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Framing climate change communication to prompt individual and collective action among adolescents from agricultural communities

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ABSTRACT

Climate communication research suggests strategic message framing may help build public consensus on climate change causes, risks and solutions. However, few have investigated how framing applies to adolescents. Similarly, little research has focused on agricultural audiences, who are among the most vulnerable to and least accepting of climate change. Among 950 high school agriculture students in North Carolina, we found agriculture and environment framing of climate change, but not community and health frames, elicited feelings of worry, and these together with community frames elicited hope. Further, students feeling more worry were more supportive of individual and collective action. Those accepting climate change and females had more emotive responses and higher support for all action measures, and acceptance of human causes predicted more worry and support for collective action. We find these results encouraging as agriculture teachers likely employ agriculture and environment frames when following best teaching practices.

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Introduction

Despite scientific consensus around anthropogenic climate change and its observed and likely impacts (IPCC 2014; Cook et al. 2016), public opinion around climate change remains polarized and engagement remains low (Pew Research Center 2014; Hamilton et al. 2015). Although more than half of the US public believes climate change is happening and is caused mainly by humans (Hamilton et al. 2015; Leiserowitz et al. 2017), a sizable minority (between 30 and 40%) believe the causes are natural (Hamilton et al. 2015; Leiserowitz et al. 2017). Individuals who attribute climate change to natural causes are less likely to modify their actions because they believe climate change would happen regardless of human intervention (Arbuckle, Morton, and Hobbs 2013). Researchers have offered a host of reasons for persistent denial and apathy. For example, few Americans are confident that they fully grasp the complexities of the issue (Leiserowitz, Smith, and Marlon 2011), suggesting that lack of scientific understanding may partially explain the mismatch between scientific consensus and public opinion (Sterman 2011; Smith and Leiserowitz 2012). Some research suggests that citizens are more likely to act and support mitigation

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if they feel personally at risk (Howden et al. 2007). However, few perceive this personal risk, possibly due to the creeping nature of climate change and the impression that its impacts are geographically and temporally distant (Leiserowitz 2005; Nisbet and Myers 2007; Moser and Dilling 2011).

A robust body of literature also supports the notion that polarization on climate change is rooted in political ideology and cultural worldviews (Kahan, Jenkins-Smith, and Braman 2011; Unsworth and Fielding 2014; Huxster, Carmichael, and Brulle 2015; Hornsey et al. 2016). Those leaning toward conservative viewpoints and hierarchical-individualist worldviews are more sceptical of anthropogenic climate change and those with more liberal and egalitarian communitarian worldviews are more accepting (Dunlap, Xiao, and McCright 2001; Kahan, Jenkins-Smith, and Braman 2011; McCright and Dunlap 2011a; Unsworth and Fielding 2014). These polarized leanings can be explained by our tendency to seek information from those who share our way of thinking (e.g. seeking news sources that provide ideologically-compatible framings) (Hamilton 2011) as well as our remarkable ability to selectively assimilate information in ways that reinforce our pre-existing viewpoints (Nickerson 1998; McPherson, Smith-Lovin, and Cook 2001).

Climate denial and scepticism around climate change are particularly acute within United States agricultural communities, which are simultaneously highly vulnerable to and sceptical of anthropogenic climate change (Berry et al. 2006; Arbuckle, Morton, and Hobbs 2013). Weather and climate have direct impacts on farming industries (Prokopy et al. 2015), and agriculture contributes to global climate change by producing greenhouse gases (just under a quarter of global emissions [Smith, Bustamante et al. 2014]). Further, unsustainable soil practices can reduce the carbon storage potential of soils (Lal 2004). These contributions to climate change also present opportunities to make dramatic reductions in global emissions. Despite this vulnerability and opportunity to mitigate climate change, farmers' beliefs about climate change and its causes have been found to vary considerably (Arbuckle, Morton, and Hobbs 2013). In an Iowa study, a substantial number of farmers fell into the categories of not accepting climate change is happening or stating that there is insufficient evidence to support it (32.1%), thinking it is a natural phenomenon (24.2%), or agreeing that human ingenuity would enable adaptations (31.3%) (Arbuckle, Morton, and Hobbs 2013). Further, the respondents in these categories tended not to support mitigation policy, and their attitudes toward adaptation were directly related to their perception of climate change risk (Arbuckle, Morton, and Hobbs 2013).

