



Assessing the Influence of Educational Interventions on the Climate Change Beliefs of Evangelical College Students

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Assessing the Influence of Educational Interventions on the Climate Change Beliefs
of Evangelical College Students

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for the degree of Master of Liberal Arts in Extension Studies

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Abstract

Despite an overwhelming scientific consensus, much of the American public remains skeptical of anthropogenic climate change. This disparity seems particularly evident among evangelical Christians, who consistently demonstrate greater skepticism with regards to climate change. Indeed, numerous barriers impede evangelical acceptance of human-caused climate change, including theological conservatism, scientific skepticism, political affiliations, and socio-cultural influences. In order to address this problem climate advocates have attempted to engage the evangelical community through various educational initiatives. However, no previous research has yet provided empirical measurement regarding the efficacy of such programs.

The current research addresses this lack of information by measuring the influence of a climate education lecture at an evangelical Christian college. Using pre- and post-treatment surveys to measure participants' beliefs in climate change, this study provides quantitative data on the influence of an educational intervention on students' climate change beliefs. The results demonstrate a significant increase in the pro-climate beliefs of evangelical college students following participation in a climate education lecture. Conversely, the research found no additional influence from education specifically addressing common climate misconceptions, or from the use of a live vs. recorded lecture. Ultimately, this research provides valuable data for those working in climate education among evangelicals, and points to several new opportunities for research in the area of faith-based climate communication.

Dedication

This thesis is dedicated to my wife and kids. Thank you, Becky, Cadie, Lilee, and Ian, for your patience while I pursue a passion, a vision, and a calling. And thank you for inspiring me to make this a better world.

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Many people have helped make this research a reality. Thank you Katharine Hayhoe, for being willing to come to Houghton and give your presentation so that I could do this research study. Without your willingness to devote your time and energy to this project I would not have been able to do this research. Thank you Doug Hayhoe, for serving as my thesis director, for shepherding me through this process, and for taking many hours of your time to read and offer valuable feedback along the way. Thank you Aaron Routhe, for helping shape this idea in the early stages of its development. Thank you Ramon Sanchez and Piers MacNaughton, for helping move my early idea into a proper thesis proposal. Thank you Mark Leighton, for signing off on the research study. Thank you Paul Young, for teaching me how to use SPSS and helping with the statistical analysis. Thank you John Wise for helping create my survey. Finally, thanks to all the students who participated in the research project.

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Chapter I

Introduction

Global climate change represents one of the most challenging problems facing the world in the 21st century. According to the Intergovernmental Panel on Climate Change (IPCC), average global temperatures rose by 0.85 degrees Celsius from 1880 to 2012, with climate models predicting an additional one to five degree climb by 2100 depending on human emissions over the coming century (IPCC, 2013). Such temperature increases contribute to significant disruptions in the global climate system, including rising sea levels, an increased frequency and intensity of certain types of natural disasters, dramatic changes in precipitation patterns, a change in wildfire patterns, shrinking Arctic sea ice, retreating glaciers, biodiversity loss, and ocean acidification, among many others. Beyond these ecological concerns, climate change also leads to a host of humanitarian dilemmas including mass human displacement, decreased food production, spreading disease vectors, water security issues, and national security interests. With over 97% agreement, climate scientists point to human activities—in particular, the widespread combustion of fossil fuels—as the primary drivers behind such global changes (Anderegg, Prall, Harold, & Schneider, 2010; Cook et al., 2013; Doran & Zimmerman, 2009).

Despite overwhelming scientific agreement regarding the urgent ecological and humanitarian implications of climate change, the American public has nevertheless responded slowly to this challenge. Indeed, just 29% of Americans ranked “dealing with

global warming” as a top political priority in January 2014—placing it second-to-last among 20 policy issues (Pew Research Center, 2014). Similarly, a cross-national survey found Americans rank near the bottom in terms of concern over global warming—with the U.S. placing 40th of 47 countries measured (Kvaloy, Finseraas, & Listhaug, 2012). While many factors influence this reluctance, a culture of skepticism concerning scientific claims about climate change pervades much of the general American public. One demographic group, in particular, consistently resists the scientific consensus on climate change—evangelical Christians. One 2008 study found that just 44% of evangelicals believed global warming to be caused mostly by human activities, compared to 64% of non-evangelicals (Smith & Leiserowitz, 2013). Similarly, a 2011 survey found that a mere 27% of white evangelicals believed there to be a scientific consensus on climate change, compared to 40% of the general American public (Public Religion Research Institute, 2011).

Widespread evangelical reluctance to accept anthropogenic climate change presents a significant hurdle to U.S. efforts at addressing this issue. Not only do evangelicals form a sizable minority of the overall U.S. population—26% according to a 2008 report by the Pew Forum on Religion & Public Life—but perhaps more importantly, evangelicals continue to wield significant political and cultural influence in the United States, especially within the Republican Party (Gold & Russell, 2007; Hirschhorn & Pinto, 2012; Mead, 2006). Given both their relative size and considerable influence in conservative politics, the importance of engaging this reluctant, yet strategic, group cannot be overstated. The prominent positions of highly influential, evangelical climate skeptics, such as Sarah Palin, Dr. James Dobson of Focus on the Family, Tony

Perkins of the Family Research Council, U.S. Senator James Inhofe, and climate scientist Roy Spencer, among others, further underscores the need to find a way forward on climate communication with the evangelical community. Groups such as the Cornwall Alliance, an organization dedicated to resisting environmental outreach efforts among conservative Christians, have complicated such prospects through their efforts to create confusion about climate science (Beisner, Driessen, McKittrick, & Spencer, 2006).

Over the past few years, new research has shed important light on what evangelicals believe about climate change, as well as the various worldviews, attitudes, and social influences guiding these beliefs. As a result, scholars have been able to identify key scientific, theological, political, and cultural barriers hindering broader evangelical engagement with this topic. Some progressive Christian leaders have attempted to address this climate skepticism by bringing climate change into discussion as a moral issue facing the church; yet their efforts have not gone unchallenged, with many conservative Christian leaders publicly denouncing this burgeoning evangelical climate movement. Moreover, I have not been able to find any studies attempting to measure the impacts of such climate education efforts. In other words, while we at least partially understand why evangelicals are reluctant to accept anthropogenic climate change, there appear to be no data assessing the effectiveness of current attempts to influence evangelicals toward more climate-friendly beliefs. This lack of knowledge significantly hinders the ability of climate educators and activists to communicate successfully with the evangelical community and thus to impact their approach to climate change.

In order to address this data gap, my research study measured the quantitative effects of an educational intervention on evangelical beliefs and attitudes regarding global climate change. The study involved students at Houghton College, a Christian liberal arts college located in western New York and known as an evangelical institution. Volunteer study participants were randomly assigned to one of three treatment groups of equal size. Participants attended either a live or recorded lecture and completed a pre- and post-treatment survey asking about their climate change beliefs. All presentations detailed the case for anthropogenic climate change, as well as the necessity of a Christian response, but featured slight variations in content in order to examine the influence that common misconceptions have in determining climate change beliefs. The first treatment group attended a live lecture about the science and ethical implications of climate change. The second group watched a recorded version of an equivalent presentation. The third treatment group watched the same recorded presentation, but with a short section addressing common misconceptions about climate change deleted from the recording.

Despite the challenges of engaging evangelicals on climate change, I hypothesized that a carefully constructed educational intervention about climate change would result in significant increases in pro-climate beliefs among evangelical college students (H1). In this study “pro-climate beliefs” refers to perspectives and opinions consistent with the scientific consensus of anthropogenic climate change. Given widespread popular misconceptions about climate change I further hypothesized that this increase would be greater for participants presented with specific information addressing common climate misconceptions compared to those missing such information (H2). Finally, it is important to recognize that the type of climate education effort used in this

study (having a content expert travel a long distance to present a lecture) results in significant greenhouse gas emissions, thus exacerbating the very problem the intervention seeks to address. However, it remains unknown whether a live lecture will result in any greater influence than a recorded version. My final question thus seeks to explore this relationship by hypothesizing that a live version of an educational intervention on climate change would result in a greater increase in the pro-climate beliefs of evangelical college students compared to an equivalent recorded version (H3).

Many scholars have noted the potential for the burgeoning evangelical climate movement to influence the national climate conversation (McCammack, 2007; Nagle, 2008; Simmons, 2009; Smith & Leiserowitz, 2013; Wilkinson, 2010). In fact, a messaging study by the progressive evangelical group Sojourners found 25% of evangelicals to be in the “movable middle” on climate change—that is, not firmly entrenched in a position on the issue (Schmitt, 2014). Because of their strategic political influence and currently shifting and diversifying views on climate change at least one scholar has asserted that evangelical Christians may represent “America’s greatest hope for instituting climate change legislation” (McCammack, 2007, p. 645). While there remain many obstacles to engaging evangelicals on climate change, I believe this research will provide climate educators and activists with a better understanding of the impacts that different approaches to climate education may have on evangelical beliefs. Specifically, the information gathered from this study will enable environmental leaders to use empirical data to shape their approach to future climate education efforts, with the ultimate goal of contributing toward a broader shift in evangelical beliefs and attitudes regarding global climate change.

Chapter II

Background

The evangelical climate movement can trace its roots at least as far back as 1993 with the founding of the Evangelical Environmental Network (EEN). The EEN has been actively involved in most major evangelical environmental efforts and has led the way in Christian climate action. Their 2002 “What Would Jesus Drive” campaign garnered international attention, as have their efforts to frame climate action as a pro-life issue. The first important evangelical statement on global warming came from a gathering of Christian scientists in 2000 following the international climate negotiations in The Hague. This was followed by the 2002 Oxford Conference on Climate Change—a forum for Christian leaders convened by Sir John Houghton, a practicing evangelical and the former co-chair of the Intergovernmental Panel on Climate Change scientific working group. Richard Cizik—then Vice President for Governmental Affairs with the National Association of Evangelicals—credited this gathering and the testimony of Houghton for his own personal “conversion experience” on climate change (Haag, 2006). Cizik and the NAE later went on to partner with Harvard’s Center for Health and the Global Environment to create “Scientist-Evangelical retreats,” some of the first intentional efforts to influence evangelical leaders’ beliefs about climate change (Cizik, 2008). The year 2004 brought two important milestones with the adoption of the Sandy Cove Covenant—a commitment by mainstream evangelical leaders to prioritize environmental issues, including climate change—and the adoption by the NAE of “For the Health of the

Nation: An Evangelical Call to Civic Responsibility” (National Association of Evangelicals, 2004)—a statement placing “creation care” among seven strategic, political priorities.

The movement gained significant media attention in 2006, when 86 evangelical leaders from across the country signed a declaration placing climate change front and center on the evangelical agenda. This Evangelical Climate Initiative (ECI) affirmed four key claims: that human-induced climate change is real, that the consequences will be significant and will hit the poor the hardest, that Christian moral convictions demand a response, and that the need to act is urgent (ECI, 2007). While this effort was not the first such document addressing evangelical environmental concern, the ECI stands out for its boldness in tone, its specificity in addressing climate change, and the broad influence of the signatories on the list—which includes executives from the National Association of Evangelicals, Christian college and seminary presidents, leaders of prominent evangelical non-governmental organizations, and well-known, mega-church pastors. In effect, the ECI helped bring national attention to an emerging movement of evangelical climate activists.

Since 2006 the evangelical environmental movement has continued to proliferate with countless organizations, institutions, and leaders taking up the moral cause elaborated by ECI leaders. In 2008, a group of church leaders signed the Southern Baptist Declaration on the Environment and Climate Change, pledging themselves to respond to the threat of climate change through personal action and teaching “in accordance with our Christian moral convictions and Southern Baptist doctrines” (Merritt, 2008). Renowned climate scientist Katharine Hayhoe co-authored a book in

2009 with her husband Andrew Farley, a Baptist pastor, entitled *A Climate for Change: Global Warming Facts for Faith-Based Decisions*. This was followed in 2010 by EEN founder Jim Ball's *Global Warming and the Risen Lord* and Katharine Wilkinson's 2012 *Between God & Green: How Evangelicals are Cultivating a Middle Ground on Climate Change*. Along with a host of other publications on Christian environmental stewardship, these books have importantly helped make the case for a distinctly Christian response to the problem of climate change.

The evangelical climate movement significantly broadened itself in 2010 when the Lausanne Movement—a global evangelization movement started by Billy Graham and representing Christians in nearly 200 countries—adopted the Cape Town Commitment. This Commitment reaffirmed many traditional evangelical beliefs shared by Christians around the world, but also added explicit language supporting creation care, environmental advocacy, and efforts to address climate change. The document named creation care “as a gospel issue within the Lordship of Christ,” and identified climate change as “probably the most serious and urgent challenge faced by the physical world” (The Lausanne Movement, 2010). This document, which provided bold support for environmental action, has been affirmed by thousands of evangelical leaders, who represented nearly every country in the world. Lausanne teamed up with the World Evangelical Alliance to expand on this work by hosting a creation care follow-up consultation in Jamaica in 2012. The outcome of this meeting included a formal “Call to Action” listing ten specific steps the church should take in relation to environmental stewardship, including “radical action to confront climate change” (Bliss, Cook, Kaweesa, & Ko, 2012).

Other recent, noteworthy advancements include the founding of Young Evangelicals for Climate Action—an advocacy group that continues to attract media attention from both the secular and Christian press—and Climate Caretakers, a campaign to mobilize evangelicals to prayer and action on climate change. In addition, in 2013 more than 200 prominent evangelical scientists issued an open letter calling the U.S. Congress to act on climate change (Ackerman & Boorse, 2013). As a result of these efforts and others, the evangelical climate movement has made important progress in the last 10-15 years. Indeed, despite their skepticism, some researchers have found evangelicals to be not nearly so monolithically opposed to environmental causes as had previously been assumed (Danielsen, 2013; Smith & Johnson, 2010; Smith & Leiserowitz, 2013).

