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Understanding and modifying beliefs about climate change through educational travel

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ABSTRACT

Understanding the factors that shape individuals' beliefs about climate change is key to the development of effective climate change communication and education strategies. In this study, we test a path model of the social psychological antecedents of beliefs about climate change and evaluate the effectiveness of an educational travel program in changing them. Results show that environmental worldview and affective association with nature are two significant predictors of students' belief in the occurrence of climate change. Gender was found to influence belief in an anthropogenic causation, while political orientation was a significant predictor of conviction that climate change is occurring. Regression analysis was used to test for changes in climate beliefs before and after participation in an educational travel experience, compared to a control group, using a quasi-experimental design. Results indicate participation strengthened climate change beliefs.

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Climate change beliefs; quasi-experiment; educational travel

Introduction

Study abroad is a large and growing market for overseas travel among university students in the United States. For instance, over 310,000 United States college students studied abroad for academic credit during the 2015/16 school year (IIE, 2016). Exponents of educational travel (e.g. university-sponsored study abroad) suggest that it has the potential to be a transformative experience for students (Paige, Fry, Stallman, Josic, & Jon, 2009), especially in terms of changing participants' beliefs and behaviors associated with issues of sustainability (Tarrant, 2010). Climate change is perhaps the most pressing issue facing the global community (Dubois & Ceron, 2006; Hall et al., 2015; McCright & Dunlap, 2011), and thus, is a salient topic of instruction and experience for educational travel programs. Past work has explored tourists' understanding of tourism's impact on climate change (Becken, 2004; Dillimono & Dickinson, 2015) and suggested recommendations for improving the sustainability of educational travel (Long, Vogelaar, & Hale, 2014). Others have demonstrated international study abroad experiences can have profound effects on participants' global perspectives (Tarrant, Rubin, & Stoner, 2015), foreign language fluency (Brecht, Davidson, & Ginsberg, 1995) and intercultural competencies (Williams, 2005). Yet, there

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has been limited work exploring the social psychological antecedents of students' beliefs about climate change, or the relative influence of tourism experiences in changing them, especially in the context of educational travel programs designed to do just that.

The educational travel market provides an opportunity to expose young adults to experiences that have a positive influence on their perspectives on the environment, including beliefs about climate change. Questions remain, however, as to what kinds of experiences can generate change, and how educators should go about designing them. Answering these questions requires an understanding of the factors that shape students' subjective evaluations of climate change issues, and evaluation of the efficacy of alternative modes of instruction and experience in shaping them. Therefore, in this study we test the influence of several constructs documented in the literature to influence beliefs about climate change including environmental worldview, affective association with nature, political orientation and gender. In particular, we test the relative efficacy of participation in an educational travel program (focusing on global sustainability) in changing participants' climate change beliefs. Results of this work can inform the wider literature seeking to understand heterogeneity in the publics' beliefs about climate change in addition to yielding recommendations for improvements in educational travel programming.

Beliefs about climate change and their antecedents

Climate change beliefs are multifaceted evaluations of a complex socio-political phenomenon. Therefore, substantial complexity exists in the underlying social and psychological factors that influence individuals' perspectives. Understanding these factors is critical for the development of educational programming that can effectively communicate climate science and begin to foster a climate-literate society (Pruneau, Gravel, Bourque, & Langia, 2003). A growing body of work has unraveled some of this complexity under the auspices of generating effective communication and education strategies (Brownlee, Powell, & Hallo, 2013; Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Rosenthal, 2015; Nisbet, Zelinski, & Murphy, 2011; Patchen, 2006). This work has revealed a number of salient factors with relevance to the current study, including the influence of one's environmental worldview, political orientation, affective connection to nature and gender on beliefs about climate change.

Environmental worldview: New ecological paradigm (NEP)

Enduring trans-situational beliefs can influence the acceptability of climate-related information. Social judgment theory, for instance, suggests that information is processed and assimilated or rejected according to its (in)congruence with existing beliefs (Sherif & Hovland, 1961). Past work has identified a variety of such cognitive structures that influence individuals' beliefs about climate change. The NEP scale is perhaps the most-widely tested among these (Dunlap, Van Liere, Mertig, & Jones, 2000; Zografos & Allcroft, 2007). The NEP is a measure of the degree to which an individual subscribes to an eco-centric worldview, wherein *Homo sapiens* is regarded as a part of the ecosystem and subject to the constraints of nature. Alternatively, a rejection of an eco-centric worldview is an acceptance of the human exemptionalist paradigm, which suggests that humans are endowed with the capacity to develop technological innovations and avoid the constraints of a physically limited environment (Dunlap & Van Liere, 1978).