As in the larger public debate, farmers' political affiliations are prominent determinants of risk perception and belief (Smith, Liu et al. 2014). Conservative, rural, male ranchers and farmers in Nevada saw climate change as less harmful to their communities and as a low national priority when compared to their female or liberal counterparts (Smith, Liu et al. 2014). In addition, the American Farm Bureau Federation along with other agricultural interest groups have voiced opposition to climate policy and have cast doubts on human-caused climate change (McCright and Dunlap 2010; Union of Concerned Scientists 2010; Prokopy et al. 2015). The prevalence of conservative ideology in farming communities paired with the denialist rhetoric espoused by community leaders both likely contribute to persistent scepticism (Propkopy et al. 2014). Although addressing climate change will arguably require buy-in from diverse communities, the agricultural community is among the most critical because of their high vulnerability to climate change and the global dependence on the viability of agricultural industries for food security.

Research suggests that message framing techniques that attend to ideological drivers of climate change perceptions may be a promising tool for effective climate change communication (Maibach, Roser-Renouf, and Leiserowitz 2008; Myers et al. 2012; Krantz and Monroe 2016). Nisbet and Mooney (2007) define frames as 'interpretive storylines' that define why an issue is a problem, who might be responsible, and what can be done. Framing can be used to simplify information about the topic, giving more weight to certain elements over others (Nisbet and Mooney 2007). As people tend to choose information that lines up with their prior beliefs (Bernauer and McGrath 2016), framing a message for a particular audience may make it easier for people to pay attention to evidence (e.g. the causes of climate change, likely impacts) or to accept new policies or recommended behaviours (Maibach, Roser-Renouf, and Leiserowitz 2008; Nisbet 2009). Research shows that framing may not directly boost support for

climate-friendly policies (Bernauer and McGrath 2016; Krantz and Monroe 2016), but it can change people's emotions toward a subject. For instance, a simple framing of climate change as a public health concern made people more hopeful than when using a national security frame (Myers et al. 2012), and a stewardship frame used with forest landowners increased feelings of efficacy (Krantz and Monroe 2016). These emotional shifts may be key to changing behaviour. Smith and Leiserowitz (2014) found that emotions of worry and hope are strong predictors of climate change policy support. While a frame might not directly change behaviour, framing climate change in a way that makes a specific audience feel hope or concern may have the potential to trigger those feelings, which may in turn, positively influence individual or collective climate change action.

Another promising path for navigating the influence of ideology on climate change perceptions is working with younger audiences. Although ideology and worldview seem to be the primary drivers of climate change perceptions among adults (Hamilton 2011; Hornsey et al. 2016), they seem to be less influential over children (Stevenson et al. 2014). Among adults, education level seems to be associated with higher levels of polarization along ideological lines (Hamilton 2011; Kahan et al. 2012; Unsworth and Fielding 2014), suggesting that education may not mitigate gaps in policy support. Although children are polarized at low levels of climate change knowledge, as climate change knowledge increases, the effect of worldview disappears, suggesting that children may be more receptive to climate change education than adults (Stevenson et al. 2014). Further, both climate-related hope and concern have been linked to climate-friendly behaviours among adolescents (Stevenson and Peterson 2015). As the next generation of decision-makers, children and teenagers present a unique opportunity to foster climate change hope, concern, and action.