Yet in spite of these progressive efforts many conservative evangelical leaders have strongly opposed such climate advocacy. For example, the Cornwall Alliance has led the way in arming evangelical climate skeptics with a variety of arguments against climate science, and their efforts have proven relatively influential among many conservative evangelicals. Their most recent open letter addressed to “the people, their local representatives, the state legislatures and governors, the Congress, and the President of the United States” has attracted the signatures of more than 300 academics and pastors (Cornwall Alliance, 2015). While this letter admits to human-caused climate change, it argues that the anthropogenic influences are exaggerated, that changes will prove beneficial to humankind, and that continued fossil fuel use remains necessary for alleviating poverty. Many Cornwall arguments seem to revolve around making the case

for free-market economics as the solution to social and environmental problems, thus intentionally linking climate change with political ideology.

Challenges to Engaging Evangelicals on Climate Change

Perhaps more so than other religious groups, evangelical Christians appear to wield considerable political and cultural influence in the United States. This influence often manifests itself in public debates over controversial environmental topics, including climate change. Numerous studies have identified a negative relationship between environmental concern and various aspects of conservative Christian belief (Chesnes & Joeckel, 2013; Eckberg & Blocker, 1989; Eckberg & Blocker, 1996; Guth, Green, Kellstedt, & Smidt, 1995; Hand & Crowe, 2012; Hand & Van Liere, 1984; Sherkat & Ellison, 2007). At the same time, other researchers have found at least some characteristics of conservative Christianity to be positively correlated with environmental concern, including frequency of prayer (Boyd, 1999) and church attendance (Killburn, 2014; Woodrum & Wolkomir, 1997). Specifically related to climate change, many researchers have noted a generally skeptical position on climate change among conservative Christians (Carr, Patterson, Yung, & Spencer, 2012; Fusco, Snider, & Luo, 2012; Kilburn, 2014; Peifer, Ecklund, & Fullerton, 2014). Similarly, Smith and Leiserowitz (2013) found evangelicals to be less likely than non-evangelicals to believe that global warming is happening or caused by humans. Overall, the emerging consensus seems to be that conservative Christianity tends to be associated with reduced levels of environmental concern, and particularly with climate concern. This difficult, and

sometimes antagonistic, relationship creates important obstacles to addressing climate change and other environmental problems.

Given the importance of finding solutions to the problem of climate change, addressing evangelical climate skepticism forms an important priority for American efforts to deal with this issue. Nevertheless, significant challenges continue to hinder efforts to impact evangelical attitudes and beliefs about climate change. These challenges may be grouped into four broad categories—theological conservatism, scientific skepticism, political affiliations, and socio-cultural influences. In order to effectively influence evangelical climate beliefs and attitudes, environmental leaders will need to understand both the barriers and opportunities presented by each of these challenges.

Theological Conservatism

The suggestion that Christian theology may be at least partly to blame for modern environmental destruction goes at least as far back as 1967 with the publishing of Lynn White's essay "The Historical Roots of our Ecologic Crisis." In this seminal work, White argued that the biblical theology of human exceptionalism reveals Christianity's essentially exploitive nature and was ultimately to blame for modern ecological problems. While White's position has received much criticism over the years, scholars importantly credit him with being the first to explore the link between Christian theology and modern environmental behavior (Chesnes & Joeckel, 2013; Nagle, 2008). In support of White's claim, some recent studies have identified a strong correlation between theological conservatism and a reduced concern over environmental issues (Chesnes &

Joeckel, 2013; Hand & Crowe, 2012). Given this connection, several theological principles commonly associated with evangelical tradition complicate efforts to influence climate change beliefs.

The biblical notion of “dominion” represents the first and perhaps most discussed theological principle related to Christian environmental engagement. This concept derives from Genesis 1:28, which states; “And God blessed [humans], and God said unto them, be fruitful, and multiply, and replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth.” (King James Version). Right from the outset of the Bible, this passage grants humans a special status and appears to legitimize the type of anthropocentric exceptionalism posited by White. Statements from organizations such as the Cornwall Alliance seem to buttress White’s argument. For example, their most recent open letter states that by using fossil fuels, “we liberate from the tomb of the earth the carbon dioxide on which plants and therefore all the rest of life depend. This beautifully reveals the Creator’s wisdom and care for all of his creation” (Cornwall Alliance, 2015). Others have used the theological premise of “Imago Dei”—the biblical teaching that humans have been created in God’s image and thus given a unique position above the rest of the created order—to justify a lifestyle leading to abuse of nature (Bryant, 2000). In a qualitative series of focus group interviews on evangelical climate beliefs, researchers found such anthropocentric attitudes common among their participants, though they clarified that this view was moderated by a belief that such special status imputed a responsibility to steward God’s creation (Carr, et al., 2012).

A second theological challenge relates to biblical literalism. Belief in the literal truth of the Bible can complicate efforts to engage Christians on scientific matters, with narrow biblical interpretations leading to assumptions about scientific accuracy or dependability. While Boyd (1999) found no connection between biblical literalism and support for the environment after controlling for demographic variables, others have shown that such a connection may exist specifically when dealing with climate change. For example, Carr et al. (2012) observed the tendency of interviewees to interpret climate data in light of the Bible, even to the extent of using the Bible as a “litmus test” for climate accuracy. They likewise noted that the absence of climate change in the Bible led some participants to assume that it was not an important issue. In an empirical analysis of the 2008 National Election Study, Killburn found biblical literalism to be strongly associated with belief in primarily natural causes of climate change, even after controlling for denominational and political affiliation (2014). Killburn suggests that, given the strength of biblical literalist beliefs, this linkage will likely increase. At the same time, appealing to the biblical basis for environmental stewardship has constituted a key strategy for many evangelical environmental organizations, and may provide a viable alternative for biblical literalists concerned about staying true to their beliefs.

Beliefs about the sovereignty of God form a third barrier. The biblical principle of God’s sovereignty maintains both that God is all-powerful and that nothing happens without his direct permission. Carr et al. found that a common belief in God’s sovereignty inhibited participants from accepting climate science and provided justification for dismissing the idea as “religiously unenlightened hubris” (2012, p. 288). Peifer et al. (2014) found similar results in their interviews with parishioners from two

evangelical churches in Texas, noting that when asked about climate change many participants responded with comments about God's sovereignty. The perspective that nothing could happen without God's permission renders scientific evidence about climate change irrelevant to such individuals, thus enabling a suspension of disbelief regarding the science supporting climate change. In other words, climate change, if happening at all, must be part of God's ultimate plan. Distinguished evangelical theologian Wayne Grudem puts the criticism this way:

It does not seem likely to me that God would set up the world to work in such a way that human beings would eventually destroy the earth by doing such ordinary and morally good and necessary things as breathing, building a fire to cook or keep warm, burning fuel to travel, or using energy for a refrigerator to preserve food (Cornwall Alliance, 2006).

Despite these objections, it should be noted that, while the sovereignty of God may be an indisputable evangelical belief, the implication that God's all-powerfulness precludes human interference with natural systems does not hold universal acceptance. Evangelical climate scientist, Katharine Hayhoe, for example, explains this conundrum by highlighting the theological principle of free will—the idea that God allows humans to make choices, and then face the consequences of those choices (Martin, 2014).

Christian eschatology—theological beliefs regarding future “end-times” events—presents a fourth important barrier to engagement with climate change. One particular strain of eschatological theology called premillennial dispensationalism proves to be especially problematic for Christian environmental concern. The central tenets of this belief (so far as they pertain to climate change) hold that Jesus will soon return to earth, “rapture” all believers to heaven, and then destroy the earth with fire before recreating a new one. Given the temporality of the earth and its destiny for destruction, this line of theology precludes most, if not all, concern regarding climate change. In fact, within this

theological framework, apocalyptic climate scenarios anticipate the rapture, and some adherents could legitimately argue in favor of hastening this destruction. While Nagle (2008) notes that this argument has not been widely made on the larger evangelical stage of opinion, even among climate skeptics, and Wilkinson (2010) doesn't find this objection in her interviews, several other scholars have noted significant correlations between such end-times beliefs and anti-environmental attitudes.

Guth et al. (1995) identified conservative eschatology as the strongest predictor of environmental apathy, and Leduc (2007) found biblical apocalyptic beliefs to be influential in the public understanding of environmental issues. More specifically, Barker & Bearce (2011) found belief in end-times theology to significantly predict opposition to government action on climate change, even accounting for political ideology, and Carr et al. (2012) observed that eschatological beliefs, premillennial and otherwise, reduced concern over climate change. Noting the similarities between end-times beliefs and the secular language of climate apocalypse, Peifer et al. (2014) observed the tendency of interviewees to refer to God's sovereignty in an excuse to dismiss concern. In other words, regardless of the causes and consequences of climate change, Christians have nothing to fear because it all must be part of God's plan. This leads to a total rejection of what is perceived to be secular fear-based posturing, and negates many of the traditional arguments for acting on climate change.

A fifth barrier lies in evangelical fears that engaging with environmental issues may lead some to replace worship of God with worship of the earth. This concern is buttressed by the spiritual connotations of such commonly used environmental terminology as "mother earth," "Gaia," "ecocentric," and even "environmentalism."

Indeed, the fear that well-meaning Christians may wander into pantheism represents an obstacle to evangelical engagement with environmental issues. Carr et al. (2012) found most interview participants to be at least somewhat reluctant to believe in climate change because of this association. Similarly, Peifer et al. (2014) found this concern to dampen evangelical support for environmental issues, with interviewees going out of their way to uphold a “sacred hierarchy” of God, humans, and then the environment. Some conservative leaders go even farther, claiming environmentalism to be a religious force out to attack evangelical Christianity (Cornwall Alliance, 2010). The concept that Christian exceptionalism provides access to unique spiritual privileges undergirds this fear. This perceived threat of a competing environmental religion thus elicits strong reactions from some evangelicals and can serve to effectively block evangelical engagement with climate change (Carr et al., 2012; Simmons, 2009). Evangelical suspicion of the New Age movement and the perceived religious ties between environmentalists and earth worship remain widespread and prevent many evangelicals from taking seriously modern environmental challenges (Simmons, 2009). Moreover, the apparent threat of an environmental religion—with climate activists as the spiritual leaders—moves climate change out of the scientific sphere and makes it into a competing belief system.

While much of the literature about evangelical climate skepticism has focused on theological barriers, a careful analysis of statements made by evangelical climate denial groups shows that most arguments against climate change take place on the scientific and the socio-political levels. In fact, the theological arguments used by both evangelical climate advocates and skeptics reveal striking similarities, with both sides agreeing on the

necessity for careful earth stewardship, the possibility of environmental degradation on account of human sin, and the need to prioritize care for the poor (Nagle, 2008). For example, Carr et al. (2012) found unanimous support for environment awareness and action when stemming from a desire to care for God's creation, and Peifer et al. (2014) found a consistent rhetoric of stewardship in their interviews. The important distinctions here seem to be motivation and moderation, as many interviewees expressed concerns about the perceived motives of non-Christian environmentalists and caution about becoming too extreme. Similarly, in her qualitative focus group research, Wilkinson (2010) noted the conspicuous absence of theological arguments against climate change. These findings suggest that while theological conservatism may influence climate change beliefs, theology alone likely cannot explain evangelical climate skepticism, and it appears that other, underlying barriers may be contributing toward evangelical climate perspectives.

Evangelical Scientific Skepticism

Hulme (2009) points out that because of the intangibility and complexity of many aspects of climate change, most people will need to develop their climate change beliefs based on their general trust in science and other sources of climate change information. This may prove problematic for evangelical Christians, as noted by some scholars, who have attributed their reluctance to accept anthropogenic climate change to a general culture of skepticism toward science (Nagle, 2008; Wilkinson, 2010). Indeed, narrow Christian perspectives on controversial scientific topics, such as evolution and climate change, may thwart productive dialogue between faith and science. As a result many

conservative Christians feel compelled to choose between their religious beliefs and the assertions of science.

This conflict becomes further complicated by the tenuous relationship between evangelical beliefs and certain scientific principles. Writing for the popular evangelical publication *Christianity Today*, Andy Crouch (2005) identifies climate science as a matter of trust because the average individual is incapable of understanding most scientific tools, methods, and calculations. However, this framework of trust becomes problematic for evangelicals when scientific and religious claims appear to conflict. In fact, sociologist John Evans (2011) finds that in such cases conservative Protestants systematically choose to believe in the religious claims, assuming the scientists to have made a mistake. Segmenting out such problem issues enables evangelicals to retain a general faith in science while avoiding compromise on important religious beliefs. The perception of a theological conflict with climate science thus empowers evangelicals to justify their skepticism and to dismiss the scientific evidence as politically or ideologically driven misinformation.

Evans (2011) discards the popular notion that conservative Protestants reject science in general, actually finding them to be equally knowledgeable and involved with science as non-participants of religion. Instead, he attributes conservative Protestant skepticism about scientific claims more to distrust of scientists, rather than of science in general. Evans (2011) found that conservative Protestants wanted to limit the influence of scientists on moral issues, such as evolution and global warming because they didn't trust scientists to be pursuing a moral agenda. Evans and Feng (2013) describe this as a moral competition, thus placing climate change into the same dangerous category as

evolution or stem cell research—scientific agendas to be opposed. These findings are consistent with the research of Kahan, Jenkins-Smith, and Braman (2011) who found that individuals tended to evaluate the trustworthiness of scientific experts in part based on their positions regarding climate change. In other words, individuals tended to trust experts who agreed with their own beliefs about climate change, while distrusting those who disagreed. Put another way, scientists operate on a different value system and therefore cannot be trusted on scientific issues that have moral implications. These studies suggest that mere climate education alone may not solve the problem of evangelical climate skepticism, and that the faith-science divide among conservative Christians derives not from scientific ignorance, but from competing cultural, religious, and ideological beliefs.

