Changing evangelical minds on climate change

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Abstract

One quarter of Americans self-identify as evangelical and a strong majority of these reject human-induced climate change. Can one lecture on climate science from a Christian perspective change their minds? Here, we examine the response of undergraduates at three evangelical institutions, located in upper state New York, Texas, and Canada, to a recorded lecture by an evangelical climate scientist. Pre/post-test surveys posed six questions from the Global Warming’s Six Americas instrument with additional questions on participants’ political and theological perspectives. All populations showed significant pre/post-test gains on almost every question, immediately after the intervention, with gains among the most conservative population being as large as the others. A one-month delayed post-survey showed that gains were still significant relative to pre-test values for most of the questions. Furthermore, gains did not decrease when the Christian frame was removed, except on one item related to Christian responsibility. These results suggest that even a limited exposure to accurate information can change minds, and that the context in which the information is presented (here, the evangelical college and faculty sponsor) may be more important than the content frame.

Introduction

In the United States, political affiliation is the primary predictor of the extent to which individuals accept that climate is changing due to human activities and are concerned over the potentially serious impacts (Leiserowitz et al 2018). This holds true for the general public as well as science teachers (Plutzer et al 2016), and grade 6–20 educators from regions across the country (McNeal et al 2014b). Even in Canada, there are significant differences regarding climate change acceptance between those who self-identify as Conservative versus Liberal, NDP, or Bloc Quebecois (Lachapelle et al 2014, Poushler 2016).

One quarter of Americans self-identify as evangelical (Lifeway Research 2017). Some evidence suggests that an overwhelming majority of them supported the Republican presidential candidate in the 2016 election (Bailey 2016), although this is contested by some (Carter 2016). At the same time, they overwhelmingly reject anthropogenic global warming (Chesnes and Joekel 2013, Arbuckle and Konisky 2015, Branch et al 2016). This is seen in the Cornwall Alliance’s ‘Evangelical Declaration on Global Warming,’ signed by many evangelical theologians, church leaders, and some scientists (Cornwall Alliance 2009), intended to move evangelicals away from worrying about climate change. Some researchers have found that the linkage between religious beliefs and dismissal of anthropogenic climate change is not necessarily causal (Schmitt 2014, Ecklund et al 2017). Rather, political ideology may lead to this rejection, which is then seemingly justified with Christian theology4. However, it is the strong correlation between US evangelical beliefs and rejection of climate science that forms the basis for this study evaluating the efficacy of targeted interventions with this group.

Studies indicate that less than 60 min of intervention with undergraduate students can change their minds. It has been shown that gains were still significant relative to pre-test values for most of the questions. Furthermore, gains did not decrease when the Christian frame was removed, except on one item related to Christian responsibility. These results suggest that even a limited exposure to accurate information can change minds, and that the context in which the information is presented (here, the evangelical college and faculty sponsor) may be more important than the content frame.

4 Seemingly, because such justifications are directly contradicted by statements from a wide range of Christian leaders, from Pope Francis (Pope Francis 2015) to the US National Association of Evangelicals (National Association of Evangelicals 2015) and the World Evangelical Alliance (World Evangelical Alliance 2015).
understanding of climate change (McCuin et al 2014, McNeal et al 2014a, Rannay and Clark 2016, Gil 2017). When the intervention was more intensive, significant gains persisted two years later (Burkholder et al 2017). One study examined the effect of a controlled intervention specifically on students at Houghton College, an evangelical institution in rural, western New York (Webb and Hayhoe 2017). After either attending a live lecture or viewing a nearly identical recorded lecture on climate change by an evangelical climate scientist who framed a discussion of the science, impacts, and solutions within the context of Christian stewardship and concern for our global neighbors, students displayed significant pre-post gains in their understanding and acceptance of human-induced climate change and the need for solutions. This last study, while illuminating, raised a number of questions. Would students at evangelical colleges with populations that were more politically conservative show similar pre-post gains after the same presentation? Would these gains persist? And to what extent were gains influenced by the Christian frame and identity of the presenter, as opposed to the content or the context of the presentation?