Drawing on the NEP, Kellstadt, Zahran, and Vedlitz (2008) found a direct association between the acceptance of an eco-centric worldview and concern regarding climate-related risks. Similarly, Xue, Marks, Hine, Phillips, and Zhao (2016) demonstrated support for the relationship between environmental worldview, measured by the NEP and concern over climate risks in a Chinese population. Whitmarsh (2011) found that eco-centric NEP scores were significantly and negatively related to skepticism of an anthropogenic (AN) cause of climate change. Finally, in a

meta-analysis of the extant literature on climate change beliefs, Hornsey, Harris, Bain, and Fielding (2016) found that the NEP was a strong correlate of a belief in climate change and an AN cause.

Basic beliefs about the human-environment relationship, like those measured by the NEP, serve as a filter for processing environment-related information and, thus, have the potential to shape evaluations of climate change. Whitmarsh (2011) suggests that confirmation bias can play a part in the formation of climate change attitudes as individuals seek information that conforms to previously held values. The evidence for climate change is congruent with an eco-centric worldview which paints humanity as one component of the broader ecosystem and, therefore, capable of generating impacts on Earth's climate system. Alternatively, an anthropocentric worldview, where humans are conceptualized as apart from nature, is inconsistent with this evidence (Hall et al., 2015). Consequently, the more strongly one subscribes to an eco-centric conceptualization of the human-environment relationship, the more likely one may be inclined to believe that climate change is occurring and that it stems from AN activities.

Affective connection to nature: Connectedness to nature

In addition to worldview, affect has been linked to beliefs about climate change (Scanell & Gifford, 2013). Leiserowitz (2006), for instance, demonstrated that negatively evaluated affective imagery associated with climate change is related to greater perceived risk. That is, public evaluations of climate change issues are not only cognitive and rooted in factual knowledge of climate risks, but are also influenced by emotion and experience. Thus, dual processes exist as mechanisms to influence public acceptance of climate-related information (Leiserowitz, 2006). Information presented alongside emotional imagery, or associated with experience, is more likely to be assimilated and potentially influence more specific beliefs and behaviors. Or as Epstein (1994, p. 711) argues, "experientially derived knowledge is often more compelling and more likely to influence behavior than is abstract knowledge." In the context of climate change, affective association with nature may influence beliefs about climate change through experience in nature (Williams, Patterson, Roggenbuck, & Watson, 1992). Thus, educational travel programs that include nature-based experiences with climate-sensitive environs may build affective association and elicit emotive responses that reinforce information demonstrating how such environs are in jeopardy.

The Connectedness to Nature Scale (CNS) is a measure of one's affective attachment to nature (Mayer & Frantz, 2004). Empirical work drawing on the CNS has found association between the scale and pro-environmental beliefs, attitudes and behaviors. Gosling and Williams (2010), for instance, found that farmers' affective attachment to nature, measured by the CNS, predicted native vegetation conservation behaviors on their properties. Similarly, Geng, Xu, Ye, Zhou, and Zhou (2015) provide support for the relation between affect toward nature and pro-environmental behavior. Therefore, one's affective association with nature can have an influence on beliefs about climate change issues. The greater affective association one has with nature, the more likely one is to perceive threats to personally relevant environments (Kyle, Graefe, Manning, & Bacon, 2004), even if the threat stems from a global phenomenon.

Political orientation

Political orientation is an important predictor of beliefs about climate change, as individual beliefs are in part constructed by social relationships including identification with broader social groups. In support of this proposition, Hornsey et al. (2016) report that political affiliation is the strongest predictor of a belief in climate change across the literature on the subject. Fielding and Hornsey (2016) suggest social identity plays a role in the acceptance of in-group norms

related to climate change beliefs, especially those constructed by political affiliations. In the United States, Dunlap, McCright, and Yarosh (2016) and McCright and Dunlap (2011) document a widening gap in belief in the occurrence (OC) of climate change as a function of political orientation and party identification. Republicans (i.e. individuals with a generally conservative political orientation) are generally, and increasingly, less accepting of a belief in AN climate change than Democrats (i.e. individuals with a generally liberal political orientation) (Dunlap et al., 2016). In fact, the highly politicized nature of climate change has brought political orientation and party affiliation to the center of attitudinal research in the United States. Across the literature, results suggest individuals who hold a conservative orientation are less likely to believe climate change is occurring or that it stems from AN causes (Hornsey, Harris & Fielding, 2018).