At least some evangelical distrust of science appears to be rooted in the creation-evolution debate (Carr et al., 2012; Killburn, 2014; Wilkinson, 2010). On the one hand, evolution and climate change represent clearly different topics. While evolution deals with the question of human origins and the progression of life on earth, climate change addresses the impacts of a particular biogeochemical process in the atmosphere. Yet, despite such differences, climate change and evolution share certain commonalities that could be perceived as threatening to evangelical beliefs—in particular, references to geological timeframes, challenges to divine control of global, historical events, and implications for socio-moral beliefs and worldviews. The underlying association implies that because secular scientists believe in both evolution and global warming, and since evolution is obviously wrong, then global warming must be false as well. While few may make this argument so directly, evolution frequently comes up in discussions about

climate change, and the two remain closely associated in the minds of many evangelicals (Carr et al., 2012; Nagle, 2008). Writing about this connection, Crouch lamented, “perhaps no result of the creation-evolution stalemate is as potentially disastrous as the way it has stymied courageous action on climate change” (2005, p. 66). In his research on the connection between climate change beliefs and biblical literalism, Killburn took this linkage further, suggesting that, like evolution, climate change may be emerging as an “identity-defining belief” for biblical literalists (2014, p. 475). Given the strength of evangelical opposition to evolution, this linkage should generate significant concern for environmental leaders attempting to promote more climate-friendly beliefs among evangelicals.

Political Affiliations

Despite their scientific bases, controversial topics such as evolution and climate change no longer represent matters of science alone for many conservative Christians, but have instead become political battlegrounds. This politicization creates major challenges for evangelicals who have come to strongly identify with the Republican Party. Indeed, the politics of climate change have become deeply split along partisan lines, with Republicans overwhelmingly skeptical of anthropogenic climate change (McCright & Dunlap, 2011; Leiserowitz, Maibach, Roser-Renouf, & Hmielowski, 2011). Evangelical support for conservative and Republican politics has increased over the past several decades (Mead, 2006; Gold & Russell, 2007; Hirschhorn, 2012). In conjunction with this increase, Gold and Russell (2007) showed a weakening independent effect of evangelicism on voting from 1980 – 2004, suggesting a growing convergence between

evangelical and Republican Party identification. Given the pervasive influence of climate skepticism within the Republican Party, such a convergence would have important implications for evangelical climate attitudes, suggesting that climate beliefs may actually be more informed by political ideology, than by theology or science. This finding could also explain the results of Danielsen's (2013) study examining the environmentally related content of three influential, evangelical publications between 1984 and 2010. This study found that discussion of environmental issues had both increased and become more polarized over time. She noted in particular that while early approaches to environmental topics in the 1990's were more theologically focused, since 2004 the discussion had become increasingly political in nature. The findings of Evans and Feng (2013) support this, demonstrating that climate skepticism among fundamentalist Protestants is most directly rooted in age, political conservatism, and Republican Party affiliation than in religious identity or beliefs.

The increasing politicization of climate change may also be seen in the recent public flip-flopping from leaders within both the evangelical and Republican communities. Influential Republican leaders such as John McCain, Mitt Romney, Newt Gingrich, Tim Pawlenty, and Marco Rubio have all changed their positions to become more publicly skeptical of climate change as the issue has become increasingly taboo among GOP voters. Evangelical television personality Pat Robertson likewise followed a similar path. Long derisive of climate change, Robertson publicly declared himself a "convert" to anthropogenic climate change during the unusually hot summer of 2006, a claim that he followed with a 2008 commercial publicly bringing attention to the issue. However, as recently as 2014, Robertson derided belief in global warming as "idiocy,"

claiming it to be part of a socialist agenda to take control of industry (RWW News, 2014). Robertson's change of position demonstrates how climate science has become politically charged for many Christians who see it as a threat to their socio-political worldview. Wilkinson (2010), for example, noted the tendency for evangelicals to associate climate change with liberal politics—with Al Gore personifying the connection. Given his political baggage for many conservatives, Gore's emergence as an international, climate change figurehead may be a key barrier to acceptance of climate science. Peifer et al. (2014) note this association in their interviews. Understanding the political nature of climate change within the church, Evangelical Environmental Network President, Mitch Hescox, regularly describes himself as a life-long registered Republican when speaking in support of climate change action. This technique could hold merit for reaching evangelicals who remain cautious of liberal political associations.

This association comes with important implications for politically conservative evangelicals. During the mid 2000's Richard Cizik, the former Vice President for Governmental Affairs with the National Association of Evangelicals (NAE), attempted to make climate change a more visible part of the NAE agenda. In response to Cizik's efforts, James Dobson and other prominent leaders of the Christian right issued a letter calling for Cizik to be restrained, claiming that he was using "the global warming controversy to shift the emphasis away from the great moral issues of our time, notably the sanctity of human life, the integrity of marriage, and the teaching of sexual abstinence and morality to our children" (CNN, 2007). This statement reveals the pervasive concern among notable Christian leaders that climate change would pull attention away from important conservative political issues. As with Robertson's recent claims about climate

change, the Dobson letter reveals fundamental fears related to the connection between climate change and a politically liberal agenda. Indeed, scholars have noted the tendency for evangelicals to reject environmentalism along with a whole package of other traditionally liberal causes (Danielsen, 2013; Simmons, 2009; Wilkinson, 2010). For politically conservative evangelicals, this linkage places climate change in the same political box as abortion, gay marriage, evolution, and other liberal issues. With such an association, the science of climate change becomes irrelevant as evangelicals are enabled to dismiss the issue as easily as they reject other plans advanced by the political left.

Socio-Cultural Influences

The complex interactions between science, politics, and climate change beliefs have led some scholars to suggest that public divisions over climate change may originate from worldview-driven cognitive styles (Kahan et al., 2012; Lewandowsky, Gignac, & Oberauer, 2013). For example, Kahan suggests “cultural cognition,” which he defines as “influence of group values—ones relating to equality and authority, individualism and community—on risk perceptions and related beliefs” as a tool for understanding political conflict over the credibility of scientific data on climate change (2010, p. 296). In their nationally representative survey, Kahan et al. (2012) found cultural worldviews to be the most significant predictor of climate change risk perceptions, even after controlling for scientific literacy. Specifically, they found that hierarchical individualists—those with high respect for authority and value of personal liberty—rated climate risks significantly lower than egalitarian communitarians—those prioritizing collective attention to personal needs and more equal social structures. The authors did note a correlation between

cultural worldview and political orientation, but explained that their combined effects exceeded the influence of political orientation alone (Kahan et al., 2012). These findings help explain how theological conservatism, scientific skepticism, and political affiliation could work together to form a distinct cultural worldview and frustrate efforts to influence evangelical climate beliefs.

Some scholars have suggested that certain economic worldviews may play an important part in shaping climate change beliefs. Wilkinson's (2010) qualitative research revealed significant evangelical fears of climate change being used as a liberal agenda to advance government regulation and impinge on free-market ideology. Lewandowsky et al. (2013) likewise found free-market economic beliefs and political conservatism to be strong predictors of climate science rejection. This point likewise seems to be a key argument of the Cornwall Alliance—a faith-based public policy group focusing on environmental issues—whose arguments rely heavily on free-market economic beliefs.

Kahan (2013) describes this type of cognitive function as ideologically motivated reasoning, or the tendency of individuals to interpret information through the lens of a specific cultural goal that may not be concerned with the accuracy of the information. Such reasoning works to protect identity and uphold group membership, which Kahan describes as an individually rational approach to risk-related information such as belief in climate change. This motivated reasoning becomes even more important when such beliefs convey social meanings—that is pitting the beliefs of one group against another (Kahan, 2013). Kahan notes that when specific, ideologically motivated positions become associated with a particular affinity group it becomes extremely difficult to change individual beliefs about that position, as doing so would jeopardize the

individual's standing within the group. This appears to be the case with evangelical skepticism about climate change, and could help explain economic objections to climate change given the prevalence of free-market ideological thinking within evangelical circles.

Social norms play an important role in shaping climate behavior and beliefs, with individuals unconsciously forming their climate perspectives to align with those of their peers. To this end, several researchers have pointed toward social norms as a source of influence toward pro-environmental attitudes and behaviors (Ferguson, Branscombe, & Reynolds, 2011; Nigbur, Lyons, & Uzzell, 2010; Rabinovich, Morton, Postmes, & Verplanken, 2012). Others, however, have cautioned that such social norming can swing both ways and sometimes includes negative influences, as well. For example, Schultz, Nolan, Cialdini, Goldstein, & Griskevicius (2007) found that homeowners adjusted their household energy use to fit the average within their community by either increasing or decreasing usage depending on whether they were already consuming above or below average. In their research on norm conformity with climate-friendly behaviors, Masson and Fritsche (2014) demonstrated that while individual behavior may be highly influenced by group norms, this pattern only held when individuals held high levels of self-investment or perceived importance related to the group. The researchers found this to be particularly true when the behaviors were perceived to be "high cost," requiring higher levels of self-investment in order to be influenced by group norms. Bolsen, Leeper, & Shapiro (2014) demonstrated that when others are perceived to be less supportive of climate-friendly behaviors individuals are correspondingly less likely to support such efforts themselves. These findings imply that influencing evangelical

beliefs about climate change may prove particularly difficult given that current social norms within the evangelical community tend to lean toward dismissal of anthropogenic climate change.

The combined effects of theological conservatism, scientific skepticism, political affiliations, and socio-cultural influences appear to have succeeded in lodging climate skepticism within the evangelical tribe mentality—thus creating a formidable barrier to climate education efforts. All appear to impact evangelical opinions about climate change, although the extent to which each influences climate change beliefs has not been fully analyzed. If climate educators hope to influence evangelical climate change beliefs, greater research will need to be done examining the dynamic interactions between these challenges. In order for climate education efforts to be effective, practitioners should carefully consider which of these barriers present the most fundamental challenges to climate beliefs, as well as strategic approaches for how to address these barriers in a constructive manner.

Influencing Evangelical Beliefs on Climate Change

Despite the urgency of finding a solution to the climate change communication problem, I found no empirical studies analyzing the impact of climate change education on evangelicals. Scholarly efforts in this area appear to be either primarily descriptive or correlational studies of the relationship between evangelicals and climate change beliefs. Descriptive research has focused on characterizing the nature of evangelical engagement with climate change by describing the history, barriers, challenges, and opportunities related to evangelical climate beliefs and communication (Danielsen, 2013;

McCammack, 2007; Simmons, 2009). While unable to deliver testable data, these studies have brought valuable context for understanding the topic. Some qualitative research has gone further, providing a more thorough understanding of evangelical perspectives on climate change through interviews and focus groups (Carr et al., 2012; Wilkinson, 2010). These, however, still fall short of providing evidence-based experimental analysis. Many correlational studies have investigated the linkages between specific evangelical beliefs and climate change (Chesnes & Joeckel, 2013; Hand & Crowe, 2012; Killburn, 2014). While these studies have contributed important insights, their reliance on limited survey data renders them insufficient for in-depth causal explanations. Smith and Leiserowitz (2013) provide a rich explanatory analysis that takes into account such factors as cultural worldviews and affective imagery, but still do not address specific educational efforts. Taken together, this body of research has made critical contributions to the literature on evangelical climate perspectives. However, no study has attempted to use empirical evidence to assess the influence of specific climate education programs on evangelical beliefs about climate change.

A broader analysis of the literature on religious, environmental interventions reveals one study that used psychological and ethnological methodologies to determine the impact of a 10-month educational program called the Living Ocean Initiative (LOI) on a diverse group of religious congregations (Warner, Brook, & Shaw, 2012). The program involved faith leaders from 49 congregations who participated in a one-day retreat at the Monterey Bay Aquarium, received a packet of religious environmental education resources, and were encouraged to initiate follow-up activities within their congregations. The faith leaders completed pre- and post-LOI surveys measuring their

religious identity strength, environmental identity strength, and environmental behavior. Results of the initiative were mixed. Warner et al. (2012) concluded that carefully designed religious environmental interventions could increase pro-environmental behavior within local congregations, but likely only for groups with a history of environmental concern. The authors explained this disparity by highlighting the importance of continuity between environmental efforts and previously held religious beliefs and interests. Furthermore, Warner et al. found that religious activities following the LOI emphasized a propensity for ethics-based approaches to environmental work, as opposed to issue-based. This finding echoed Smith and Pulver's (2009) research into the work of 42 U.S.-based religious, environmental organizations, in which they found a strong preference for religious environmentalism grounded in attitudinal, worldview, and lifestyle choices, as opposed to specific environmental issues or public policies.

Unfortunately, Warner et al.'s (2012) study sample included only non-evangelical congregations around Monterrey, California—an area known for its liberal politics and social progressiveness. Given the lack of evangelical representation in the study, the social progressiveness of the northern California culture, and the political liberalness of the region, the applicability of these results to more conservative evangelical audiences remains in doubt. Nevertheless, their study does point to the value of connecting environmental work to the existing social and theological values already present within religious communities. This finding suggests important implications for climate communication efforts with evangelicals, for whom existing beliefs and worldviews hold high social significance.

Looking beyond religiously targeted educational interventions on climate change reveals other studies with a similar focus. For example, one such study assessed the influence of a national entertainment-based educational program on high school students (Flora, et al., 2014). This study evaluated the results of a brief (1-hour) climate education program with high school students, finding significant increases in students' knowledge of climate science, positive engagement with climate, and short-term climate-related behaviors. Flora et al. (2014) demonstrate that brief exposure to a climate education program can influence students' engagement with climate change, at least over the short-term.

