretation is in line with the proposal that attribution of damage to climate change is a critical step necessary to produce increased mitigating attitudes [112]. We used the Sobel test for mediation using the bootstrapping method with bias-corrected confidence
estimates of coefficients [113,114] using the jamovi Advanced Mediation Models module developed for this purpose [115].

Table 2. Multiple Regression Analyses Predicting Self-Reported Mitigating Attitudes and Behaviors based on Human Exceptionalism Measures, Hurricane Perceptions, and Climate Change Concern.

| Predictor | Mitigating Attitudes | Mitigating Behaviors |
|-----------|----------------------|----------------------|
| Linking hurricane damage to climate change | 0.349 *** | 0.324 *** |
| Feeling close to hurricane victims | 0.040 | 0.095 |
| Being personally impacted by hurricanes Florence or Michael | −0.012 | −0.036 |
| Climate change concern | 0.314 *** | 0.169 |
| Implicit exceptionalism | 0.120 | 0.103 |
| Explicit exceptionalism | −0.155 | −0.109 |
| Total $R^2$ | 0.348 *** | 0.222 *** |

Values represent standardized regression coefficients. *** $p < 0.001$.

Results revealed that linking hurricane damage to climate change mediated the relationship between explicit exceptionalism and both mitigating attitudes and behaviors. For mitigating attitudes, the indirect effect was −0.09, which was reliably different from zero as evident by the bootstrapped standard error (95% confidence interval based on 1000 resamples −0.20 to −0.04, $z = 2.35$, $p = 0.019$; see [116]). The direct effect from explicit exceptionalism to mitigating attitudes was not significant ($\beta = −0.15$, $p = 0.161$), showing that linking hurricane damage to climate change fully mediated this relationship (Figure 7a). For mitigating behaviors, the indirect effect was −0.07, which was reliably different from zero as evident by the bootstrapped standard error (95% confidence interval based on 1000 resamples −0.15 to −0.03, $z = 2.28$, $p = 0.023$). The direct effect from explicit exceptionalism to mitigating attitudes was not significant ($\beta = −0.12$, $p = 0.331$), showing again that linking hurricane damage to climate change fully mediated this relationship (Figure 7b).

Figure 7. Proposed mediation models depicting standardized regression coefficients for the relationship between explicit exceptionalist thinking about global climate change and mitigating attitude (a) and mitigating behaviors (b), as mediated by linking hurricane damage to climate change. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. 
3.3.4. Does Increasing the Salience of the Relationship between Humans and Climate Change Reduce Exceptionalist Thinking?

The goal of the concept map intervention was to encourage participants to draw connections between humans and climate change, thereby rendering the relation more salient. To check whether participants did indeed include humans in their maps, a team of trained research assistants examined the maps for (a) the presence of human-related causes of climate change and (b) the presence of effects of climate change on humans. Human-related causes and effects included any explicit mention of humans, human-specific behaviors (e.g., littering), or human-specific artifacts (e.g., cars, cities). All but one participant included explicit mention of human causes in their maps (99%). However, only about half of students (50%) included explicit mention of human effects in their maps. Indeed, mirroring the results of Study 1, there was a significant difference between the inclusion of human-related causes and the inclusion of human-related effects, as evidenced by a McNemar test: $\chi^2 = 48.02, p < 0.001$. Despite the difference between causes and effects, the fact that a majority of participants mentioned humans in their conceptual maps suggests that the manipulation successfully increased the salience of connections between humans and climate change (see Figure 8 for sample concept maps).