Despite the potentially synergistic effects of using strategic framing with younger audiences to promote climate change concern and action, little research has addressed the topic. Although a few researchers have addressed climate change perceptions among agricultural audiences (Arbuckle, Morton, and Hobbs 2013; Wojcik et al. 2014; Prokopy et al. 2015), few if any have specifically addressed children in that community. Given the encouraging emerging work with climate change education among younger audiences suggesting that adolescents may be receptive to climate education (Flora et al. 2014; Stevenson et al. 2014), as well as the possibility that children and adolescents from agricultural communities may be ideologically predisposed to climate scepticism (Prokopy et al. 2015), research is needed to understand how younger audiences in agricultural communities may respond to climate communications. Further, although several studies have demonstrated message framing can be a useful tool among sceptical audiences (Sterman 2011; Fleischer 2013; Krantz and Monroe 2016), few have considered its use among younger generations (Corner and Roberts 2014; Corner et al. 2015). Because individuals are more receptive to those frames with which they most closely identify (Davis 1995; Scheufele 1999), agriculture students may be most receptive to messages that focus on climate impacts and solutions specific to agriculture. This is in contrast with an environment frame (e.g. biodiversity conservation) employed by many environmental education materials or health frames, which have been shown to be effective among broad audiences (Myers et al. 2012). By considering message framing with younger agricultural audiences, research may be able to demonstrate a potential for raising the next generation of farmers to understand their vulnerability to climate change, opportunity to make a real difference, and substantial contribution to global food security.

This study begins to address the need to examine how message framing may affect emotional responses to climate change and subsequent individual and collective action among adolescents with a case study of agricultural students in North Carolina. Because previous research has found message framing is unlikely to change support for climate policy (Bernauer and McGrath 2016) but directly impacts emotional responses that may be precursors to behaviour (Smith and Leiserowitz 2014; Myers et al. 2012), we proposed a path model in which message framing predicted emotions, which in turn predicted intended individual (e.g. energy conservation) and collective (e.g. support for mitigation policies) behaviours. We predicted that agricultural students who were presented with an agriculture-based frame would feel more hope and worry as compared to those students presented with environmental, community, or health frames. Although concern for environment, community, and public health may

resonate with students, agriculture frames may best connect with agricultural students' personal experiences, which may make climate information more personally relevant and salient (Scheufele 1999). We also predicted that students who feel more hopeful and worried would have greater support for both intended individual behaviours and support for collective action. We also accounted for student beliefs around climate change (that it is happening and human caused) as well as demographic factors including gender and ethnicity, as these have been shown to impact climate concern and behaviour among adolescents (Stevenson et al. 2014; Stevenson and Peterson 2015). Further, we accounted for political affiliation because of the well-documented relationship between political ideology and climate change perceptions (Dunlap and McCright 2008; Unsworth and Fielding 2014). Although many high school students are not yet of voting age, political ideology begins forming in late adolescence (Yates and Youniss 1998) and may impact climate perceptions.

Methods

Sampling

We emailed all high school agriculture teachers in North Carolina (437 teachers) asking if they would participate in the study. Of these 437 teachers, 64 responded (14.6% response rate) and 37 administered the survey to their students (57.8% compliance). Low teacher response rate may indicate some amount of self-selection bias among teachers, but this bias would not transfer to students as students are assigned to teachers randomly, or at least independent of teacher views on climate change (e.g. classroom make-up and conflicting classes to create student schedules). Further, previous research has found limited associations between teacher and student climate change beliefs (Stevenson, Peterson, and Bradshaw 2016). There were 950 student responses in the sample whose parents expressed either consent or did not opt out of the study (NC State University IRB review board, IRB #6216, assurance number 00003429). Most (55.0%) identified as male, with 42.6% females and 2.4% identifying as other. The majority were White (65.5%), with lower percentages identifying as African American (12.4%), Hispanic (8.4%), Asian (1.1%), Native American (1.8%), multiracial (7.6%), or other (3.2%).