Given the lack of literature on experimental interventions with explicitly evangelical groups, evidence-based suggestions for influencing evangelical beliefs about climate change remain elusive. The selective acceptance of scientific principles underscores the uncertainty surrounding controversial scientific topics within the evangelical community, and seems to imply the need for greater education on the science of climate change. However, the efficacy of this "knowledge deficit model" remains problematic. Rather than leading to a convergence of belief in anthropogenic climate change, researchers have demonstrated that higher levels of education (Hamilton, 2011) and scientific literacy (Kahan et al., 2012) actually lead to greater cultural polarization in climate change beliefs. Kahan et al. (2012) explain this polarization as most likely being due to unconscious efforts by individuals to minimize their social risk by interpreting data in light of shared group values and beliefs. Thus it appears that socio-cultural influences may explain some of the reasoning behind evangelical segmentation of threatening scientific issues.

At the same time, other researchers have demonstrated an important connection between climate-specific knowledge and belief in human-caused climate change. Among Australians, Guy, Kashima, Walker, & O'Neill (2014) found a significant correlation between specific climate change knowledge and acceptance of anthropogenic climate change compared to those who were less knowledgeable about climate change. Unlike other studies that have relied on more generalized proxy measures, such as scientific knowledge in general, Guy et al. demonstrate that understanding the causes of climate change leads to a greater willingness to accept the fact that it is occurring. Perhaps more importantly, they found knowledge about climate change reduces the negative influence of individualistic ideology on climate change beliefs. Similarly, Ranney, Clark, Reinholz, & Cohen (2012) found a dramatic increase in climate change acceptance among American survey participants after reading a 400-word description of how climate change works. McCuin, Hayhoe, & Hayhoe (2014) showed similar results through their use of educational interventions among college students at Texas Tech University. These findings suggest that while a generalized knowledge-deficit model may be inadequate for addressing the gap of climate change acceptance in the United States, climate-specific education may hold promise for promoting greater acceptance of anthropogenic climate change.

Because of the complexity of the science behind climate change, the testimony of trusted experts plays a key role in communicating climate change to the public. In spite of the polarizing role that scientific knowledge appears to play in shaping climate change beliefs, multiple studies have shown perceived scientific agreement on climate change to be a powerful predictor of beliefs about climate change, even controlling for worldview

and party affiliation (Ding, Maibach, Zhao, Roser-Renouf, & Leiserowitz, 2011; Lewandowsky, Gignac, & Vaughan, 2012; McCright, Dunlap, & Xiao, 2013). In a nationally representative survey, van der Linden, Leiserowitz, Feinberg, & Maibach (2015) found there to be a significant and causal association between increasing public perception of the scientific consensus and belief in anthropogenic climate change.

These findings have led some researchers to refer to scientific consensus as a “gateway belief,” meaning that it holds important potential for swaying public opinion on anthropogenic climate change (van der Linden, Leiserowitz, Feinberg, & Maibach, 2014). Van der Linden et al. (2014) explain this phenomenon by noting that knowledge of the scientific consensus represents a different type of scientific knowledge. According to a 2012 study, 76% of Americans trusted climate scientists as a source of information on global warming—making them more trustworthy on global warming than other (non-climate) scientists, TV weather reports, the mainstream media, President Obama, or Mitt Romney (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Howe, 2012). This gateway belief approach certainly holds important potential for finding new ways to engage climate skeptics. Nevertheless, as previously noted, evangelicals seem to be particularly distrustful of secular scientists.

While it remains unclear how this distrust may influence evangelical perspectives on climate change, some have suggested that a way around this problem may be to include the perspectives of Christian scientists in the climate conversation (Carr et al, 2012; McCammack, 2007). This strategy would be consistent with the findings of Kahan et al., who recommend that climate educators utilize “culturally diverse communicators whose affinity with different communities enhances their credibility” (2012, p. 734).

This strategic use of trusted experts may help address evangelical concerns about trust, worldview, and socially shared values. In a study addressing American attitudes toward the controversial human-papillomavirus (HPV) vaccination, Kahan noted participants “felt that it is safe to consider evidence with an open mind when they know that a knowledgeable member of their cultural community accepts it” (2010, p. 297). This finding conveys important implications for climate change communication with evangelical Christians—namely, the importance of communicating about climate change in a way that does not threaten existing value systems. While evangelical Christians may be overly skeptical of human-caused climate change, this strategy of engaging trusted scientists who share the same faith foundation and value system appears to hold promise.

Even with recent developments in the evangelical climate movement, numerous challenges continue to impede broad-based evangelical engagement with climate concern. Indeed, one sobering analysis found no evidence for substantive changes in environmental beliefs and behaviors among fundamentalist Christians (a subset of conservative evangelicals) between 1993 and 2010 (Hand & Crowe, 2012). This finding, combined with the many barriers detailed above and the persistent strength of evangelical opposition to climate advocacy, calls into question the efficacy of current efforts to influence evangelical climate beliefs and attitudes. More importantly, the lack of empirical data measuring the impact of climate education efforts with evangelicals reveals an important omission from the literature on climate change education and indicates a critical area of study that could contribute to important advances in efforts to influence climate change beliefs in one key demographic of the American public.

The Role of Misconceptions

Misconceptions about the causes, effects, and evidence for climate change present a significant barrier to effective public engagement with this issue. While the scientific literature presents a clear case for anthropogenic climate change, numerous misconceptions remain widespread and pervasive among the general public. Such confusion stems from many different sources, with much of it coming from the popular news media. One study done by the Union of Concerned Scientists (2014) found 30% of CNN's coverage and 72% of Fox News' coverage of climate science to be "misleading." The journalistic tendency to present "both sides," of an issue may unintentionally exacerbate this problem by lending the appearance of scientific support for such misconceptions. Numerous scholars have noted the prevalence of important misconceptions related to climate change understanding among college students (Huxster, Uribe-Zarain, & Kempton, 2015; Manolas & Filho, 2011; Versprille & Towns, 2015). Such misconceptions hold true even for college students concerned about climate change (Wachholz, Artz, & Chene, 2014), suggesting that misconceptions represent an important area to be addressed in climate education efforts.

The widespread public argument over such topics as natural cycles, the influence of the sun, the scientific consensus, impacts on the poor, etc. demonstrate an important disconnect between public understand of climate change and the scientific data. Such misconceptions hinder individuals' ability to engage with climate change in an effective manner because they prevent the development of new knowledge (Manolas & Filho, 2011). This suggests the need to address common climate misconceptions in order to create new foundations upon which to build knowledge of climate change. While

numerous scholars have warned against using this type of knowledge-deficit approach to climate education (Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008; Hamilton, 2011; Kahan et al., 2012), there is some reason to hope that such a strategy may hold value for dispelling common misconceptions.

In their assessment of a reading-based intervention, McCuin, Hayhoe, & Hayhoe (2014) found that a misconceptions-based approach to climate education resulted in greater understanding of the greenhouse effect and global warming. The authors concluded that specifically addressing misconceptions was more effective at promoting conceptual change on the topic of the greenhouse effect and global warming compared to traditional instruction. In a similar study involving undergraduate students, Heddy and Sinatra (2013) demonstrated that carefully designed teaching techniques on the topic of evolution can result in conceptual change regarding students' beliefs on evolution. The study demonstrated that a transformative and experiential teaching model on evolution results in higher levels of conceptual change when compared to a group receiving a more conventional teaching technique. Nevertheless, the comparison group, which relied on a refutational style of instruction that sought to address common misconceptions about evolution, still demonstrated a significant positive effect on knowledge acquisition (Heddy & Sinatra, 2013). Other researchers have similarly supported this approach of directly addressing evolutionary misconceptions as an effective tool for promoting education on evolution (Foster, 2012; Nelson, 2008). Given the parallels between evolution and climate change within evangelical circles, these findings may provide valuable insight into climate communication among evangelicals. Likewise, as previously noted, other researchers have demonstrated that climate-specific education can

promote greater agreement with anthropogenic climate change (Guy et al., 2014; McCuin, et al., 2014; Ranney et al., 2012).

In spite of these studies, the efficacy of addressing common climate change misconceptions as an instructional tool aimed at influencing evangelical climate beliefs has not been examined. The results of similar strategies used by evolutionists, as well as those of some climate educators, suggest that addressing misconceptions may provide an alternative to the knowledge-deficit approach. This study aims to explore this possibility by comparing the results of identical presentations with or without climate misconceptions.

Live versus Recorded Lecture

The type of educational intervention employed in this study—flying a content expert thousands of miles to lecture for one hour—necessitates a relatively large environmental footprint and could thus be said to be inherently unsustainable or even counterproductive. This begs the important question of whether it is prudent to utilize such methods even should they prove effective in influencing climate change beliefs. Indeed, many scholars have noted no significant difference in terms of knowledge retention among students participating in recorded lectures versus those who attended equivalent live versions (Ellis & Mathis, 1985; Schreiber, Fukuta, & Gordon, 2010; Solomon, Ferenchick, Laird-Fick, & Kavanaugh, 2004). These findings seem to support the premise that a digital lecture on climate change could accomplish the same purpose as a live lecture, without causing undue carbon pollution, assuming the same number of students would attend.

Nevertheless, such studies on students' knowledge retention from recorded lectures tend to focus on the dissemination of content within the classroom setting and do not address optional lectures offered outside the classroom experience. Additionally, the research on the effects of live versus recorded lectures does not take into account the controversial nature of topics such as climate change, nor the persuasive intent of a lecture designed to influence beliefs about climate change. Some researchers have found that, when given the option of live versus recorded lectures, most students prefer the live format (Ward, Garrett, & Marsh, 2006; Schreiber et al., 2010). Ward et al. (2006) echoed the above results regarding equivalent test performance, though they interestingly found that 77% of students perceived themselves to have tested better on material presented by a live instructor.

Overall, there remains a lack of comparative research assessing the relative influence of live versus recorded lectures for outside the classroom educational lectures. Similarly, it remains unknown whether a particularly controversial topic such as climate change might be viewed differently depending on the physical presence of a content expert. Given the delicacy of climate change within the evangelical community and the importance of using trusted experts to communicate the information, this study hypothesizes that a live lecture will actually result in a greater change in students' beliefs regarding climate change. This hypothesis is based on the nature of the topic and the fact that attendance at the lecture is entirely optional.

Chapter III

Methods

Despite some understanding of the influences on evangelical climate change beliefs and attitudes, there exists very little empirical research assessing the impacts of efforts to affect these perspectives. Additionally, it remains unclear whether specifically addressing common misconceptions about climate change, or whether a live vs. a recorded presentation, will result in a significant difference in beliefs for this population. My study addresses these gaps of knowledge by providing quantitative data on the changes in participants' beliefs about climate change after participating in one of three educational interventions. This was accomplished by using pre- and post-treatment surveys to measure the specific climate change beliefs of evangelical, undergraduate college students. The importance of this study rests both in the value of the data gathered from the research, but also in the novelty of the study design and focus, which appears to be, so far as I can tell, the first attempt to evaluate the influence of a climate change intervention intentionally designed for faith-based audiences.

Research Location

This research study took place at Houghton College, a Christian liberal arts college located in rural, western New York. Houghton is affiliated with the Wesleyan Church and is a fairly typical evangelical school. Houghton's 1,000 students represent 41 states and 31 foreign countries, though the majority of students come from the mid-

Atlantic region. Houghton students come from 30 different Christian denominations—primarily those within the evangelical, Protestant tradition. Students tend to be predominantly white, middle-income, largely conservative (both politically and theologically), and between the ages of 18 and 22. While not frequently discussed, the prevailing narrative on campus regarding climate change seems to be one of skepticism. Houghton has placed an increasing emphasis on environmental sustainability throughout the past six years, though many students remain largely unaware of these efforts. For example, one internal assessment of an educational program performed by the author in fall 2013 found most first-year students to be relatively uninformed about creation care issues, and open, but skeptical, regarding the topic of climate change. This study took place in February 2014.

Participants

Participants for the research study were recruited voluntarily from among the general Houghton College undergraduate student population. Participants self-selected into the research study by registering through an online consent form. All participants were at least 18 years of age or older. The procedures for student recruitment may be found in the “Procedures” section below.

A total of 128 students agreed to participate in the research study. Of these, 116 completed the pre-treatment survey. 91 participants completed both the pre- and post-treatment surveys, though three of these were rejected—one for not listing their treatment group and the others for not taking the surveys within the required timeframe. Altogether, n=88 students completed all three required activities (the pre-treatment

survey, the treatment, and the post-treatment survey), and were therefore included in the final analysis. Of the 88 participants there were 31 from the live treatment group, 27 from the recorded treatment group with misconceptions, and 30 from the recorded treatment group without misconceptions. Demographic characteristics of the 88 participants were as follows:

- Gender:
 - Male = 24
 - Female = 63
- Year at Houghton:
 - 1st year = 38
 - 2nd year = 15
 - 3rd year = 16
 - 4th+ year = 19
- Academic major (participants could select more than one):
 - Natural Sciences & Mathematics = 31
 - Humanities (Art, Music, English, Writing, and Languages) = 24
 - Intercultural Studies = 18
 - Social Sciences (History, Political Science, Psychology, Sociology, and Recreation) = 13
 - Education = 8
 - Communication = 8
 - Undecided/Interdisciplinary = 8
 - Business and Accounting = 7

- Denominational background:
 - Nondenominational/Other Evangelical = 31
 - Wesleyan/Holiness (including Salvation Army, Christian & Missionary Alliance and Free Methodist) = 13
 - Mainline Protestant (including Presbyterian, Lutheran, Episcopalian, Anglican, United Methodist, etc.) = 13
 - Other Christian = 12
 - Baptist = 8
 - Roman Catholic = 5
 - Charismatic/Pentecostal = 3
 - Other non-Christian/none = 2

- Political ideology:
 - Very conservative = 7
 - Moderately conservative = 34
 - Neither liberal nor conservative = 21
 - Moderately liberal = 17
 - Very liberal = 7

- Political party identification:
 - Strongly Republican = 5
 - Moderately Republican = 32
 - Neither/Independent = 27
 - Moderately Democrat = 9
 - Strongly Democrat = 3

The median study participant was a female, first year student in the natural sciences or mathematics, coming from a nondenominational Christian background, and politically leaning slightly toward the right. It is worth noting that three times as many participants identified as Republicans compared to Democrats. While not surprising, this finding provides valuable background information for interpreting the study results—particularly given the strongly negative relationship between Republican Party identification and climate change beliefs. Surprisingly, 23% - 36% of participants do not come from an evangelical background—the range due to the non-specific “Other Christian” category. All participants, however, have been immersed in the milieu of evangelical culture through their experience at Houghton College.