Gender

Women, on average, exhibit greater environmental concern than men (Flint et al., 2017; Kellstedt, Zahran, & Vedlitz, 2008; Scott & Willits, 1994; Stern, Powell, & Hill, 2014). Women have also been shown to display higher levels of concern over issues related to climate change (McCright, 2010), and are more likely to believe that climate change is occurring (Morrison, Duncan, & Parton, 2015). This gender effect is hypothesized to stem from social origins. Stern, Deitz, and Guagnano (1995), for instance, suggest gendered socialization processes in Western society may yield differing value orientations between men and women, where women possess higher altruistic values, and thus, greater concern and awareness regarding environmental issues. Differences in "moral reasoning," as suggested by Stern et al. (1995), may stem from women's subordinate status imposed by most societies, or from concern over health outcomes for children, traditionally held disproportionately by mothers. Therefore, women, compared to men, may display greater attention to environmental and social issues like climate change, and may have stronger beliefs that climate change is occurring and that it stems from AN activities.

Collectively, these studies suggest climate change beliefs are a function of a variety of variables including one's environmental worldview, affective association with nature, political orientation and gender. Social psychological theories of attitude change (e.g. social judgment theory) hypothesize that individuals evaluate information according to existing beliefs, experiences and social relationships. Thus, understanding the influence of these variables on evaluations of climate change can assist educators seeking to modify students' understanding and beliefs, as students will be more or less receptive to climate-related information as a function of their pre-existing beliefs and identities (Brownlee et al., 2013). A belief in climate change is a prerequisite to action. Improved understanding of the factors influencing students' beliefs about climate change will better position educators to leverage these beliefs to generate behavioral change.

Educational travel as a mechanism for changing beliefs

Travel is one mechanism that has been shown to contribute to individuals' perspectives and behaviors related to the environment (Ballantyne & Packer, 2011; Powell, 2005; Tarrant, 2010). The impact of such experiences on changes in environmental attitudes, behavioral intentions and actual behavior within nature is a growing area of interest (Lee, Jan, & Huang, 2015). While a limited body of work has explored environmental attitudes in the educational travel segment specifically, a broader base exists in the sustainable tourism literature from which to draw.

In a meta review of the related literature, Ardoin, Wheaton, Bowers, Hunt, and Durham (2015) identified 30 articles documenting the impact of travel and environmental education on changes in tourists' environmentally related knowledge, attitudes, intentions and actual behaviors. Their findings revealed that roughly half of the studies identified positive changes in target variables (Ardoin et al., 2015). For instance, Powell and Ham's (2008) work in Galapagos National Park and

Hughes and Morrison-Saunders' (2005a, 2005b) research in natural areas of Australia demonstrated positive attitudinal changes as a result of visitor experiences. Studies finding positive change in participants' attitudes suggest that interpretation and education-related components play an important role (Mayes & Richins, 2008; Stern et al., 2014; Weiler & Smith, 2009). Similarly, Coghlan and Kim (2012) argue engaging students in conservation-related activities can significantly contribute to changes in environmental attitudes. This position is echoed by the works of Powell, Kellert, and Ham (2009) and Lee and Moscardo (2005).

Educational travel experiences provide necessary interpretation and education-related components as well as prime opportunities for students to engage in conservation-related actions (i.e. tree plantings, beach clean-up, measuring and monitoring climate change indicators, etc.). Experience in nature, especially within sensitive environs, is widely hypothesized to yield changes in affect, identification and behavioral intent toward those places (Stedman, 2002; Williams et al., 1992). Landon, Tarrant, Rubin, and Stoner (2017), for instance, demonstrate growth in students' intent to engage in pro-environmental behaviors following participation in sustainability-focused educational travel. Similarly, Rexeisen (2013), found study abroad experience significantly altered students' environmental worldviews.

Brownlee and Verbos (2015, p. 2) suggest, "[e]ffective environmental education and interpretation, including climate change education in outdoor recreation areas, relies explicitly on understanding an audience's values, attitudes and beliefs, particularly towards a specific issue, such as climate change." Thus, educational travel where students have experience with climate-sensitive natural ecosystems and receive direct instruction about them may be an effective means of influencing students' perspectives on climate change. To improve the ability of such programs to elicit change in participants' attitudes, educators must understand the social psychological mechanisms that influence participants' beliefs a priori. Similarly, evaluating existing programs in their ability to achieve desired outcomes is critical for continuous quality improvement in educational travel programming. As such, the purpose of this study is to understand how environmental worldview, affective association with nature, political orientation and gender influence beliefs about climate change and the effect of educational travel on these influences.