Method

To address the questions raised by our previous study, we conducted a series of experiments with undergraduate students at two other evangelical undergraduate institutions with similar theological positions to that of Houghton College, but one which we assumed might be more politically conservative (Dallas Baptist University (DBU) in Dallas, TX, and one in Canada (Tyndale University College in Toronto, Ontario), using the same survey and recorded lecture as used at Houghton College. The recorded lecture was very slightly revised for the colleges in Texas and Ontario, to make some of the impacts more relevant to their geographic areas. Three studies were conducted at DBU, giving us five groups to compare in total: Houghton (February 2015, 88 participants), Tyndale (October 2015, 47 ps), DBU1 (November 2015, 51 ps), DBU2 (March–April 2016, 67 ps), and DBU3 (March 2017, 109 ps). The DBU2 participants also completed a delayed post-survey a month later.

Survey

The survey consists of two sections (appendix A). The first includes demographic questions (gender, year of study, major), religious questions (Christian denomination, beliefs about the Bible, beliefs about origins, influence of senior church pastor or youth leader), and political/economic questions (citizenship status, political beliefs, political party identification, views on the free market). Questions in the second section of the survey were taken from Global Warming’s Six Americas surveys (Leiserowitz et al 2011). They include six questions about global warming (appendix A, #13–20, where answer categories for each question are also given):

1. Is the climate changing?
2. Why is the climate changing?
3. Why should we care?
4. What can we do about this problem?

Intervention

The 44 min recorded lecture was originally made for the study at Houghton College in February 2015 (see appendix B for an outline). Its introduction and conclusion present the difference between faith and science, and refer to Biblical verses on the stewardship of God’s creation and on loving our neighbor as ourselves (i.e. caring for the global poor, likely to be most impacted by climate change). The rest of the lecture presents relevant scientific data, suitable graphs, and photos, around these four topics:

1. Is the climate changing?
2. Why is the climate changing?
3. Why should we care?
4. What can we do about this problem?

For the Canadian experiment, some of the US-specific information on climate impacts was replaced with an equal amount of Canadian-specific information in the video. For the last study groups at DBU, to assess the impact of the Christian frame of the recorded lecture, the 44 min recorded lecture was edited down to 38 min by removing all Christian and Biblical references, found principally in the introduction and conclusion. We also removed the identification of the presenter as an evangelical. Since shortening the recorded lecture at Houghton College by a larger amount (10 min), by removing explanations of common misconceptions, had not significantly affected the pre-post gain achieved there (Webb and Hayhoe 2017), we
felt that the 6 min difference in length in the DBU3 study was not a critical factor, allowing us to focus on the effect of removing the Christian frame in this last study.

Population
At Tyndale, as at Houghton, participants were recruited with in-class and across-campus invitations, a promise of being anonymous, and a small incentive of winning a book coupon. At DBU, participants were enrolled in a non-science majors biology course, in three different semesters. No incentive for participation was offered, but class time was given, and anonymity was maintained. Very few participants at Tyndale (4%) and DBU (4%) were enrolled in a science or mathematics major, unlike at Houghton where more than a third were (36%). Almost all participants at Houghton (94%), Tyndale (98%), and DBU (99%) viewed the Bible as either ‘the actual word of God and is to be taken literally,’ or that ‘it is the inspired word of God but not everything it should be taken literally’ (appendix A). Three quarters of participants at Houghton (72%), Tyndale (77%), and DBU (71%) were female. Most participants at Tyndale were in their first year (70%), whereas at DBU and Houghton, participants were spread across the four undergraduate years (41% in their first year at DBU, 43% in their first year at Houghton). For some analyses, participants who were non-citizens of the country (<6%), or had left a question blank, such as the one on political party identification (<10%) or scientific consensus on climate change (<22%), were excluded. This somewhat reduced the number of participants for those analyses. (The tables include the number of participants in each analysis.)