Procedures

Participants were recruited from among the general Houghton College student body population using standard advertising techniques commonly employed by programming staff looking to attract student participation in college events or activities. These methods included public poster displays (see Appendix C), two recruitment emails sent to all students, two live announcements at the start of chapel, and voluntary announcements by some faculty members at the beginning of their classes. Campus-wide emails were sent directly from the researcher. All faculty members were asked if they would be willing to make an announcement in their classes and were provided with a script. Chapel announcements were given by a student volunteer and were fully scripted. Recruitment began three weeks prior to the intervention with poster placement and the first campus-wide email. The other recruitment efforts were spread out over the course

of two weeks, with recruitment concluding 8 days before the intervention. All recruitment took place on the Houghton College campus or via electronic communication with Houghton students.

Students registered to participate in the study by agreeing to an online consent form, which gathered their name, email address, and notice of consent. The link to this form was provided in all electronic communication. In addition, public computers with browsers open to the consent form were placed in a common traffic area of the campus center building in order to facilitate ease of registration. Oral recruitment efforts directed the potential participants to contact the researcher directly for the consent form or to use the public computers in the campus center. Upon receiving their consent to participate a confirmation email was sent to the participant's email address in order to verify their registration. In addition, participants were asked to electronically re-confirm their consent to participate at the start of both the pre- and the post-treatment surveys. In order to incentivize participation six participants were randomly selected using a random number generator at the conclusion of the research study to each receive a \$25 gift card. This incentive was communicated in all recruitment efforts.

One week prior to the treatment all participants received a personal email assigning them to their randomly proscribed treatment group, explaining the treatment procedures, and containing instructions and a link for completing the pre-treatment survey. Participants were sent a follow-up email two days later—five days prior to the treatment—reminding them to take the pre-treatment survey prior to the start of the treatment. Another email was sent the evening before the treatment to remind the participants of their treatment group and instructions for participation. Immediately

following the treatments all participants were sent a link to the post-treatment survey and were asked to complete the survey before 11:00 a.m. on the following day when the same speaker would be presenting in chapel. Participants submitting late survey responses (after the start of the treatment for the pre-treatment surveys and after the start of chapel for the post-treatment surveys) were excluded from the research study.

All three treatments took place in different locations on the Houghton College campus. The treatments took place simultaneously in order to control for any one treatment influencing the outcome of another. A Houghton College faculty member was present at each of the treatments to give a formal introduction to the speaker and, in the case of the recorded versions, to ensure there were no technical problems with the recordings.

In addition to the quantitative data gathered from the surveys, I held three follow-up focus group discussions aimed at providing a richer contextual analysis to the treatments. The focus groups were held three weeks after the intervention, with each group including only participants from the same treatment. Due to technical problems, the audio-recorded data from these focus groups was lost prior to transcription. As a result, no remaining data exists from the focus groups, and this information has thus been excluded from the research analysis and discussion.

Instructional Content

Dr. Katharine Hayhoe, a prominent evangelical climate scientist and director of the Climate Science Center at Texas Tech University, presented all three lectures. Dr. Hayhoe is known, not only for being a highly qualified scientist, but also a world-class

communicator on climate issues. Her presentational style reflects a warm personality, an academically serious, yet light-hearted manner, and a genuine integration of faith and science. Each lecture incorporated a PowerPoint presentation with graphic visuals, text, charts and graphs, and even a few humorous images. For the recorded lectures, Dr. Hayhoe alternated the video image of herself speaking with a representation of her PowerPoint slides. Each slide was left on the screen long enough for participants to read any included text and thoroughly examine all charts or graphs.

The three presentations varied somewhat in length due to the nature of the experiment. The first treatment (the live lecture) lasted 52:41; the second treatment (recorded with misconceptions) lasted 43:51; and the third treatment (recorded without misconceptions) lasted 33:21. The reason for the time difference between treatments two and three is obvious, as the third treatment intentionally omitted a 10-minute portion of the presentation to test whether specific information about misconceptions played a role in influencing climate change beliefs. While the first and second treatments used the same lecture slides, the live lecture proved to be 9 minutes longer than the recorded version. This difference is due primarily to the human tendency to elaborate before a live audience as compared to a virtual presentation. For example, the live version included extra ad-lib examples of key points, several side stories, and additional elaboration on some points. While this could pose a material difference, the core content remained the same between treatments one and two, and the extra elaboration merely provided additional examples rather than making new points.

The lectures followed a 4-point outline plus a short introduction and conclusion. During each section Dr. Hayhoe posed a key question then proceeded to answer with

specific examples. During her introduction, Dr. Hayhoe began by discussing the difference between faith and science, highlighting the notion that faith is based on things spiritually discerned, whereas science is based on observation. The first section then asked the question “is climate changing?” This section began by discussing the difference between weather and climate. Dr. Hayhoe went on to discuss the importance of understanding variability and then presented evidence for a changing climate, including rising global temperatures, precipitation changes, changing growing seasons, stronger storms, retreating glaciers, large-scale crop losses, etc.

The second section addressed “why is climate changing?” The first part of this section included the 10-minute piece on misconceptions that was excluded from treatment #3. This portion focused on three common misconceptions about climate change—that it is caused by variability in the sun’s energy output, by long-term natural cycles, or by long-term changes in the earth’s orbit. For each of these examples, Dr. Hayhoe explained why we might think these “usual suspects” could be the cause of climate change. She then provided scientific data explaining how each of them couldn’t explain current observations based on conflicting evidence. The second part of section #2, which was included in all three treatment groups, made the case for anthropogenic climate change. Dr. Hayhoe explained how the greenhouse effect works and how human activity is enhancing this process, primarily through the emission into the atmosphere of greenhouse gases such as carbon dioxide and methane, thus warming the earth. She also explained the history of climate science and detailed the scientific consensus around anthropogenic climate change.

The third section asked, “Why care?” In this section, Dr. Hayhoe explained how our society is founded on the assumption of a stable climate, and she discussed real world impacts of climate change that are happening today including heat waves, health impacts, extreme precipitation events, rising sea levels, natural disasters, etc. She went on to discuss the concept of climate justice—that nations that have done the least to contribute to climate change are feeling the most significant impacts from it. Finally, she tied these arguments into her faith by stating that Christians are compelled to care about climate change because of the biblical call to “love our neighbors here and on the other side of the world.”

The fourth section took these questions to a practical level by asking, “what can we do?” Starting with the statement that our choices today will impact our world tomorrow, Dr. Hayhoe both presented a variety of specific actions to take, but also a generally recommended attitude toward climate change. Quoting 2 Timothy 1:7 from the Bible, she explained that Christians should not adopt a spirit of fear, but instead should use power, love, and sound mind to address the problem of climate change. She provided several personally applicable examples of how to act on climate change, plus some larger scale solutions. Finally, she concluded by stating that faith and science, while different, are both necessary for solving climate change. She then provided several biblical passages in support of earth stewardship.

Pre- and Post-Treatment Surveys

Survey collection was performed using Survey Monkey—an online survey tool. Participants completed a pre-treatment survey during the week prior to the lecture and a

post-treatment survey immediately after the lecture. The surveys employed a user-generated anonymous ID in order to match pre- and post-treatment surveys to a specific individual while still maintaining participant anonymity. Participants were clearly informed that they must use the exact same ID in order to enable pre- and post-survey matching. Exact wording for these instructions, along with a full copy of the surveys may be found in Appendix A and Appendix B. IP addresses were accidentally recorded in survey responses, but were immediately deleted in order to preserve anonymity.

Survey questions fit into three different types of groupings. Seven demographic questions asked about gender, year at Houghton, student major, denominational background, citizenship, political ideology, and political party affiliation. Five additional questions asked about participants' beliefs on topics that have been correlated in other studies with climate change beliefs. The correlated-belief questions were added in order to identify potentially confounding or intermediary variables. These questions asked about participants' beliefs regarding the truth of the Bible, the origin of the world, free market ideology, the relationship between truth and science, and the influence that their pastor's beliefs' might play in forming their own opinions about climate change. An analysis of these correlated-belief questions has not been included in this research study, but will provide the content for future research. Both the demographic questions and the correlated-belief questions were only asked on the pre-treatment survey, as it was assumed they would not change on account of the treatment.

The core content for the research study relied on nine questions specifically addressing participants' climate change beliefs. The first seven climate change questions were taken directly from "Climate Change in the American Mind" by Leiserowitz,

Maibach, Roser-Renouf, Feinberg, & Howe (2013). These questions form the basis for the Six America's screening tool used by the Yale Project on Climate Change

Communication in numerous studies, and are as follows:

1. Recently, you may have noticed that global warming has been getting some attention in the news. Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world's climate may change as a result. What do you think: Do you think that global warming is happening?
2. [If yes to #1] How sure are you that global warming is happening?
3. [If no to #1] How sure are you that global warming is not happening?
4. Assuming global warming is happening, do you think it is...
 - a. Caused mostly by human activities
 - b. Caused mostly by natural changes in the environment
 - c. Caused by both human activities and natural changes
 - d. None of the above because global warming isn't happening
 - e. Other
5. Which comes closest to your own view?
 - f. Most scientists think global warming is happening
 - g. Most scientists think global warming is not happening
 - h. There is a lot of disagreement among scientists about whether or not global warming is happening
 - a. Don't know enough to say
6. How worried are you about global warming?

7. How much do you agree or disagree with the following statement: I could easily change my mind about global warming?

The final two climate change belief questions were adapted from the same study by Leiserowitz et al. (2013) and ask:

1. How much do you think global warming will harm...?
 - a. You personally
 - b. People in the United States
 - c. People in developing countries
 - d. Future generations of people
2. Do you think addressing global warming should be a low, medium, or high priority for each of the following:
 - a. You personally
 - b. Houghton College
 - c. Christians in general
 - d. The U.S. President and Congress

The survey was tested for readability and clarity during the semester prior to the research study. This test run was used on graduating seniors who would not be present on campus during the time of the research study, and thus would not be participating in the actual study. The test found no significant problems with question design or clarity, and resulted in only a few minor changes in wording.

Chapter IV

Results

This chapter presents the comparison of the pre- and post-treatment survey results for each of the three groups and for the overall total of all subjects. The first section discusses the survey questions, including details about how they were coded and how they were used for the analysis. The subsequent sections address each of the three hypotheses using data from the survey questions and appropriate statistical analysis. Because the surveys utilized ordinal data, nonparametric tests were chosen to provide statistical analysis. H1 was analyzed using the Wilcoxon Signed-Ranks Test. The second and third hypotheses were analyzed using the Mann-Whitney Test.

Survey Questions and Coding

Of the nine climate-related questions in the surveys, three were coded together as part of the same question and one other question was not analyzed, leaving six questions that were ultimately used in the statistical analysis. These six questions were used to test each of the three hypotheses.

Is Global Warming Happening?

The first question addressed whether the participant believed global warming to be happening by combining responses from three different questions into a single coded variable. After recording their response to the question “do you think that global

warming is happening?” the survey used skip logic to direct them either toward “how sure are you that global warming is happening?” or “how sure are you that global warming is not happening?” Participant responses were coded into a 9-point scale ranging from (1) “extremely sure” global warming is not happening to (9) “extremely sure” global warming is happening. Participants who answered, “do you think that global warming is happening?” with “don’t know” were coded as (5) and were not asked the follow up question about certainty.

What Causes Global Warming?

The second question asked; “assuming global warming is happening, do you think it is...” then offered the following responses (3) “caused mostly by human activities,” (2) “caused by both human activities and natural changes,” and (1) “caused mostly by natural changes in the environment.” “Other” and “none of the above because global warming isn’t happening” were also offered, but received no responses.

Is There a Scientific Consensus on Global Warming?

The third question asked “which come closest to your own view?” Responses included (3) “most scientists think global warming is happening,” (2) “there is a lot of disagreement among scientists about whether or not global warming is happening,” (1) “most scientists think global warming is not happening,” and (not coded) “Don’t know enough to say.” “Don’t know enough to say” received five responses and was excluded from analysis.

How Worried are you about Global Warming?

The fourth question asked “how worried are you about global warming?” Responses included (4) “very worried,” (3) “somewhat worried,” (2) “not very worried,” and (1) “not at all worried.”

How much do you Think Global Warming Will Harm...?

The fifth question was a matrix of four sub-questions and asked, “How much do you think global warming will harm...?” The four sub-questions were “you personally,” “people in the United States,” “people in developing countries,” and “future generations of people.” Responses included (4) “a great deal,” (3) “a moderate amount,” (2) “only a little,” (1) “not at all,” and (not coded) “don’t know.” Only one “don’t know” response was recorded, and this response was excluded from analysis. Participant responses to each of the four sub-questions were summed to create a single coded variable between 4 and 16 to generate an overall scale of perceived harm from global warming.