Instrumental development

We drew on three instruments for this study, one which addresses the potential for framing to directly impact emotions (Myers et al. 2012), another specifically designed to measure climate change perception among agricultural communities (Arbuckle, Morton, and Hobbs 2013), and another assessing environmental behaviours among adolescents (Stevenson and Peterson 2015). First, we asked respondents about the degree to which they agreed that climate change is (1) happening and (2) human caused. These questions were adapted from the Six Americas study (Leiserowitz et al. 2017) and have performed well in previous studies with adolescents (Stevenson et al. 2014, 2015; Stevenson, Peterson, and Bondell 2016). Next, students were randomly presented with a climate news story presented in one of four frames: agriculture, community, health, and environment. We used an article identical to the one in Myers et al. (2012) for the health frame, and made minor changes to employ the other three frames (see online Supplemental Information for copies of the frame text). Each article followed the same format. It began with a quote to introduce the idea that climate change would have significant impacts on the environment, agricultural systems, communities, and public health, respectively. The next section, titled, 'Global warming threatens America's/American [Environment, Agriculture, Health, Community],' gave more detail on the expected impacts, which we would expect to elicit feelings of worry. The final section, titled, 'Actions to limit global warming benefit [the environment, agriculture, health, community] in many ways,' outlined co-benefits between reducing emissions and the topic of the frame, which we would expect to elicit feelings of hope. Next, students were asked to respond to the degree to which the article made them feel worried or hopeful. To measure support of collective action, students were asked to respond to questions about support for adaptation and mitigation

measures (adapted from Arbuckle, Morton, and Hobbs [2013]). We measured intentions to participate in individual actions with items addressing information seeking, individual energy saving behaviours, and transportation choices (Stevenson and Peterson 2015). Because our entire instrument has been used in previous studies with adolescents, we did not pre-test this instrument. Online supplemental materials include verbatim item wording for the entire instrument and reliability and validity statistics for the climate action scale.

Analysis

We first tested for differences in emotional responses (i.e. hope and worry) associated with the different frames using ANOVA. We then completed a post-estimation Tukey analysis to test for differences among individual frames and emotional response (Stevens 2012). We then used the SEM function in STATA 14.1 to test the utility of our proposed path model. Path model analysis is a case of structural equation modelling that links observed variables in causal chain (Streiner 2005). Although path analysis does not test for causality, it does provide information on the degree to which the data are consistent the proposed model (Streiner 2005). Fit indices provide a measure of congruence between the observed and theoretical models, including standardized root mean residual (SRMR), which measures the difference between the residuals of the sample covariance matrix and that proposed by the model (Wuensch 2012). The rule of thumb for acceptable SRMR is values less than 0.08 (Wuensch 2012). In constructing our path model, we considered the frame as a categorical variable with the agricultural frame as the reference category, as we were interested in testing each frame in comparison with the agricultural frame. We included the remaining three frames (health, community & environment) as predictors of both hope and worry, which in turn predicted support for adaptation, support for mitigation, and intended individual behaviour. We also controlled for gender, belief that global warming is happening, belief that is human caused, and political affiliation (Republican and Democrat vs. Unaffiliated or Independent) by including a path to each endogenous variable in the model. An examination of the sample proportions compared with enrolment data for agriculture classes in North Carolina revealed that our sample underrepresented males. We weighted the analysis to correct for this difference.

Results

Summary statistics revealed that on average, students felt intermediate levels of hope (2.42 out of 5, SD = 1.08) and worry (mean = 2.63/5, SD = 1.27). Students were generally supportive of adaptation measures (mean = 3.9/5, SD = 1.06) and mitigation measures (mean = 3.87, SD = 1.14) and reported moderate likelihood of engaging in climate-friendly behaviours (32.5/50, SD = 7.62). Framing was related to changes in hopefulness (df = 3, $F = 6.2$, $p < 0.001$), but not changes in worry (df = 3, $F = 2.35$, $p = 0.071$) or either measure of collective action (adaptation: df = 3, $F = 0.50$, $p = 0.681$; mitigation: df = 3, $F = 0.70$, $p = 0.555$). The agriculture and environment frames were both associated with a significantly higher level of hopefulness among students as compared with the health frame (Figure 1).