Figure 8. Sample fuzzy concept maps drawn by participants who included explicit human-relevant effects (e.g., “loss of cities”, a) and did not include climate change effects on humans (b). * Indicated the initial concept provided for participants.
As in Study 1, the participants showed different attributions to humans versus non-human for both climate change causes and effects via comparison of difference scores to zero (climate change causes: \(t(100) = 23.96, p < 0.001, \text{Cohen’s } d = 2.38\); climate change effects: \(t(100) = 12.87, p < 0.001, \text{Cohen’s } d = 1.28\)). To determine the effect of the concept map intervention on exceptionalist thinking about climate change, we computed a 2 (FCM condition: First, Last) \(\times\) 2 (Property type: Causes, Effects) mixed ANOVA on differential attribution scores. We found a significant main effect of map order on attributions: \(F(1, 99) = 7.41, p = 0.008, \eta^2 = 0.03\). The participants who completed FCMs first showed less implicit exceptionalism than those who completed FCMs last (Figure 9a). As in Study 1, differences between attributions to humans versus nonhumans were larger for climate change causes (\(M = 3.16\)) than for climate change effects (\(M = 1.33\)), \(F(1, 99) = 82.06, p < 0.001, \eta^2 = 0.28\). These factors did not interact. In contrast, drawing FCMs first versus last had no effect on agreement with explicit exceptionalism (\(t(99) = 0.36, p = 0.722\), see Figure 9b), nor did it have an effect on overall climate change concern, hurricane perceptions, or reported mitigating attitudes or behaviors (\(t(99) \leq 1.66, p \geq 0.100\)).

![Figure 9](image_url)

**Figure 9.** Comparison of Implicit Exceptionalism (a) and explicit exceptionalism (b) for participants who constructed fuzzy concept maps first (FCM First) and last (FCM Last). **p < 0.01.

### 3.4. Discussion

The results suggest that highlighting linkages between humans and global climate change can reduce exceptionalist thinking. Participants spontaneously included human causes of climate change, and to a lesser degree, effects of climate change on humans, into their FCMs. Moreover, participants who drew an FCM prior to completing other measures showed less implicit exceptionalism (via differential attribution to humans versus nonhuman organisms) than those who drew an FCM afterwards. However, we saw no impact of the manipulation on explicit exceptionalist thinking, or on other measures of hurricane perception, attitudes, or behaviors. Although the impact of the manipulation was small and localized, the manipulation itself was quite subtle. As such, a stronger
manipulation might have more marked effects on human exceptionalism, and perhaps other related constructs.

Our findings also suggest that exceptionalist thinking has implications for how participants interpret real-world extreme weather events. Specifically, exceptionalism was negatively associated with feelings of closeness to hurricane victims and with linking hurricane damage to climate change. Exceptionalism was also negatively associated with mitigating attitudes and behaviors, although the relationship here was more complex. Specifically, explicit exceptionalist thinking may decrease connections between global climate change and real-world environmental disasters which, in turn, appears to decrease pro-environmental attitudes and behaviors. This finding suggests that the negative influence of exceptionalist thinking about climate change on reducing mitigating attitude and behaviors is exacerbated by the lack of attributing hurricane damage to climate change. By this account, explicit human exceptionalism about climate change may decrease the likelihood of drawing associations between climate change and severe weather events. This attribution failure, thereafter, may translate the general framework of human exceptionalism surrounding climate change into decreased pro-environmental attitudes.

4. General Discussion

Across two studies, we explored the implications of one intuitive pattern of thinking—human exceptionalism—for global climate change understanding and engagement. In Study 1, we investigated exceptionalist thinking about climate change among novices and experts, identifying ways in which human exceptionalist thinking sometimes aligns with formal scientific beliefs and sometimes conflicts with expert opinion, indicating misconceptions. In Study 2, we investigated the effects of exceptionalism on key facets of climate change engagement, finding interconnections between human exceptionalist thinking about climate change, attribution of hurricane damage to climate change, mitigating attitudes, and mitigating behaviors. We also attempted to reduce exceptionalist thinking about climate change through a fuzzy concept map intervention.