Priority of Addressing Global Warming

The final question was a matrix of four sub-questions and asked, “Do you think addressing global warming should be a low, medium, or high priority for each of the following?” The four sub-questions were “you personally,” “Houghton College,” “Christians in general,” and “the U.S. President and Congress.” Responses included (1) “low,” (2) “medium,” and (3) “high.” Participant responses to each of the four sub-questions were summed to create a single coded variable between 4 and 12 to generate an overall scale of perceived importance of addressing global warming.

Results for H1 using Wilcoxon Signed-Ranks

Because the surveys utilized ordinal data it was therefore determined that the data failed to meet the assumption of having an equal-interval scale. As a result, the Wilcoxon Signed-Ranks test was chosen as an appropriate nonparametric option to test for H1. The Wilcoxon Signed-Ranks test avoids the problem of not having an equal-interval scale by focusing on the direction between the pre- and post-treatment surveys to determine whether there is a significant difference. The raw data results for both the pre- and post-tests for all three treatment groups were included in the analysis.

The results indicate a significant difference between the pre- and post-test measures for all groups on all six assessed questions, with all questions pointing toward an increase in pro-climate beliefs (Table 1). The questions were coded such that smaller numbers indicate anti-climate beliefs while larger numbers indicate pro-climate beliefs. Thus, the negatively signed-ranks demonstrate an increase in pro-climate beliefs, as reflected by all six questions (Figure 1). These findings are consistent with H1 that a carefully constructed educational intervention about climate change will result in significant increases in pro-climate beliefs among evangelical college students.

Table 1. Descriptive statistics for all treatment groups using Wilcoxon Signed-Ranks.

Survey Question	W	N _{s/r}	z	P
Is global warming happening?	-895	44	-5.22	< 0.0001
What causes global warming?	-552	40	-3.71	0.0001
Is there a scientific consensus on global warming?	-297	27	-3.56	0.0002
How worried are you about global warming?	-1084	47	-5.73	< 0.0001
How much do you think global warming will harm...?	-1976	68	-6.04	< 0.0001
Priority of addressing global warming	-1245	54	-5.36	< 0.0001

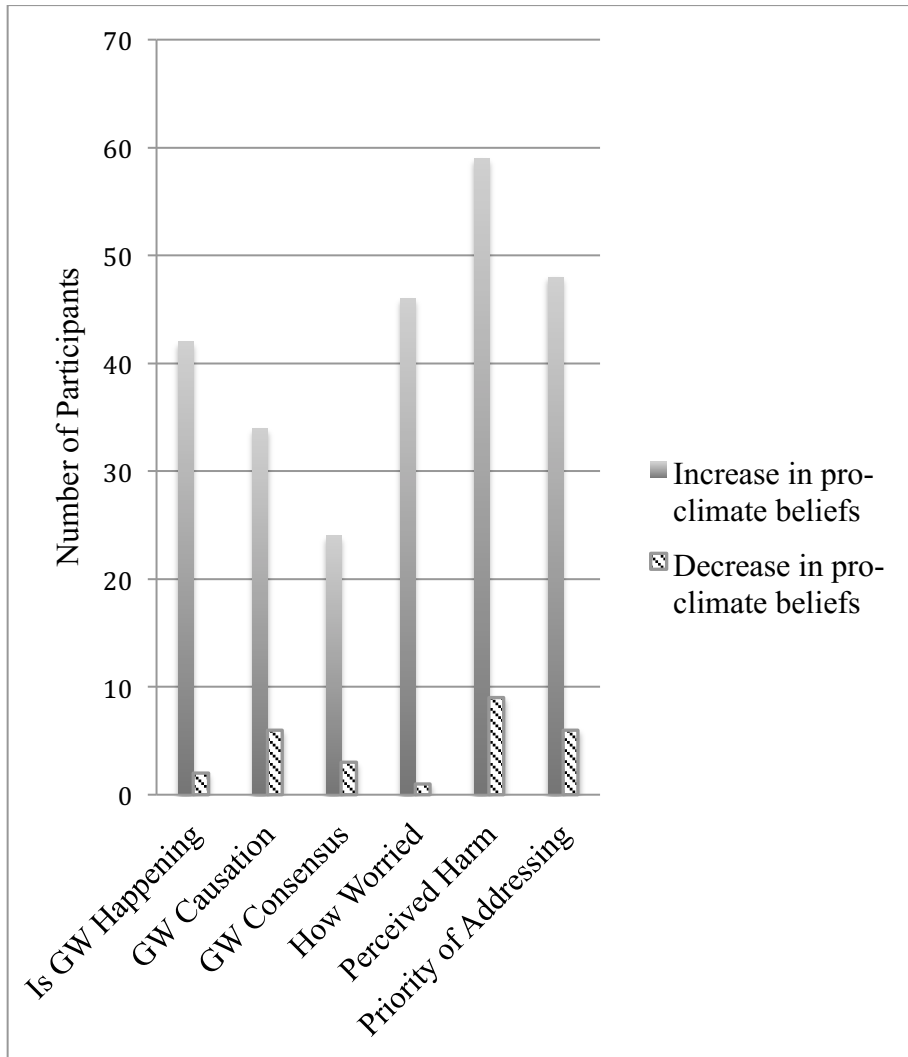


Figure 1. Direction of movement from pre-test to post-test regarding participants' climate change beliefs for each of six assessed questions.

Results for H2 using Mann-Whitney

The Mann-Whitney test was selected to test H2, which hypothesized that a presentation addressing common misconceptions about climate change would result in a greater increase in pro-climate beliefs compared to one without information on misconceptions. Mann-Whitney is designed to test the significance of the difference between independent samples. For H2 the two samples include treatment groups two (T-

2, recorded version with misconceptions) and three (T-3, recorded version omitting misconceptions). In order to compare the difference between T-2 and T-3 the Delta values between the pre- and post-tests were used in the analysis.

The results indicate no significant difference between T-2 and T-3 on five of the six questions (Table 2). As for the question, “is global warming happening?” the results indicate a significant difference at the $p < 0.05$ level, but in the opposite direction from the hypothesis, with T-3 (no misconceptions) showing a greater increase in pro-climate beliefs than T-2. Thus, the results of each of the research questions do not provide support for H2.

Table 2. Descriptive statistics for T-2 and T-3 using Mann-Whitney.

Survey Question	Mean ranks for T-2	Mean ranks for T-3	U_a	z	P
Is global warming happening?	33.3	25.1	288	1.86	0.0314
What causes global warming?	28.9	29.1	407	-0.02	0.4920
Is there a scientific consensus on global warming?	25.6	32.1	497	-1.46	0.0721
How worried are you about global warming?	29.1	28.9	401.5	0.05	0.4801
How much do you think global warming will harm...?	28.3	29.7	425	-0.31	0.3783
Priority of addressing global warming	31.3	26.9	343	0.98	0.1635

Results for H3 using Mann-Whitney

H3 hypothesized that a live presentation would result in a greater increase in pro-climate beliefs compared to an equivalent recorded version. Mann-Whitney was again used to test for H3 by comparing treatment groups one (T-1, live lecture) and two (T-2,

recorded lecture). In order to compare the difference between T-1 and T-2 the Delta values between the pre- and post-tests were used in the analysis.

The results indicate no significant difference between T-1 and T-2 on five of the six questions (Table 3). As for the question of perceived harm, the results indicate a significant difference at the $P < 0.05$ level in the direction hypothesized, with participants attending the live lecture demonstrating a larger increase in perceived harm from global warming. Thus, five of the six questions fail to provide support for H3, while the question of perceived harm appears to provide support for H3.

Table 3. Descriptive statistics for T-1 and T-2 using Mann-Whitney.

Survey Question	Mean ranks for T-1	Mean ranks for T-2	U_a	z	P
Is global warming happening?	28.1	31.1	461	-0.65	0.2578
What causes global warming?	27.6	31.7	477.5	-0.91	0.1814
Is there a scientific consensus on global warming?	32.3	26.3	332	1.34	0.0901
How worried are you about global warming?	29.6	29.3	414	0.06	0.4761
How much do you think global warming will harm...?	26.1	33.4	525	-1.65	0.0495
Priority of addressing global warming	28.5	30.7	451	-0.50	0.3085

Summary of Results

The results demonstrated support for H1 with the combined data of all three treatment groups showing a significant change in global warming beliefs, moving in the direction of an increase in the pro-climate beliefs among the subjects. This influence is demonstrated through signed-rank analysis and may be seen in all six questions regarding belief in the existence of global warming, its causation, the scientific consensus, personal

concern over the issue, the perceived degree of harm caused by global warming, and perceived priority of addressing global warming. For all questions participants' belief in, and concern over, global warming increased.

Second, the analysis found no statistical support for H2, that addressing common misconceptions about climate change would result in a greater increase in pro-climate beliefs, for any of the six assessed questions. In fact, the question "is global warming happening?" found opposing evidence, demonstrating a significantly ($P = 0.0314$) greater increase in pro-climate beliefs among the group without misconceptions.

Third, the analysis found mixed, though primarily negative results for H3, which stated that a live intervention would result in a greater increase in pro-climate beliefs. One of the six questions (perceived harm caused by global warming) found a significant ($P = 0.0495$) increase in the pro-climate beliefs among those attending the live lecture. However, the other five questions found no significant relationship between the two treatment groups.

The results of this study do not provide causal evidence for the influence of educational interventions on the climate change beliefs of evangelical college students. However, they do provide data to support the first hypothesis, to reject the second, and mixed results for the third. In addition, the results point to several important implications, as well as some limitations and opportunities for future research. Each of these will be discussed in detail in the next section.

Chapter V

Discussion

This chapter puts the findings of the research into context by discussing each hypothesis with regards to both the current results and the pre-existing literature. This will be followed by a general discussion of the implications of the research, research limitations and opportunities for future research. Finally, a conclusion will bring together the most salient findings of the research.

Discussion of Hypotheses

The primary hypothesis (H1) of this research states that a carefully constructed educational intervention will result in significant increases in pro-climate beliefs among evangelical college students. By using signed-rank analysis on six survey questions the research findings demonstrate a significant change in participants' climate beliefs following an educational intervention on climate change. These results are significant across all six assessed questions and point toward an increase in pro-climate beliefs and concern among the participants. While the research design does not allow for a causal analysis, the data affords significant results that are consistent with H1 and which demonstrate a measurable change in participants' beliefs about climate change following an educational intervention.

Comparisons between these findings and others in the literature remain limited given the lack of research on the influence of climate change interventions among

religious participants. However, expanding the scope of climate education efforts reveals consistency with the results of other studies. For example, several studies have shown reading passages focused on climate education to be effective at producing conceptual change in participants' beliefs about and understanding of climate change (Guy, et al., 2014; McCuin et al., 2014; Ranney et al., 2012). The current research extends these findings by demonstrating a similar increase in pro-climate beliefs based on participation in a lecture-based instructional intervention. Similarly, a study of high school students found a significant increase in pro-climate beliefs and behaviors after participating in a 1-hour climate education program (Flora, et al., 2014). Despite limited empirical data on the influence of religious climate change interventions, the results of this study remain consistent with previous research assessing the influence of climate education efforts among secular audiences. In addition, a broader look at the literature points to two important findings that could provide additional insight into these results.

Several studies have shown that consensus messaging—demonstrating the scientific agreement on climate change—influences climate beliefs in a positive direction (Ding, et al., 2011; Lewandowsky, et al., 2012; McCright, et al., 2013). Some have even referred to consensus messaging as a “gateway belief” for influencing opinions about climate change (van der Linden, et al., 2014). The presentations used in this research study devoted approximately two and a half minutes to establishing the scientific consensus on climate change through both verbal lecture and visual graphics. While the influence of consensus messaging was not independently analyzed, previous research would suggest that its influence on the current study would likely be in a positive

direction. Thus the observed increase in pro-climate beliefs would be consistent with the research on consensus messaging.

Second, based on focus group interviews, some researchers have proposed that using Christian experts to communicate climate change to evangelicals may be effective at influencing their climate beliefs (Carr et al., 2012; Wilkinson, 2010). Kahan's research (2010) on cultural cognition supports such suggestions by demonstrating that ordinary people evince greater trust in experts who share their same cultural values when confronted with controversial scientific issues. The current research model was designed specifically to account for these findings by incorporating a speaker whose religious background and values corresponded with those of the audience. To accentuate such shared religious values, the speaker included biblical text and spiritual commentary in the presentation, while employing theological language commonly accepted within evangelical circles. As with consensus messaging, the effect of this element has not been measured independently. Nevertheless, the resulting increase in pro-climate beliefs shows consistency with what would be expected based on the above research.

Unlike with the first hypothesis, the research failed to provide support for H2, which hypothesized that presenting participants with information specifically addressing common misconceptions about climate change would result in a greater increase in pro-climate beliefs compared to those not receiving such information. Using the Mann-Whitney test, the analysis found no statistical difference between T-2 and T-3 for five of the six questions, including global warming causation, the scientific consensus, personal concern over the issue, the perceived degree of harm caused by global warming, and perceived priority of addressing global warming.

The other question, “is global warming happening?” did show a significant difference ($P = 0.0314$), with participants in the group omitting information about misconceptions demonstrating a larger increase in pro-climate beliefs (Figure 2). The direction of this difference runs opposite that predicted by the hypothesis.