Path analysis and including control variables uncovered more nuanced relationships. We identified a mediating relationship where agricultural or environmental framing predicted the emotion of worry, which in turn predicted intended individual behaviour and support for collective action. When considering all control variables, students who were assigned agricultural frames were more hopeful and worried than those students who were assigned the health frame (for both hope and worry) and the community frame (for worry only) (Figure 2). We found no difference in hopefulness between those students who read the environment or community frames compared with those who read the agriculture frames (Figure 2). Similarly, we did not detect a difference in levels of worry between those who read the agriculture and environment frames (Figure 2). We also found partial support for our hypothesis that students who felt more worry and hope after reading the climate change news article would be more likely to report intended individual behaviour and support for collective action (Figure 2). Level

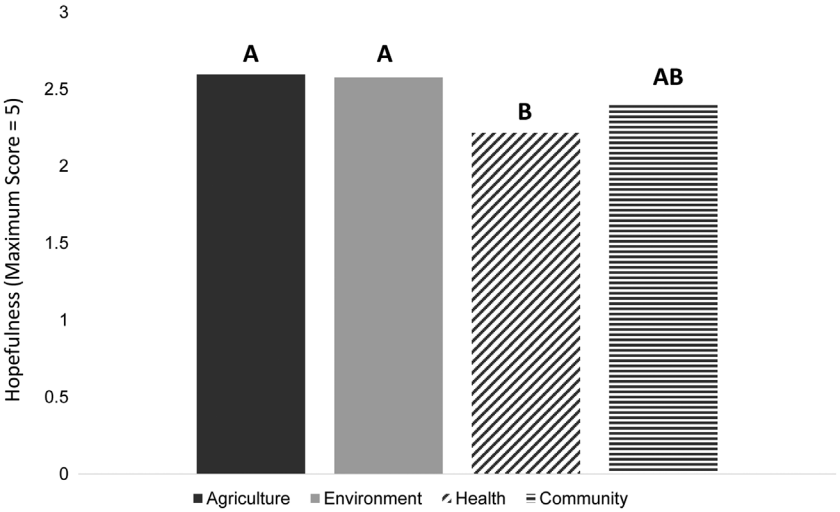
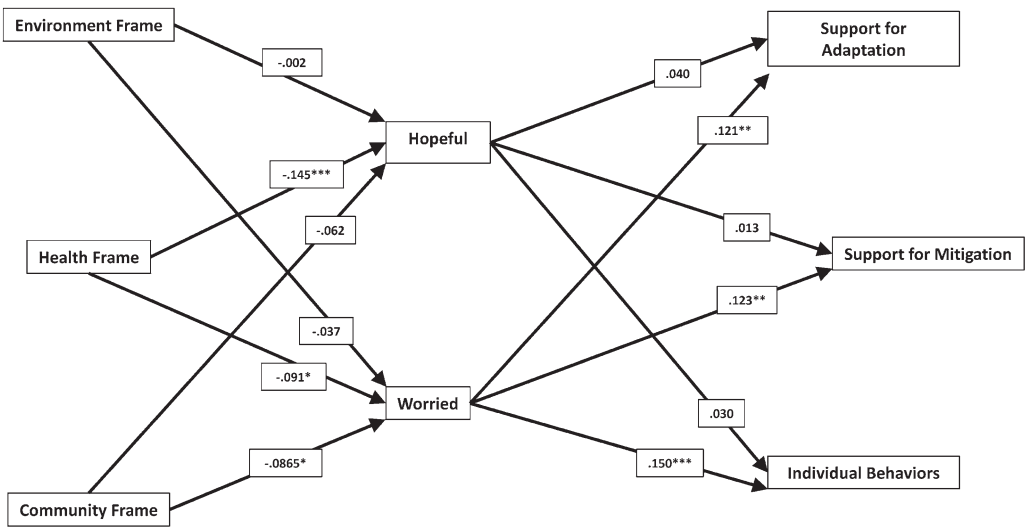


Figure 1. Mean differences in hopefulness after reading randomly assigned climate articles employing agriculture, environment, health, or community frames.

Note: Letters represent statistical significance as indicated by ANOVA followed by Tukey post-estimation analysis (Stevens 2012).



Control Variable	Hopeful	Worried	Support for adaptation	Support for Mitigation	Individual Behavior
Gender	.113***	.102**	.129***	.100**	.112**
GW Happening	.151***	.205***	.163***	.167***	.184***
GW Human Caused	.041	.116**	.076*	.145***	-.037
Republican	.041	-.042	-.061	-.052*	-.052
Democrat	.022	.037	.001	-.004	.001

Figure 2. Path diagram predicting intended individual behaviour and support for collective climate change action as a function of message framing mediated by emotional response.