The present study

In this study, we explored beliefs about climate change among participants in an educational travel program, drawing on a quasi-experimental design. Specifically, we compared student beliefs about climate change before and after participation in an educational travel program ($N = 241$), to a control group of university students undertaking general education coursework on campus ($N = 202$) during the same time period. Quasi-experimental methods allow for a more robust assessment of the treatment affect, as opposed to pre-/post-comparison alone (Shadish, Cook, & Campbell, 2002). Study participants were enrolled in a major university in the southeastern United States during the spring/summer terms of 2016. Participants received university credit for both courses (study abroad or control). In the educational travel program, students traveled to either Australia only or Australia and New Zealand for duration of 3.5 weeks. All students, however, visited the Great Barrier Reef (GBR) while in Australia. While on the GBR, students participated in lectures explicating the impacts of climate change on coral reef health and describing the socio-economic context of the fossil fuel industry in Australia, as well as completing citizen science projects related to coral health (e.g. CoralWatch, www.coralwatch.org), and engaging in interpretive dives and snorkels. Coral reefs are a harbinger of climate change as coral bleaching events are very visible, and have occurred on a global scale (Donner, Skirving, Little, Oppenheimer, & Hoegh-Guldbergs, 2005). Thus, coral reefs are (regrettably) an especially apt system for teaching climate change.

Students in the non-travel group were enrolled in general (i.e. non-sustainability and non-travel related) courses (e.g. communication, sociology, law) on campus during the same term. Course instructors were solicited as collaborators. If they agreed to participate, a pre-test survey was administered to students in the classroom on the first day of class and again on the last. The same protocol was followed for survey administration for students in the educational travel group. Non-travel courses did not have a focus on climate change or include an experiential component as part of the instructional method. No online or "hybrid" courses were recruited for participation. Students in the non-travel and educational travel groups were similar in terms of gender, but the distribution of class standing (Freshman, Sophomore, Junior, Senior) differed between groups. The educational travel group contained a greater proportion of sophomores compared to the non-travel group, whereas the non-travel group contained higher proportion of juniors. Educational travel programs were open to all majors and thus participants were roughly representative of the broader student body in terms of major of study. Roughly, 17% of the non-travel group indicated that they had previously participated in study abroad, whereas roughly 12% of the educational travel group reported the same.

Hypotheses

We hypothesized that students' beliefs about climate change were a function of their environmental worldview measured by the NEP scale. The stronger an individual subscribes to an eco-centric worldview, the stronger they will believe climate change is occurring and that it stems from human activities. Similarly, we hypothesized a direct association between students' affective association with nature, measured by the CNS, and their beliefs about climate change. We hypothesized students who reported holding a conservative political orientation (versus a liberal one), would be less likely to believe climate change is occurring or that it is a function of human activities. We hypothesized women are more likely than men to believe climate change is occurring and that it stems from AN causes.

Additionally, we hypothesized that students participating in the educational travel program, where they receive education on climate change and have experience in nature, would demonstrate greater positive increments of growth in beliefs about climate change from pre-test to post-test, than students participating in classes in a variety of non-sustainability related courses on campus during the same term.

H_1: NEP is positively related to beliefs about climate change
H_2: CNS is positively related to beliefs about climate change
H_3: Conservatism in political orientation (versus liberalism) is negatively related to beliefs about climate change
H_4: Women hold stronger (positive) beliefs about climate change than men
H_5: Students participating in an educational travel program with a climate-related education and experience will demonstrate greater growth from pretest to posttest in beliefs that affirm climate change than students in a non-travel control.

Methods

Measures

For the purposes of this study, climate change beliefs were conceptualized along two dimensions measuring a belief in the OC of climate change, and an AN causation using the scale developed by Brownlee and Verbos (2015). Six items measuring OC were queried on a seven-point Likert-type scale, where 1 = strongly disagree, 7 = strongly agree and 4 = neutral, following the stem, "on average, around the Earth I believe the following are happening . . . ." including "the

Table 1. Descriptive statistics for model variables at pre-test and post-test.

Variable	*M* (SD) – Pre-test	*M* (SD) – Post-test	Minimum	Maximum
AN	5.64 (1.74)	5.83 (1.68)	1	7
OC	5.23 (1.51)	5.54 (1.51)	1	7
CNS	3.51 (0.59)	–	1	5
NEP	3.61 (0.52)	–	1	7
Political Orientation	4.39 (1.69)	–	1	7
Gender (% Female)	69.5%	–	0	1

temperature of the ocean is increasing" and "the areas affected by drought are increasing". AN was measured using four items following the stem, "I believe that the following contribute to changes in climate around the Earth … " including "clear cutting forests" and "driving gas powered automobiles." AN items were measured on the same scale as OC. Items measuring each dimension were summed to generate scales for analysis.

Environmental worldview was measured using the NEP Scale (Dunlap et al., 2000). Following Dunlap et al. original intention, we adopted a unidimensional interpretation of the NEP. Students were presented with eight positively worded and seven negatively worded items that represent one's beliefs about the human-environment relationship. Negatively worded items were reverse-coded and all items summed to obtain a score, where higher values represent an acceptance of an eco-centric worldview (i.e. humans as a part of nature), and lower values represent an anthropocentric worldview (i.e. humans apart from nature). Responses to NEP items were recorded on a five-point agreement scale where 1 = strongly disagree and 5 = strongly agree with a mid-point of neutral.