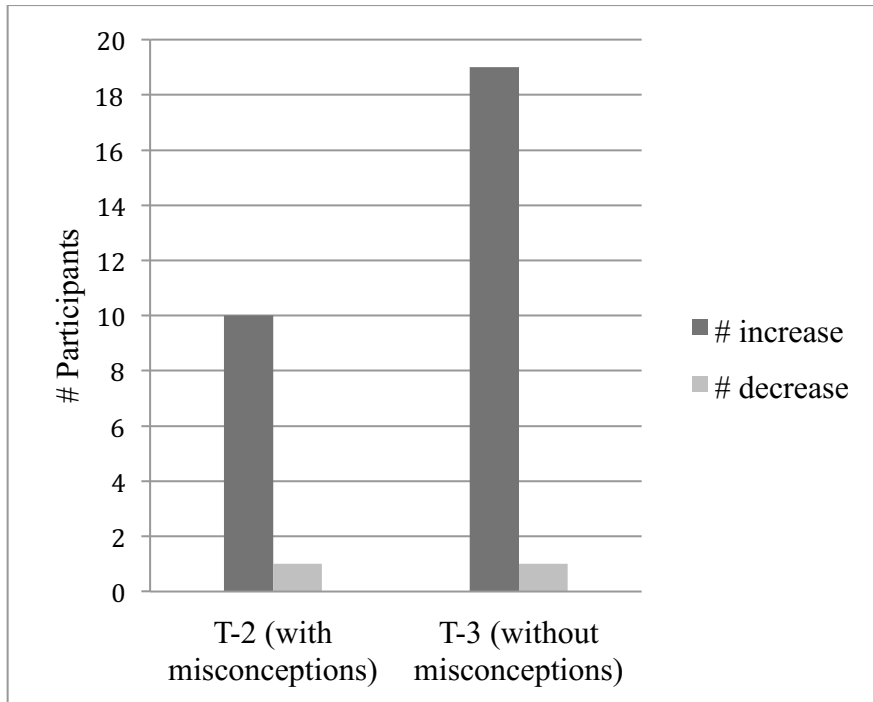


Figure 2. Changes from pre-test to post-test for T-2 and T-3 participants related to the question of “is global warming happening?”

This result represents a potentially important finding, but should be interpreted with caution for several reasons. First, as seen in Figure 2, both treatment groups saw large gains in pro-climate beliefs compared to the number of decreases. Second, whereas 44% of T-2 participants (12 of 27) answered the pre-test as being “extremely sure global warming is happening,” just 13% of T-3 participants (4 of 30) answered the pre-test with this response. As a result T-2 had much less room for an increase in pro-climate beliefs

compared to T-3 given the higher number of participants starting already at the top. Third, none of the other five questions demonstrated a significant difference between the treatment groups. Finally, because this study used 18 different statistical tests a higher significance level of $P < 0.01$ may be necessary to avoid a Type 1 error. There remains the possibility that a presentation addressing common misconceptions could result in fewer increases in belief in the existence of global warming. However, given the above points, such a conclusion should be viewed cautiously until other research can provide additional data. Regardless, for this study, explicitly responding to and refuting misconceptions did not result in increased pro-climate beliefs, and, for at least one question, may have negatively influenced pro-climate beliefs.

Overall, these results conflict with the general findings of McCuin et al. (2014), which demonstrated that specifically addressing misconceptions led to greater knowledge about global warming and the greenhouse effect. Several reasons could explain this discrepancy. First, psychological research has revealed several common backfire effects common to climate education efforts. These include that hearing a myth debunked can result in greater familiarity, that too many arguments against a myth can be counterproductive, and that strong, opposing worldviews can cognitively bias participants toward rejecting conflicting information (Cook & Lewandowsky, 2011). Of these, competing worldviews would seem to be the most likely explanation for any backfire effect in view of the conservative background of the participants. However, this explanation seems limited given the fact that each treatment group saw many more increases in pro-climate beliefs compared to decreases.

Another possible explanation may be found by comparing the differences between McCuin et al.'s (2014) delayed post-test and pre-test scores. The authors found that, unlike with all other categories of questions, for questions explicitly using the term “global warming,” a misconceptions-based instruction method resulted in smaller gains in knowledge when compared with a traditional instruction method. The authors attributed this to the worldview backfire effect mentioned above. This finding holds importance for the current study, which utilizes the term “global warming” in all survey questions. If, as McCuin et al. seem to have found, the term “global warming” holds a moderating effect on any additional gains from misconceptions-based instruction, this could explain the lack of support for H2 in the current study.

A third explanation could relate to the influence of consensus messaging, which has been shown to influence climate change beliefs (Ding, et al., 2011; Lewandowsky, et al., 2012; McCright, et al., 2013). It remains possible that gains in pro-climate beliefs that might normally be attributed to a misconceptions-based approach could have already been achieved through education about the scientific consensus. Further support for this explanation could be derived from the results of the survey question asking about scientific consensus. Fully 71 out of 83 participants indicated on the post-test that most scientists agree that global warming is happening, demonstrating a high level of acceptance of the scientific consensus for all treatment groups. Whether or not scientific consensus rendered instruction about misconceptions unnecessary remains unknown, but could form a possible explanation given its influence on climate beliefs and the relatively high participant responses to this question.

Finally, as mentioned in the discussion of H1, the use of a culturally appropriate communicator has been shown to be effective at influencing beliefs regarding controversial scientific topics (Kahan 2010). As with consensus messaging, the speaker's perceived shared cultural values could have masked any influence that addressing misconceptions would normally have had on the participants' beliefs.

The third hypothesis asserted that a live version of an educational intervention on climate change would result in a greater increase in the pro-climate beliefs of evangelical college students compared to an equivalent recorded version. As with H2, the findings of the current study mostly failed to support H3, with the exception of one question. Using the Mann-Whitney test, the analysis found no statistical difference between T-1 (live) and T-2 (recorded) for five of the six questions, including the existence of global warming, its causation, the scientific consensus, personal concern over the issue, and perceived priority of addressing global warming.

The other question, which asked how much global warming would harm four different groups of people, did show a significant difference ($P = 0.0495$), with participants in the live group demonstrating a larger increase in pro-climate beliefs (Figure 3). However, as mentioned in the analysis for H2, this study used 18 different statistical tests, and a significance level of $P < 0.05$ may not be adequate to avoid a Type 1 error. Given that this question does not meet the higher standard of $P < 0.01$, along with a lack of significance from any of the other five questions; I've nevertheless chosen to reject H3. In conclusion, for this study the physical presence of the communicator did not appear to influence participants' beliefs about climate change on at least five of the six questions, and with debatable results for the other question. The lack of a clear

overall influence can be visualized by comparing the mean ranks of T-1 to T-2 on the six assessed questions (Figure 4).

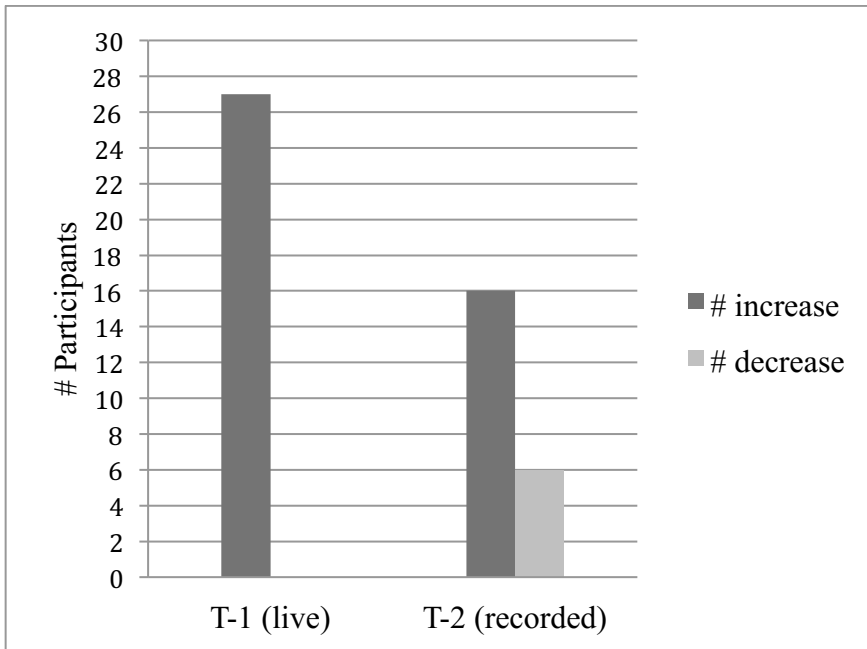


Figure 3. Changes from pre-test to post-test for T-1 and T-2 participants related to the question of perceived harm caused by global warming to four different populations.

While numerous studies have been conducted on the influence of an instructor's physical presence during classroom instruction, little research has been done on optional, extra-classroom instruction, such as a visiting guest lecture. This hypothesis was largely experimental in nature, with the goal of testing the role of physical presence for such guest lectures. Given the optional nature of the presentation and the controversial nature of the content, it was thought that the live presence of a communicator might yield greater influence on participants' beliefs about climate change. This assumption was based on research that demonstrated student preference for live presentations over recorded versions (Ward, et al., 2006; Schreiber et al., 2010).

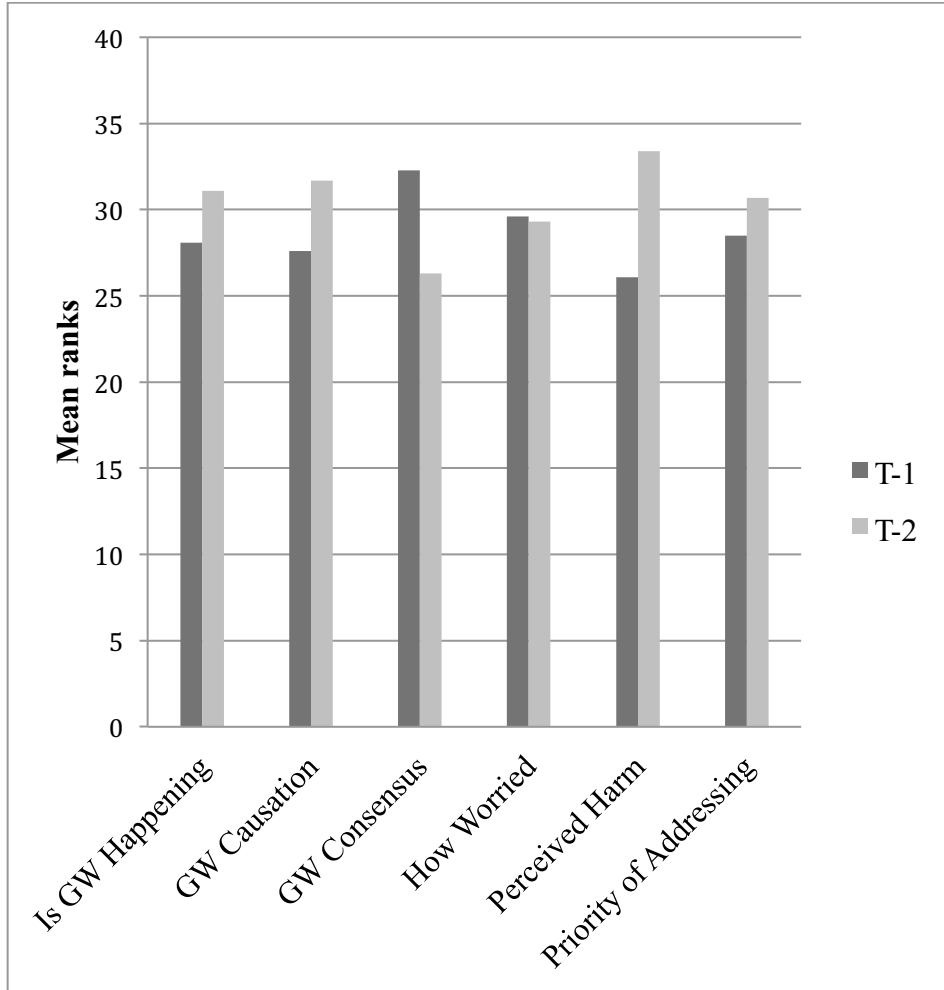


Figure 4. Mean ranks for changes in participants' pro-climate beliefs for T-1 and T-2 on all six assessed questions.

Instead, the research demonstrated consistency with other studies which found no significant difference in knowledge retention between live and recorded lectures inside a classroom setting (Ellis & Mathis, 1985; Schreiber, et al., 2010; Solomon, et al., 2004). The rejection of H3 therefore extends their work to demonstrate that physical presence of the communicator in an optional, extra-classroom lecture does not necessarily influence

participants' climate change beliefs more effectively than a recorded video by the same presenter, given that the two presentations (i.e., slides and commentary) are the same.

What remains to be seen, however, is the role that an instructor's physical presence may have in attendance at such lectures. With the current research, physical presence of a guest lecturer was not examined since participants knew they were being randomly assigned to either an in-person or recorded lecture. Part of the attraction in attending optional lectures by guest speakers is the opportunity to meet the individual in person. Without such an opportunity, event planners may find attendance lower, though this remains to be tested.

Limitations and Future Research

This research contains several important limitations. First, the lack of a control group prevented the researcher from identifying causal relationships between the interventions and the outcomes. While the results for H1 demonstrate statistical significance in a direction that is consistent with the primary hypothesis, no claims to a causal relationship may be made from the data. A control group was originally planned, but later dropped in an effort to maximize the sample size for the other treatment groups. Another reason for dropping the control had to do with the desire for all students to have the opportunity to take part in the lecture.

Further research should consider including a control group in order to test for a causal relationship between climate change interventions and evangelical climate beliefs. Should sample size remain a concern, future studies could replace one or both of the recorded lectures (T2 or T3) with the control group. Given the limited significant

findings for either H2 or H3, there appears little need to replicate the recorded versions of the lecture. Instead, the research could focus on the role of live educational interventions.