Notes: All path coefficients are standardized. Coefficients associated with the framing variables are in comparison to the agriculture frame. The agricultural frame is the reference category, and does not appear in the model but is implied as compared to each frame (environment, health, and community). The table below the path diagram includes all control variables. Each was included in the analysis as a predictor of each endogenous variable. Table values represent standardized coefficients. The model fit statistics indicate acceptable levels (SRMR = 0.055) and the overall R2 was 0.33. *$p < 0.5$, **$p < 0.01$, ***$p < 0.001$.

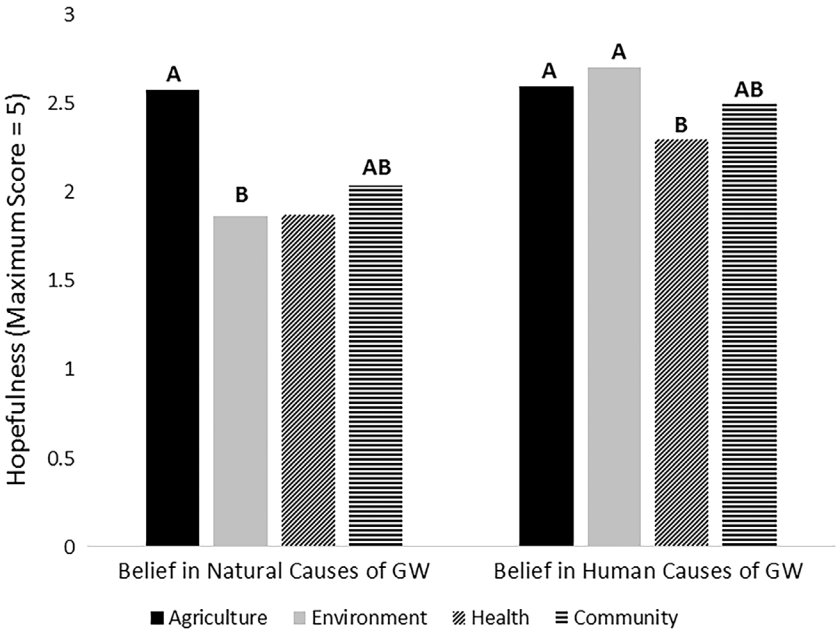


Figure 3. Mean differences in hopefulness after reading randomly assigned climate articles employing agriculture, environment, health, or community frames among those believing in natural versus human causes of global warming.
Note: Letters represent statistical significance as indicated by ANOVA followed by Tukey post-estimation analysis (Stevens 2012).

of worry was positively correlated with all three of these factors, but level of hope had no relationship with support for adaptation, support for mitigation, or higher personal intended behaviour (Figure 2).

Although not part of our hypotheses, several relationships between the control variables and both emotional responses and intended individual behaviour and support for collective action variables were of note. Females were more worried and hopeful than males, as well as more likely to support adaptation and mitigation measures and report intended individual climate-friendly actions (Figure 2). Similarly, the more likely students were to report that they thought global warming was happening, the more likely they were to report feelings of worry and hope, as well as support for adaptation, mitigation, and individual climate-friendly behaviours. Republicans were less likely than Independents or those politically unaffiliated students to support mitigation actions. There was no difference between Democrats and Independents or unaffiliated voters (or future voters) on any measures. Belief that global warming was human caused was positively related to feelings of worry (but not hope), and support for adaptation and mitigation (but not intended individual behaviour) (Figure 2). We used *post hoc* ANOVA and Tukey tests to further examine the relationship between climate change beliefs and framing responses. We generated a binary variable for those who believe in natural versus human causes of global warming to examine differences in emotional responses to framing among these groups. We found that those accepting of human causes had similar responses to framing as reflected in the overall summary statistics, with environment and community frames associated with a more hopeful response than health frames (Figure 3). However, among those sceptical of human causes, the agriculture frame was associated with greater levels of hopefulness than environment and health frames (Figure 3).