Affective association with nature was measured using the CNS (Mayer & Frantz, 2004). The CNS scale is comprised of 14 items including, "I often feel a sense of oneness with the natural world" and "I often feel a kinship with plants and animals". CNS items were measured on a five-point agreement scale where 1 = strongly disagree and 5 = strongly agree. Negatively worded items were reverse coded.

We operationalized political orientation as a measure of one's identification with either liberals or conservatives along a continuum in order to better characterize "leaners" (e.g. independents that weakly identify with one position) (Petrocik, 2009). This measure, therefore, is a global measure of political orientation rather than one's specific party affiliation. Participants were asked to respond to the following item "When it comes to politics do you consider yourself liberal, conservative, or neither liberal nor conservative?" Response options ranged from "very liberal" (1) to very conservative (7), with a mid-point of "neither liberal nor conservative". Last, gender was operationalized with a self-reported dichotomous item; either male or female. Responses were coded such that 1 = female and 0 = male. Descriptive findings indicated participants were predominantly female (70%) and on average were slightly more conservative than liberal ($M = 4.3$). Item means and standard deviations for NEP, CNS, political orientation and gender are presented in Table 1.

Analysis

Measurement

Prior to examining our hypotheses, the measurement properties of the OC–AN scale were tested using confirmatory factor analysis. Separate CFA models were estimated for pre-test and post-test. All analyses were performed in the statistical software Stata version 15 (Statacorp, 2017), with models estimated using the full-information maximum likelihood estimator to account for missing values. OC and AN were hypothesized to exist on the same conceptual plane. That is, although they are related, one construct is not temporally antecedent to the other. Model fit was assessed using the chi-squared test, Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI) and Root Mean Square Error of Approximation (RMSEA) (Kline, 2016). We considered the

model an adequate fit for the data if the chi-squared test was not statistically significant ($\alpha = 0.05$), or the RMSEA was 0.08 or less and the CFI and NNFI were roughly 0.95 or greater.

Path model of antecedents of climate change beliefs

To assess H_1–H_4, we then tested our hypothesized model of the antecedents of beliefs about climate change using path analysis on pre-test scores for students from both the educational travel and the on-campus groups. This analysis examined the determinants of beliefs about climate change among "untreated" students as well.

Path analysis is a multivariate analytical technique that allows for the estimation of simultaneous equations with multiple correlated dependent and independent variables (Ullman & Bentler, 2013). Although it shares some conceptual overlap with regression techniques, particularly in the interpretation of parameters, it is preferred over multiple regressions when the goal is to test the validity of a network of hypothesized causal relationships, as was the case in this study. In path analysis, one can determine the plausibility of a generalized hypothesis by testing it against real world data. The extent to which population and model-derived covariance matrices converge provides evidence for the plausibility of the candidate model. Therefore, model fit is an important part of model testing. We used the same criteria for the evaluation of the measurement model to assess path model results.

Regression models for treatment effects

We tested the influence of participation in the educational travel experience on students' beliefs about climate change (H_5) using multiple regression. Separate models for OC and AN were estimated where post-test scores were regressed onto pre-test scores and a dummy variable coding for students that participated in the treatment program versus the control. Therefore, controlling for values of OC and AN at pre-test, the dummy variables represents the difference in post-test score between students participating in the climate education program and the control (e.g. the treatment effect).[1]

Results

Measurement model results

The results demonstrated that the hypothesized two-dimensional structure of the OC/AN instrument was an adequate fit for the data, at both pre-test and post-test, after allowing error terms for the items "burning fossil fuels, such as oil and gas" and "driving gas powered automobiles" to covary. Item means, standard deviations, standardized factor loadings and standard errors for the tests of the measurement model are presented in Table 2. Both OC ($\alpha = 0.96_{pre}/0.97_{post}$) and AN ($\alpha = 0.97_{pre}/0.98_{post}$) demonstrated adequate reliability (Vaske, Beaman, & Sporanski, 2017). Similarly, the NEP ($\alpha = 0.80_{pre}$) and CNS ($\alpha = 0.84_{pre}$) scales were reliable according to accepted values.

Path model results

A correlation matrix of model constructs (Table 3) shows that most constructs were positively correlated, except political orientation, which was negatively related to all other variables. The final path model was an adequate fit for the data ($\chi^2 = 1.87$ (2); $p = 0.392$; RMSEA = 0.00, 90% Lower CI = 0.00, 90% Upper CI = 0.092; CFI = 0.99; NNFI = 0.99). We found that environmental worldview (H_1) was significantly and positively related to both a belief in the OC ($\beta = 0.33$, $p < 0.01$) and AN causation of climate change ($\beta = 0.34$, $p < 0.01$). Connectedness to nature (H_2)

Table 2. Measurement model results.