4.1. University Undergraduate Students Exhibit Human Exceptionalist Thinking about Climate Change

In Study 1, we investigated whether novice undergraduates’ patterns of reasoning about climate change aligned with human exceptionalism. We also sampled environmental science experts to provide insight into the veracity of such patterns of thinking. We found that undergraduate university students clearly exhibited exceptionalist thinking about climate change, but not about biology or ecology. When reasoning about causes and effects of climate change, novices’ projections to humans consistently differed from projections to all other species, clearly demonstrating human exceptionalism. Experts only shared the same exceptionalist patterns of thinking for one property: “contributes to climate change.” Unlike novices, experts did not think that humans were uniquely likely to emit greenhouse gases, or uniquely unlikely to suffer the effects of global climate change—possible habitat loss and extinction—than other species.

These results demonstrate how human exceptionalist thinking, like other kinds of intuitive thinking, e.g., those in [43–49], may, in some cases, be consistent with scientific understanding (seeing humans as exceptional in their causal role in global climate change) but may, in other cases, be at odds with it (e.g., seeing humans as uniquely impervious to the effects of global climate change). To the extent that exceptionalist thinking may be used as a cognitive shortcut when reasoning about climate change, this can lead to inferences with unpredictable levels of accuracy. When teaching or informing others about climate change, educators and scientists should be aware of the potential for human-exceptionalist-consistent misconceptions for cases where humans should be considered similarly to other species in relation to climate change and discourage these erroneous inferences (e.g., in the case of likelihood to face habitat loss).
Human causes of global climate change were also more salient than climate change effects on humans among Study 2 participants. When drawing FCMs, participants were twice as likely to include human causes as to include effects on humans. This accords with other findings demonstrating that people do not readily discuss human-relevant effects of climate change [39–61]; see also [34], Study 2. Although we tend to acknowledge humans’ role in causing climate change, discussing the effects of climate change on humans may be more difficult for myriad reasons. For example, we may be biased towards optimism [117,118] or belief in a just world [119], which both contradict the notion that innocent people will be harmed or killed from climate-change-exacerbated natural disasters. Similarly, denial may play a protective role if it is too distressing to think about potential climate change impacts [120]. Indeed, adults tend to reject the notion of human extinction in general [54]. These factors may contribute to the patterns of exceptionalist thinking that we observed, particularly when thinking about climate change effects.

Interestingly, the results also demonstrate that novice beliefs were relatively non-exceptionalist when considering ecological relationships. This finding was somewhat surprising given previous findings that people engage in human-centered thinking about ecosystem conservation, e.g., as shown in [56,57]. While individuals are exceptionalist in their conservation preferences, making decisions that best benefit humans above other species, e.g., as in [57], our work demonstrates that people understand that humans are part of larger, interconnected ecosystems. This raises the possibility for future research to reduce a bias towards human-focused conservation decisions by reminding individuals that humans are part of interconnected ecosystems. Similarly, we may be able to harness the lack of exceptionalist thinking about ecology to reduce erroneous exceptionalist thinking about climate change. If we are ecologically connected to animals with a vulnerable habitat, are we not vulnerable as well?

4.2. Human Exceptionalist Thinking about Global Climate Change Predicts Beliefs about Extreme Weather Events, Mitigating Attitudes, and Mitigating Behaviors

In Study 2, we found that human exceptionalist thinking was negatively related to several metrics of climate change engagement. Higher explicit exceptionalism predicted a lower likelihood to link hurricane damage to global climate change, lower endorsement of support for mitigating attitudes, and fewer self-reported mitigating behaviors. Higher levels of both implicit and explicit exceptionalism were associated with feeling less close to the victims of hurricanes Florence and Michael. Importantly, we found that the degree to which our participants ascribed hurricane damage to global climate change mediated the relationship between explicit exceptionalism and both mitigating attitudes and self-reported mitigating behaviors. This mediation suggests that individuals who thought in exceptionalist ways were less likely to make connections between climate change and hurricane damage. In turn, the way they interpreted real-world events had an impact on their attitudes and behaviors relevant to climate change mitigation. Together, these results demonstrate that exceptionalist thinking is relevant to actions and beliefs about global climate change that are likely to have real-world repercussions [see also 79]. Although the causality underlying environmental behavior is complex, e.g., in [121], these results also underline the importance of considering intuitive ways of reasoning when trying to understand and influence pro-environmental behavior.