Discussion

Agricultural students seem to respond most strongly to environment and agricultural frames, which is encouraging considering agriculture teachers who follow research-based practices for effective teaching are likely employing these frames. Drawing on the experiences of students when planning instruction

is a common teaching practice rooted in socio-cultural theory (Vygotsky 1986) and reflected in experiential education models (Jacobson, McDuff, and Monroe 2015) that suggests learners best acquire new knowledge by building on pre-existing understanding and experiences. Teacher training materials encourage teachers to assess prior knowledge and use examples relevant to students (Tobias 1994; Jacobs 1998). In agricultural classes, this likely means that teachers are using agricultural frames as many students come from agricultural backgrounds, select agriculture classes as electives, or both (National FFA Organization 2014), signalling interest in agricultural topics. Similarly, because agricultural teachers are addressing topics related to the environment and natural resources (National Council for Agricultural Education 2009), it is likely that they are using environment frames. Further, Krantz and Monroe (2016) found that many Southeastern agricultural audiences (i.e. forest landowners) held biospheric values, which place inherent value on the non-human world. In this way, agricultural teachers may employ both identity frames (those that connect with an audience's values and experiences) and content frames (those that emphasize certain aspects of a topic) (Scheufele 1999) that our results suggest are the most associated with an emotional response of hope or worry. Our results also suggest employing agriculture frames may be particularly effective among those sceptical of anthropogenic global warming, as the agriculture frame elicited significantly more hopefulness than either environment or health frames. Results around the lesser emotive reactions to community (in the case of worry) and health (in the case of both worry and hope) frames may be linked to higher levels of egocentrism among adolescents than adults (Elkind 1967; Frankenberger 2000). Adolescents in agricultural communities may resonate less with community and public health frames because these topics relate less directly to their experiences than the agriculture and environment frames, and because youth tend not to perceive themselves as vulnerable to health problems (Snyder et al. 2004; Hornik et al. 2008).

Although message framing may not directly relate to individual and collective action (Bernauer and McGrath 2016), our results on the mediating role of emotions suggest that framing should not be discounted as an effective strategy for encouraging climate change action among adolescents. Research supports the notion that emotions like hope and worry around environmental topics can increase the likelihood that individuals will engage in stewardship behaviours related to those topics (Swim et al. 2011; Snyder, Rand, and Sigmon 2015; Larson, Cooper, and Hauber 2016), and our results suggest the same holds true with worry in the context of climate change action among agricultural students. The lack of relationship with hope is surprising as hope and efficacy (feeling one has power to make a difference) have been shown to be linked to pro-environmental behaviours, including those related to climate change (Lorenzoni, Nicholson-Cole, and Whitmarsh 2007; Stevenson and Peterson 2015). One possibility is that the measurement of hope in this study was contextualized as a reaction to the passage students read rather than climate change hope comprised of both agency and pathways thinking, which was measured in Stevenson and Peterson (2015) or general feeling that one can make a difference, as in Lorenzoni, Nicholson-Cole, and Whitmarsh (2007). It is possible that though all frames but the health frame equally nudged readers to feel more hopeful (John, Smith, and Stoker 2009), more effort is needed to ensure these perhaps ephemerally hopeful feelings solidify enough to influence behaviour. Future research should explore whether associations between framing and feeling hopeful or worried are fleeting or if they do lead to the more cognitively-based measures of climate change hope and concern, which have also been linked to climate change action (Stevenson and Peterson 2015).

Associations with climate change beliefs in this study are consistent with previous literature supporting that acceptance of anthropogenic global warming is positively related to climate change engagement, including the likelihood of climate change action. Among adults in agricultural communities, understanding climate change is happening was linked to both concern for climate change and support for adaptation, and understanding human causes was linked to mitigation support (Arbuckle, Morton, and Hobbs 2013). Similar trends have been found in numerous studies among the general adult population (Evans, Milfont, and Lawrence 2014; van der Linden 2015; van der Linden, Maibach, and Leiserowitz 2015) and were consistent with our results. Further, acceptance that global warming was happening and human caused were the most important predictors of both individual and collective action, which is consistent with previous research among adolescents linking climate change beliefs