	Pre-test[a]		Post-test[b]	
	M (SD)	λ (SE)	*M* (SD)	λ (SE)
Occurrence				
The temperature of the ocean is increasing	5.34 (1.68)	0.90 (0.01)***	5.70 (1.65)	0.95 (0.00)***
The areas affected by drought are increasing	5.21 (1.60)	0.90 (0.01)***	5.48 (1.59)	0.89 (0.01)***
Air temperature is increasing	5.35 (1.66)	0.91 (0.01)***	5.58 (1.66)	0.92 (0.01)***
The number of flooding events are increasing	5.04 (1.60)	0.85 (0.01)***	5.36 (1.57)	0.86 (0.01)***
Sea level is rising	5.25 (1.76)	0.89 (0.01)***	5.59 (1.68)	0.93 (0.01)***
The amount of ocean ice is decreasing	5.40 (1.77)	0.86 (0.01)***	5.63 (1.71)	0.87 (0.01)***
Anthropogenic causation				
Clear cutting forests	5.58 (1.85)	0.95 (0.00)***	5.78 (1.72)	0.92 (0.01)***
Driving gas powered automobiles	5.58 (1.85)	0.94 (0.01)***	5.82 (1.76)	0.98 (0.00)***
Burning fossil fuels, such as oil and coal	5.74 (1.86)	0.95 (0.00)***	5.92 (1.79)	0.98 (0.00)***
Clearing land for human use	5.59 (1.83)	0.97 (0.00)***	5.79 (1.73)	0.94 (0.00)***

*$p \leq 0.10$.
**$p \leq 0.05$.
***$p \leq 0.01$.
[a]Pre-test: $\chi^2 = 213.24$ (32); $p < 0.000$; RMSEA = 0.081; CFI = 0.985; NNFI = 0.979.
[b]Post-test: $\chi^2 = 283.08$ (32); $p < 0.000$; RMSEA = 0.096; CFI = 0.981; NNFI = 0.974.
Fully standardized factor loadings reported.

Table 3. Correlation matrix of model variables.

	NEP	CNS	POL	GEN	OC	AN
NEP	1.00					
CNS	0.45	1.00				
POL	–0.48	–0.29	1.00			
GEN	0.18	0.17	–0.10	1.00		
OC	0.37	0.28	–0.30	0.06	1.00	
AN	0.31	0.21	–0.21	0.10	0.84	1.00

NEP: new ecological paradigm; CNS: connectedness to nature; GEN: gender; OC: occurrence; AN: anthropogenic causation.

was significantly and positively related to OC ($\beta = 0.11$, $p = 0.021$), but not AN. We did not find a significant relationship between political orientation and AN. We did, however, find that political orientation (H_3) was significantly, and negatively, related to OC ($\beta = -0.09$, $p = 0.004$) and that women (H_4) reported a stronger belief in AN causation ($\beta = 0.06$, $p = 0.027$). We did not find a gender effect on a belief about the OC of climate change. The model explained 20% of the variance in OC and 15% of the variance in AN. A summary of model results is presented in Table 3.

Regression model results

Statistically significant treatment effects were observed for both the OC and AN models, controlling for belief scores at pre-test (H_5). Students that participated in the educational travel program recorded post-test scores for belief in the OC of climate change 0.33 points higher than students in the control (Table 4). This effect, however, was relatively small ($\eta^2 = 0.01$). A similar pattern of result was observed for the model predicting belief in AN causation. Controlling for pre-test scores, students that participated in the educational travel program exhibited scores on the AN causation scale 0.35 points higher than students in the control. Again, this effect size was not large ($\eta^2 = 0.01$) (Table 5).

Discussion

Predictors of beliefs about climate change

The social psychological antecedents of beliefs about climate change are of consequence to the design of effective climate change education and interpretation programming (Brownlee &

Table 4. Path model results predicting belief in the occurrence and anthropogenic causes of climate change.

Dependent variable	Independent variable	β (SE)	z-value	R^2
Occurrence ←	Connectedness to nature	0.11 (0.05)	2.30*	0.20
	Environmental worldview	0.33 (0.05)	6.94***	
	Political orientation	–0.09 (0.03)	–2.90**	
	Gender (female)	–	–	
Anthropogenic causation ←	Connectedness to nature	0.07 (0.05)	1.47	0.15
	Environmental worldview	0.34 (0.05)	6.99***	
	Political orientation	–	–	
	Gender (female)	0.06 (0.03)	2.21*	

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.
$\chi^2 = 1.87$ (2); $p = 0.392$; RMSEA = 0.00 [90% CI = 0.00, 0.092]; CFI = 0.99; NNFI = 0.99.

Table 5. Model predicting post-test belief in the OC of climate change ($n = 429$).