It is important to emphasize that our findings do not speak to a causal direction. One possibility is that exceptionalist thinking decreases attributions of damage to global climate change. If so, this could stem from perceived psychological distance [90,91]; exceptionalist thinking could be considered a type of psychological distance which may use humanness or taxonomic space to create distance between oneself and climate change effects. Alternatively, attributing damage to climate change may decrease exceptionalism (perhaps by underscoring that humans are vulnerable after all), and thereby impact mitigating attitudes. Although our data do not allow us to adjudicate between these alternatives, or indeed others, we observed clear links between explicit human exceptionalism and attributing
hurricane damage to climate change. These results thereby suggest that exceptionalist thinking may be closely and inversely related to identifying concrete, current, and local effects of climate change. This finding resonates with other findings of the importance of attributing damage from weather events to climate change, e.g., in [73,112]. Such attributions may be necessary to make links between the abstract notion of climate change and personal experiences.

Moreover, this relationship between exceptionalist thinking and linking extreme weather to climate change may be especially important because linking extreme weather to climate change, in turn, has been shown to predict important outcomes such as climate change concern [122], motivation to act [74,123], and soliciting funding for adaptations [73]. Indeed, damage attribution may be an important step to encourage individuals to engage in mitigating actions [73]. It is possible that targeting human exceptionalist thinking alongside damage attribution may be one avenue to overcome concerns that highlighting consequences of climate change may be insufficient to enact changes [112]. It is important to note, however, that there remains a debate in the field regarding the veracity of attributing weather events to climate change [124]. Nevertheless, these types of connections may be beneficial when communicating with the public in order to highlight how humans are not as separable from climate change effects as they may intuitively think.

4.3. Increasing the Salience of the Relationship between Humans and Climate Change Can Decrease Human Exceptionalist Thinking

Study 2 participants were given a fuzzy concept map intervention designed to increase the salience of the relationship between humans and climate change. Those who drew an FCM prior to completing measures of exceptionalist thinking showed reduced implicit exceptionalism (i.e., they were less likely to distinguish humans from nonhumans when making attributions about climate change causes and potential effects) relative to those who completed an FCM afterwards. The FCM manipulation had no effect on agreement with explicit exceptionalist statements. This pattern partially supports our hypothesis that exceptionalist thinking could be reduced by increasing the salience of the interconnectedness between humans and global climate change.

Although our concept map intervention was designed to alter an intuitive way of thinking, many other researchers have had success with FCM interventions as a learning tool or educational intervention. In these cases, student-drawn FCMs are used as ways to identify misconceptions about links between related concepts. Teachers then target instruction to address the identified misconceptions for a review; see [125]. For example, radiology students who completed an FCM intervention in addition to lectures perform better on exams than students who just received lectures, e.g., in [126,127]. One key difference between our intervention and the prior successful interventions in the literature is that our intervention was much more subtle; participants merely constructed FCMs without subsequent discussion of the FCMs or highlighting of incorrect connections. Incorporating such strategies into future attempts at FCM interventions aimed at human exceptionalism may strengthen the intervention, enhance its efficacy, and perhaps show more widespread impacts on human exceptionalism or pro-environmental attitudes. For example, researchers could correct participants who did not include key links between humans and climate change in their concept maps, require them to draw multiple links, or emphasize these relationships when reviewing concept maps after they are drafted. Furthermore, emphasizing more local consequences of ecosystem or climate change may be a particularly strong way to emphasize these connections and decrease exceptionalist thinking, as we have found in prior work [79]. In the real world, these types of FCMs could also be incorporated in classrooms when educating students about climate change or environmental science to reduce erroneous human exceptionalism.
4.4. Limitations and Future Directions

This research represents an initial attempt to bring investigations of intuitive thinking into the domain of climate change. Although it has its limitations, this foundational work could inspire many future directions. Of specific interest to future work is to further delve into the relationship between exceptionalist thinking, attribution of weather damage to climate change, and psychological distance. Future work should also examine different types of exceptionalist thinking. We did not investigate exceptionalist thinking regarding the role of humans in combating climate change. Future research could examine whether there are exceptionalist-consistent intuitions regarding environmental stewardship (i.e., that humans are in a unique position to protect the world from climate change), or the ability to adapt to a changing climate.