with concern (Stevenson et al. 2014) and concern with action (Stevenson and Peterson 2015). These same views were more important than perceived acceptance of anthropogenic global warming among friends and family and frequency of discussion when predicting climate change concern (Stevenson, Peterson, and Bondell 2016), and similarly more important than climate change knowledge (Stevenson et al. 2015). Encouragingly, climate change education can likely foster the understanding that climate change is happening and human-caused among adolescents (Flora et al. 2014; Stevenson et al. 2014), as similar efforts among adults may be more difficult due to the powerful influence of cultural worldviews and political ideologies (Unsworth and Fielding 2014; Hamilton et al. 2015; van der Linden 2015; Hornsey et al. 2016). Climate change education efforts among adolescents may be more fruitful than adults because worldviews do not seem to have the same polarizing influence on climate change beliefs among adolescents (Stevenson et al. 2014), likely because adolescents have yet to form strong cultural worldviews or political ideologies (Vollebergh, Iedema, and Raaijmakers 2001). This may also explain the weak relationship between political affiliation and emotional response to framing and support for collective or individual action in this study. Our finding that understanding human causes of climate change had no relationship with individual behaviour is encouraging. Disagreement around the causes of climate change seems to be at the root of current polarization around climate change (Pew Research Center 2016) and among adolescents, this confusion seems to have no relationship with individual climate change mitigation behaviours like saving energy. However, our results do suggest environmental frames matter less to adolescents sceptical of anthropogenic climate change. Future research could explore potential explanations such as unique cultural identities driving both limited concern for the environment and anthropogenic climate change denial.

In addition to individual acceptance of anthropogenic global warming, the role of gender is consistent with previous research involving adolescents and highlights the need for future research to better understand how socio-demographic predictors of climate change perceptions develop and persist as young audiences mature. Females in this study were more emotive than males and more supportive of individual and collective action. This is consistent with research suggesting that both adult (McCright 2010; McCright and Dunlap 2011b; Joireman and Liu 2014) and adolescent females (Stevenson et al. 2014; Ojala 2015; Stevenson, Peterson, and Bondell 2016) are more concerned and engaged with climate change than males. Researchers have attributed this difference to more relational views of the environment (Carrier 2009), more future-oriented thinking (Joireman and Liu 2014), or gender socialization that encourages environmental concern among women (McCright 2010). We suggest that if gender differences associated with climate change perceptions and engagement are rooted in socialization, future research should address how these may progress developmentally, with gender effects possibly strengthening with age.

Other future research should address potential limitations to our study. We suggest continued research on the role of message framing in K-12 settings in additional geographical areas and conducting national, or international studies to investigate how our results apply in other regions. Further, although students enrolled in agricultural education are logically and anecdotally (based on our conversations with agriculture teachers) associated with the broader agriculture community (e.g. family members involved with the agricultural industry), researchers specifically interested in this population should capture family employment information from students in order to reliably measure differences in students from within and outside agriculture communities. Finally, although teachers reported no problems in students completing the survey, future research may want to consider readability of the news stories among adolescent populations.

Although message framing may not be needed to overcome political ideology among adolescents, it is likely a useful tool to connect with student emotions (boosting hope and worry) and ultimately encourage climate action. Much of the literature around climate change message framing highlights its importance in building saliency and engagement, especially among those audiences whose ideologies may conflict with climate change action (Nisbet 2009; Myers et al. 2012; Krantz and Monroe 2016). Our results suggest that message framing may elicit emotional responses which can in turn foster action related to information seeking, personal energy saving behaviours, transportation, and

support for adaptation and mitigation measures. Encouragingly, our results suggest that this type of framing aligns with best practices for good teaching; specifically, employing frames that draw on the backgrounds and direct experiences of students. Additionally, as climate change curricula and teacher professional development opportunities continue to develop, those developing instructional materials should seek ways to create materials that can be easily adapted to a variety of specific communities. Emerging research on adolescents offers hope that climate change education may be more impactful with younger audiences than with adults (Flora et al. 2014; Stevenson et al. 2014), and this research suggests that message framing may be a helpful tool in optimizing these efforts.

Geolocation Information

This project was conducted in North Carolina, USA.

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