	B	t-Value	p-Value	η^2
Pre-test score	0.42 (0.05)	9.36	<0.001	0.17
Treatment	0.33 (0.14)	2.45	0.015	0.01

$R^2 = 0.17$.
$F = 44.56$, $p < 0.001$; $df = 2$.

Table 6. Model predicting post-test belief in the AN causation of climate change ($n = 437$).

	B	t-Value	p-Value	η^2
Pre-test score	0.30 (0.04)	6.78	<0.001	0.10
Treatment	0.35 (0.15)	3.18	0.025	0.01

$R^2 = 0.10$.
$F = 24.39$, $p < 0.001$; $df = 2$.

Verbos, 2015). Though past work has primarily focused on the politics of climate change beliefs, our results suggest that other constructs may play a role in shaping beliefs about climate change. Environmental worldview, for instance, was the strongest predictor of both a belief in the OC and AN causes of climate change in our model (Table 6). One's basic beliefs about human-environment relationships may therefore be an important filter for the processing of climate science information (Whitmarsh, 2011), especially in the United States (Hornsey et al., 2018). These results echo past work (Hornsey et al., 2016; Kellstedt et al., 2008; Leiserowitz, 2006) finding a link between worldviews and evaluations of climate change, and further stresses the role of existing cognitive structures in the processing of information about climate. An eco-centric worldview is consistent with a belief that humans are a part of the environment, and that humans have agency in affecting the Earth climate system. An anthropocentric worldview, however, places humans apart from nature, and therefore, exogenous to natural processes. This is reflected in our results, where individuals with an eco-centric worldview had stronger beliefs in both the OC and AN causation of climate change.

Basic beliefs like those measured by the NEP, however, are resistant to change, and therefore, may not be amenable by education or experience (Heberlein, 2012). Educators seeking to modify attitudes toward climate change should work within the context of this complexity, beginning with the role that values and worldviews play in influencing specific beliefs about climate change (Crompton, 2010). Past work, for instance, suggests self-enhancement value orientations (e.g. values types that privilege personal gain) are negatively linked to evaluations of environmental concern (Schultz et al., 2005). However, this relationship can be overcome by persuasive instruments targeting utilitarian and self-relevant outcomes of environmental protection (Schultz & Zelezny, 2003). More work, however, is needed to understand framing effects that yield change in beliefs about climate change among individuals with anthropocentric worldviews. Maibach, Roser-Renouf, and Leiserowitz (2008), for instance, suggest framing climate change as an issue of

public health may influence the acceptability of climate-related messages. This finding is particularly important given that the American public has predominantly self-enhancing values (Schultz et al., 2005). Educators have long recognized the need for individualized practices that seek to align instruction with the abilities and preferred learning modes of students (Jonassen & Grabowski, 1993). The role of students' value structures in teaching values-based concepts, however, may be of equal importance, and understanding how best to use this information in study abroad programing is an avenue for future research.

Although value structures are quite stable, affect is subject to variation over time, and therefore, may be a potential target for intervention by educators interested in influencing climate change beliefs and attitudes (Nisbet et al., 2011). Nature-based experience is one way to cultivate affective bonds with the environment (Kaplan & Kaplan 1989). Despite the global nature of climate change, consequences that stem from it will have local impacts. Thus, even place-based human-environment attachments may yield positive evaluations of issues of environmental concern (Kyle et al., 2004), especially if they pose threats to valued objects. Cultivating connections with nature, therefore, is critical in fostering a citizenry that has concern for environmental issues. We found one's affective attachment to nature was a predictor of a belief in the OC of climate change. That is, a higher emotional association with nature may yield stronger affirmative beliefs about climate change.

We found, on average, females were more likely than males to believe climate change stems from AN activities. This is consistent with past work exploring the influence of gender on environmental concern (Flint et al., 2017; Stern et al., 1995), and climate change attitudes (Kellstadt et al., 2008). We did not find support for a relationship between gender and a belief in OC. Political orientation, however, was related to a belief in in the OC of climate change. Conservatives were less likely to believe in climate change or that it stems from AN causes. Social constructions of climate change issues are constantly reinforced in public discourse. In-group norms can shape individual attitudes (Fielding & Horsey, 2016). Thus, it is important to consider how political orientation can influence evaluations of climate change. Deliberate communication campaigns about climate change can affect those beliefs. Social norms messages (i.e. messages that show peers alarmed about climate change) may have particular success in shaping beliefs about climate change among those with strong social identities tied to political party affiliation (McKenzie-Mohr, 2000). It is important to note, however, political orientation was not related to a belief in AN causation. That is, although the OC of climate change is influenced by political orientation, evaluations of human impacts on natural systems are not. In the case of both OC (20%) and AN (15%), our model explained a relatively small amount of the variance. Beliefs about climate change are complex and multi-faceted. Future work should explore the role of additional variables as predictors of OC and AN. For instance, the inclusion of measures concerning personal experience with extreme weather (see van der Linden, 2015) may help to explain greater variance in both OC and AN.