Second, the study's small sample size limits the statistical significance of the findings. With no more than 31 participants per treatment group, larger changes between pre- and post-test responses are needed in order to demonstrate a significant effect. This limitation probably did not affect H1, which assessed the combined effect of all three treatment groups, but could have influenced the results of H2 or H3, each of which compared individual treatment groups against each other. Sample size was acknowledged to be an important limitation from the beginning. With only 1,000 total students, obtaining a large sample of voluntary participants was never really an option. Nevertheless, taking advantage of other recruitment methods could have increased sample size somewhat. Replicating this study at other evangelical colleges could help increase the sample size, thereby adding robustness to the findings.

Third, the research was designed to assess a convenience sample of self-selected students at an evangelical college. For obvious reasons, self-selection limits the diversity and size of the population and also risks selection bias. The within-subjects analysis used pre- and post-surveys to determine the influence of the intervention on each participant. This helped minimize the negative influence of potential selection bias by demonstrating quantifiable effects for each individual. Nevertheless, self-selection limits generalizability by reducing diversity. Theoretically, this could have been addressed by linking the study to a specific course or group of courses, but this would have added other limitations and wasn't practically an option anyway.

Another important limitation to generalizability stems from the fact that the study population was composed entirely of students at one particular liberal arts college. Thus the participants share certain commonalities, including similar experiences, age, beliefs, geography, etc. While a key goal of the research was to explore the influence of climate education on evangelicals, targeting a specific college student audience prevents the findings from being applied to broader evangelical populations. A suggestion for future research would be to replicate the study in a more diverse evangelical context, such as at a church.

The three previous limitations (small, self-selected sample size lacking in diversity) could be addressed simultaneously by simply replicating the research methodology at other evangelical colleges. This would both expand and diversify the sample size, while leading to greater generalizability of the findings. Indeed, in conjunction with Dr. Hayhoe, the researcher has already begun planning follow-up studies at other evangelical colleges in order to broaden the findings.

A fifth limitation has to do with response bias. Since the research relies on self-reported answers concerning personal, subjective beliefs, it remains subject to the possibility of biased responses. In particular, given the nature of the treatment—a lecture clearly intended to move the audience toward increased pro-climate beliefs—the social desirability bias presents an important concern. The social desirability bias recognizes that some participants may respond with the socially desirable response to survey questions in order to be perceived as responding appropriately. Knowing that they are “supposed” to be moving toward pro-climate beliefs could on its own influence participants in that direction, regardless of their actual opinion on the topic. The study

sought to minimize this effect by keeping participants' responses anonymous and by clearly communicating their anonymity to participants.

Sixth, it remains unknown whether the observed changes in participants' climate change beliefs will persist over time or whether their responses were merely short-term change of opinion. This limitation could be addressed with a delayed post-test to follow up on participants' beliefs at a later point in time. Future opportunities should consider this as an option to provide additional understanding about long-term influences.

Finally, while not necessarily a limitation, one noteworthy opportunity for future research would be to assess the influence of the speaker's perceived shared values on participants' climate beliefs. Given the strength of socio-cultural influences on evangelicals' climate beliefs, as well as the findings of Kahan's (2010) research, this approach could yield highly valuable information. Structuring such research to limit the addition of other variables may be complicated, though, and should be done carefully. One suggestion may be to present two versions of the same lecture; one including cultural and religious identifiers and language and the other without such elements.

Implications

The results of this research reveal important implications for climate education efforts among evangelicals. First, the study demonstrates that a carefully designed educational intervention on climate change can influence evangelicals toward an increase in pro-climate beliefs. Given the relative influence of evangelicals in American cultural and political discourse, as well as their current skepticism toward climate change, this finding holds tremendous import. Furthermore, it affirms the efficacy of climate

education efforts, such as those frequently undertaken by educators such as Dr. Hayhoe, and suggests that expanding such efforts may prove effective.

A second implication of the research suggests that specifically addressing common misconceptions about climate change may not be necessary in order to influence climate change beliefs. While further research may help shed additional light on this finding, the results of the current study indicate misconceptions-based instructional methods to be at best no more effective than instruction omitting misconceptions. In order to avoid potential backfire effects, climate communicators may therefore want to limit time spent discussing misconceptions during educational programs. Importantly, these findings imply that other elements of the presentation likely proved more valuable for influencing participants' beliefs. Of particular interest for future research would be to assess the roles of shared cultural values and consensus messaging among evangelical audiences.

Third, this research demonstrates no significant difference at the $P < 0.01$ level in climate beliefs based on participation in a live vs. recorded presentation. This implies that the physical presence of the communicator may not be necessary in order to influence climate change beliefs. Given the carbon footprint associated with such guest lectures—which often involve long distance air travel by a content expert—this finding holds important value. However, caution should be exercised when considering the full implications of substituting in-person lectures with recorded versions. In particular, research should be done to assess how such a change may impact lecture attendance and participant learning. Indeed, the possibility of meeting and interacting personally with the speaker may be an important driver in mobilizing attendance at such lectures. In

addition, many such educational programs include other avenues for interaction outside the lecture, such as meals with the speaker, casual interactions before or after the talk, guest appearances in classroom settings, or other speaking opportunities. Each of these additional interactions hold potential to further influence the climate beliefs of those participating.

In summary, this research suggests that investing in educational efforts to influence the climate change beliefs of evangelical college students can produce effective results.

Conclusions

As seen in the literature, numerous obstacles challenge efforts to influence evangelical beliefs on climate change. Nevertheless, a burgeoning evangelical climate movement seems to be gaining traction and holds potential for effecting positive change. This study assessed the influence of a common method employed by climate educators—using a stand-alone climate education lecture to influence beliefs.

The results of this research demonstrate that a lecture-based educational intervention can influence the climate change beliefs of evangelical college students. The research found a significant increase in pro-climate beliefs on all six measured questions, including; the existence of global warming, it's causation, the scientific consensus, concern for global warming impacts, perceived harm from global warming, and the priority of addressing global warming. This study demonstrates consistency with other research (Flora et al., 2014; Guy, et al., 2014; McCuin et al., 2014; Ranney et al., 2012), while extending the findings to a new demographic—evangelical Christians.

Alternatively, the research found no support for misconceptions-based instruction having an additional positive influence on climate beliefs. The data demonstrated no significant effect for the interaction between the group receiving instruction about misconceptions and the group omitting such instruction on five of six questions. For the other question, the research found evidence that misconceptions-based instruction may actually limit increases in pro-climate beliefs. This finding, however, is only significant at the $P < 0.05$ level. Given the lack of significance for any of the other five questions and the large number of tests used during this analysis, this result could fall within random variability. While the findings related to H2 conflict with those of McCuin et al. (2014), possible explanations for this discrepancy include potential backfire effects, the loaded nature of the term “global warming,” or masking effects from other aspects of the presentation, such as consensus messaging or the use of a culturally contextual communicator.

Similarly, the research found no significant effect at the $P < 0.05$ level for the difference between the group participating in a live lecture compared to the group participating in a recorded version of the same lecture. While this result does not coincide with the research hypothesis, it is consistent with other research demonstrating the same effect for classroom-based instruction (Ellis & Mathis, 1985; Schreiber, et al., 2010; Solomon, et al., 2004).

In conclusion, this research demonstrates that climate education programs targeting evangelicals can be effective at influence beliefs. Moreover, the research also shows that neither instruction about misconceptions nor the physical presence of the communicator plays an important role in such changes. These results provide an

important contribution to the literature, which has been notably lacking in quantitative analysis on the efficacy of climate education efforts among evangelical audiences. Indeed, this study appears to be the first to quantify the influence of an educational intervention on evangelical climate beliefs. While providing a valuable starting point for extending existing research into this demographic, the findings nevertheless leave numerous opportunities for future research. Given the urgency of addressing climate change and the influence of evangelicals in American politics, one can only hope that this and future studies continue to shed light on such educational efforts.

Appendix

Pre- and Post-Treatment Survey Text

Please create an Anonymous User ID. This ID will enable me to match participants' pre- and post-treatment survey responses while still maintaining your anonymity. It is critically important that you use the exact same ID for both the pre- and post-surveys.

To generate your Anonymous User ID, please follow this pattern. Do not use spaces, punctuation, or capital letters. Enter "un" for unknown if any of the prompts are not known.

- 2-digit birth month (e.g. "09")
- First two letters of mother's Maiden name (e.g. "sm" for Smith)
- First two letters of city of birth ("ho" for Houghton)

Example: "09smho"

1. What is your gender?
 - a. Female
 - b. Male
2. What is your current year at Houghton?
 - a. 1st year
 - b. 2nd year
 - c. 3rd year

- d. 4th year or more
3. Under which of the following broad academic categories is your major located?
- (Please select all that apply)
- a. Business and Accounting
 - b. Communication
 - c. Education
 - d. Humanities (including Art, English, Writing, and Languages)
 - e. Intercultural Studies
 - f. Music
 - g. Natural Sciences and Mathematics
 - h. Social Sciences (including History, Political Science, Psychology, Sociology, and Recreation)
 - i. Theology and Philosophy (including Bible)
 - j. Undecided/Interdisciplinary
4. Which of the following Christian denominations do you most identify with in your personal spiritual experience?
- a. Wesleyan/Holiness (including Salvation Army, Christian & Missionary Alliance and Free Methodist)
 - b. United Methodist
 - c. Baptist
 - d. Charismatic/Pentecostal
 - e. Nondenominational
 - f. Other Evangelical

- g. Mainline Protestant (including Presbyterian, Lutheran, Episcopalian, Anglican, etc.)
 - h. Catholic
 - i. Other Christian
 - j. Other non-Christian/none
5. Generally speaking, how would you describe your political beliefs?
- a. Very liberal
 - b. Moderately liberal
 - c. Neither liberal nor conservative
 - d. Moderately conservative
 - e. Very conservative
6. Are you a citizen of the United States?
- a. Yes, and I have never resided outside the United States except for brief trips of less than one year
 - b. Yes, and I have resided outside the United States for at least one year of my life
 - c. No
7. [If a. or b. to #6] Generally speaking, do you tend to identify more with the Democratic Party or the Republican Party?
- a. Strongly Democrat
 - b. Moderately Democrat
 - c. Neither/Independent
 - d. Moderately Republican

- e. Strongly Republican
8. Which of these statements comes closest to describing your beliefs about the Bible?
- a. The Bible is the actual word of God and is to be taken literally, word for word.
 - b. The Bible is the inspired word of God but not everything in it should be taken literally, word for word.
 - c. The Bible contains important moral precepts, but should not be taken as the word of God.
9. Which of the following views comes closest to your beliefs about the origins of the world?
- a. God created the world as it currently exists, and there have been no major evolutionary changes over time.
 - b. God created the world and may have used such methods as the Big Bang or long-term evolutionary changes.
 - c. The world is the product of purely natural forces, such as the Big Bang and evolution.
10. A free market system is an economic system characterized by limited government intervention, private property rights, and where economic activity, such as wages and prices, is determined solely by the forces of supply and demand. How much do you agree or disagree with the following statements?
- a. An economic system based on free markets unrestrained by government interference automatically works best to meet human needs.

- b. The free market system may be efficient for resource allocation but it is limited in its capacity to promote social justice.
- c. The preservation of the free market system is more important than localized environmental concerns.
- d. The free market system is likely to promote unsustainable consumption.
 - i. Strongly Agree
 - ii. Somewhat Agree
 - iii. Unsure
 - iv. Somewhat Disagree
 - v. Strongly Disagree

11. Thinking of the senior pastor or youth leader at your home church, how important would his/her views on climate change be to you?

- a. Very Important
- b. Somewhat Important
- c. Unsure
- d. Somewhat Unimportant
- e. Very Unimportant

12. Which of the following statements most closely describes your view of truth in science?

- a. Science is concerned with objective facts that are either correct or incorrect.
- b. Science is comprised of theories that are widely supported by experimental evidence, yet cannot be definitely proven.

- c. Science is based on human interpretation of data and frequently cannot be trusted.

[The post-treatment survey omitted questions #1-12, beginning with question #13]

13. Recently, you may have noticed that global warming has been getting some attention in the news. Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world's climate may change as a result. What do you think: Do you think that global warming is happening?

- a. Yes
- b. No
- c. Don't know

14. [If yes to #13] How sure are you that global warming is happening?

- a. Extremely sure
- b. Very sure
- c. Somewhat sure
- d. Not at all sure

15. [If no to #13] How sure are you that global warming is not happening?

- a. Extremely sure
- b. Very sure
- c. Somewhat sure
- d. Not at all sure

16. Assuming global warming is happening, do you think it is...
- a. Caused mostly by human activities
 - b. Caused mostly by natural changes in the environment
 - c. Caused by both human activities and natural changes
 - d. None of the above because global warming isn't happening
 - e. Other
17. Which comes closest to your own view?
- a. Most scientists think global warming is happening
 - b. Most scientists think global warming is not happening
 - c. There is a lot of disagreement among scientists about whether or not global warming is happening
 - d. Don't know enough to say
18. How worried are you about global warming?
- a. Very worried
 - b. Somewhat worried
 - c. Not very worried
 - d. Not at all worried
19. How much do you agree or disagree with the following statement: I could easily change my mind about global warming.
- a. Strongly agree
 - b. Somewhat agree
 - c. Somewhat disagree
 - d. Strongly disagree

20. How much do you think global warming will harm...?

- a. You personally
- b. People in the United States
- c. People in developing countries
- d. Future generations of people
 - i. A great deal
 - ii. A moderate amount
 - iii. Only a little
 - iv. Not at all
 - v. Don't know

21. Do you think addressing global warming should be a low, medium, or high priority for each of the following:

- a. You personally
- b. Houghton College
- c. Christians in general
- d. The U.S. President and Congress
 - i. Low
 - ii. Medium
 - iii. High

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