We acknowledge that these studies have limitations. One overarching limitation of this study is that the samples come from a relatively homogenous, WEIRD culture [128]. We, therefore, cannot draw conclusions about the broader distribution of human exceptionalist thinking. Indeed, given that exceptionalist thinking appears closely related to connectedness to nature [81,83], and that connectedness to nature varies meaningfully across cultures, e.g., as shown in [50], human exceptionalism is likely to vary as well [129]. For example, connection to nature is a cornerstone of many indigenous belief systems [130]. Menominee Native American children are more likely to mention psychological closeness to nature than rural European American children [131]. Moreover, these cultural differences in perception to nature influence individuals’ biological reasoning. While Menominee children symmetrically projected biological properties from human to dogs and from dogs to human, the European American children asymmetrically projected more properties from human to dog than from dog to human [132,133]. This type of anthropocentric bias in considering human properties to be more generalizable than other organisms’ may be closely related to exceptionalist thinking. Examining exceptionalist thinking across cultures is, therefore, an important avenue for future research. Likewise, variations in environment (e.g., living in rural versus urban settings) and experience with nature have been shown to impact intuitive biological thinking, e.g., in [134,135]; as such, it is important to examine how environment and experience with nature might lead to differences in human exceptionalist thinking.

The FCM manipulation in Study 2 enjoyed only limited success, in that we observed only one effect of the intervention on human exceptionalist thinking. As argued above, future iterations could more explicitly manipulate the salience of relationships between humans and animals, perhaps through the use of pre-drawn FCMs and descriptions of these interactions or through discussion and questioning of FCMs with participants. This type of manipulation may have stronger effects, and the salience between humans and climate change be more easily controlled than with the maps that participants were instructed to draw themselves. Alternatively, interventions could focus more personally on the individual rather than aiming to draw connections between climate change and humans more broadly.

5. Conclusions

Across two studies, we used implicit and explicit survey measures to assess whether novices and environmental-science experts reason about climate change in ways consistent with human exceptionalism, thereby extending investigations of the role of intuitive thinking in the domain of global climate change. Our results provide clear evidence that novices think about climate change in patterns consistent with human exceptionalism. In line with human exceptionalism, undergraduate students believe that humans uniquely contribute to climate change more than other organisms, and that humans are uniquely protected against some of the worst impacts of climate change. As such, some of these human exceptionalist beliefs are accurate, and others are misconceptions that contradict beliefs of environmental science experts. In Study 2, we also examined human exceptionalist thinking through the lens of real-world extreme weather. Our results also show that human exceptionalism has real consequences; such thinking can color the way we perceive extreme
weather events, which in turn can impact self-reported pro-environmental attitudes and behaviors. Finally, we demonstrated using a concept map intervention that increasing the salience of connections between humans and global climate change had a significant, albeit limited, impact on human exceptionalism. Thus, the findings suggest that intuitive thinking in general, and human exceptionalism in particular, make important contributions to how we understand and reason about global climate change, and may be promising targets for interventions aimed at increasing pro-environmental attitudes and behaviors.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14159519/s1, Table S1: Organisms included in Property Attribution Task, Studies 1 and 2; Table S2: Attributes used in the Property Attribution Tasks, Studies 1 and 2; Table S3: Exceptionalism Statements with Domain-Specific Variants, Studies 1 and 2; Table S4: Items included in Mitigating Attitudes Measure, with Agreement and Mean Ratings, Study 2; Table S5: Items included in Mitigating Behaviors Measure, with Mean Ratings, Study 2.

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