Implications for educational travel

While the social and psychological antecedents of beliefs about climate change have received substantial attention in the literature, and our findings in this area generally confirm what is already known (Leiserowitz, 2006; Whitmarsh, 2011), few studies have sought to understand the role of experience as a way to change climate beliefs. Certain kinds of educational travel can be an effective mechanism for initiating changes in beliefs and behaviors, as participants gain new perspectives, knowledge of ecosystems and connections to place (Ardoin et al., 2015; Powell, 2005; Powell & Ham, 2008).

Our results indicate structured travel in the study abroad context can provide an impetus for changing climate beliefs. Participants in our treatment group exhibited statistically significant,

but small, positive gains in both a belief in the OC of climate change and in an AN cause following experience with environments sensitive to the effects of climate change, and education on climate change concepts. Although our results do not permit us to determine the direct cause of this growth, they do suggest experiential education is a potential mechanism for changing beliefs about climate change. It is important to note, however, that the structure of such programs can have an influence on the cognitive, conative and affective outcomes that are realized by participants. That is, purposeful pedagogy maximizes participant experience, learning and growth (Tarrant, 2010). Future work should seek to understand how to best enhance student growth in higher-order learning outcomes, like climate change beliefs, stemming from participation in educational travel (Landon et al., 2017). Last, it will be important to understand the longer-term power of the changes that we observed. In other words, do positive changes in beliefs about climate change persist, or do they attenuate after the culmination of the experience?

As universities continue to increase opportunities for educational travel for their students, some institutions within the United States have made such travel part of required coursework prior to graduation (Horn & Fry, 2013). Given our findings, a more concerted effort should be placed on the design of educational travel concerning sensitive natural environments and climate change. Such exposure and increased awareness of climate change may contribute to greater change in beliefs and attitudes. If possible, universities should seek to assess these beliefs and attitudes longitudinally to determine the impact of study abroad in sustaining individuals' perspectives on the environment. Universities should also be cognizant of the fact that climate change education programs that rely on long-distance air travel to move students to locales are ironically contributing to the problems that they profess to solve. Discussion of that inherent hypocrisy may be an effective means of introducing personal responsibility to discussions with students. They may also seek to reduce carbon impacts through the purchase of offsets associated with program fees.

Limitations

Despite the outcomes we report, a number of limitations to this study are worth noting. First, the study population is comprised entirely of university students enrolled at a single institution. Thus, the findings should be interpreted within that context. Future work should seek to generalize these findings to a broader sample. Second, though informed by theory, the results of our path model are cross-sectional. Therefore, the causal inference is limited to the relationships implied by the underlying theory. Last, self-selection bias is possible as students choose to enroll or not in study abroad opportunities. That is, it cannot be ruled out that observed increments in climate change beliefs from pre-test to post-test are a function of predispositions for change that lead individuals to select participation rather than remaining on campus. Future research could attempt to account for some of the bias stemming from self-section using matching estimators or other synthetic control designs. While true experimentation is not possible in this context, the present study is one of very few that adopt a quasi-experimental approach. Arguably, our work demonstrates that a change in individuals' beliefs about climate exists as a result of their educational travel experience. However, the mechanism by which this change comes about remains to be explained. As such, future research utilizing qualitative methods (i.e. in-depth interviews with participants) to elucidate this process is needed. It is not known for instance, if the simple act of travel is implicit in observed changes in climate beliefs, or if the programming can be credited. Controls for travel, and content, could further elucidate the mechanisms. Additionally, while we did not ask participants about their prior coursework concerning climate change topics, such a variable may help to impact beliefs in the OC of climate change and AN causation. Finally, the increments of growth in climate change beliefs that we observed were small. This may stem from a ceiling effect where limited variance in the measurement instrument

and already high scores at pre-test limit our ability to detect growth. A broader array of outcome variables is needed in future assessments of climate education programs.

Conclusion

Understanding public opinion on climate change issues is critical in order to build support for action. Our results suggest climate change beliefs are a function of one's environmental worldview, affective association with nature, political orientation and gender. Educational travel may have a role to play in contributing to the environmental perspectives of young adults in Western society, and may be one way of modifying students' beliefs about climate change. However, the ability of educational travel programs to achieve these ends is likely enhanced if pedagogy is developed that is cognizant of the factors that influencing students' beliefs about climate change.

Note

1. We had originally tested the treatment effect using repeated measures ANOVA. However, the data failed to conform to an assumption of sphericity owing in part to unbalanced cell frequencies. The regression approach reported was chosen as an alternative.

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