Timeline
The four new studies took place between October 2015–March 2017. (The original Houghton study had taken place in February 2015.) All pre-test surveys were completed approximately a week before the recorded lecture presentation. The post-test survey was done immediately after the presentation, except at Houghton where participants were given until the next morning to complete it. (This potential problem is discussed below.) In the DBU2 study, a delayed post-survey was done a month later. In the DBU3 study, participants were randomly divided into two groups of approximately equal size. Both groups answered the pre-test survey a week ahead of time, one watched the original 44 min recorded lecture while the other watched the 38 min recorded lecture with the Christian frame removed, and both answered the post-test survey immediately after.

Analysis
The six questions on global warming used Likert-scale responses that could be ordered, but were not in a ratio or interval scale (although it could be argued that the nine optional responses to the first question, ranging from extremely sure global warming is not happening to extremely sure it is, are paced roughly eight equal steps apart). Therefore, non-parametric analysis was necessary. The Wilcoxon Signed-Rank test was used to analyze the significance of the pre-post gains and delayed pre-post gain for the six global warming questions at the various colleges. The Mann-Whitney U test was used to compare pre-post gains from the two independent samples, in the DBU3 study, one group watching the Christian-framed video, and the other, the video with the Christian frame removed. (Online calculators for these tests were used, available at www.vassarstats.net or www.socscistatistics.com.) In the analyses one-tailed tests were used, as we hypothesized that post-test scores should be greater than pre-test scores, and the impact of a Christian frame in the recorded lecture should produce higher gains with Christian respondents than when the Christian frame is removed.

Results
Survey responses confirmed that the respondents in the three studies at DBU were politically more conservative than those at Houghton or Tyndale (figure 1(a)). A Kruskal–Wallace analysis indicates that the difference is statistically significant ($H = 25.259; N = 358; p < 0.000$). Another question examining Democratic or Republican party identification yielded similar results (figure 1(b)). A Kruskal–Wallace analysis for this showed that the difference between Houghton and DBU respondents was statistically significant ($H = 30.074; N = 273; p < 0.000$). (The results for Tyndale are not shown here, due to differing variety of political parties in Canada.)

The first two research questions were: Would students at evangelical colleges with populations that were more politically conservative show similar pre-post gains, immediately after the presentation, and would these gains persist? Since we assumed yes to this question, we used a one-tailed Wilcoxon signed rank test. We see from table 1 that participants in all five studies showed pre-post gains immediately after the intervention that were statistically significant at the $p < 0.01$ level for all six questions related to global warming, with two exceptions for Q2 (Tyndale, $p < 0.360$; DBU2 $p < 0.022$). Furthermore, these gains persisted a month later for four of the six questions, in the DBU2 study.

One way of displaying these non-parametric results visually is to graph the direction of movement from pre- to post-test regarding participants’ climate change beliefs. This was done in a previous paper for Houghton College (Webb and Hayhoe 2017). For each of the six questions, the number who moved to a more pro-climate belief were graphed against the number who did not change and the number who moved to a less pro-climate belief. The direction-of-movement
graphs for the Tyndale and DBU studies looked quite similar to those for Houghton and are not presented here.

Another way to display the results is to show the percentage of the pre and post-scores that were supportive of climate change concerns. For Q1–Q4, this would mean that respondents believed global warming was happening (somewhat, very, or extremely sure), was caused mostly by human activities, was agreed upon by most scientists, and was causing participants to be somewhat or varied worried (appendix, #13–15, #16, #17, #18). Figure 2 displays these percentage scores for the first four questions for each of the five studies.

The graphs indicate that pre-test scores for DBU participants were lower than for Houghton and Tyndale participants. Using the Kruskal–Wallis test for ordinal data between independent samples, we find that these differences in pre-test scores were significant for Q1 ($H = 28.16$, $p < 0.000$), Q3 ($H = 10.75$, $p < 0.030$), and Q4 ($H = 27.71$, $p < 0.000$), but not for Q2 ($H = 4.91$, $p < 0.30$). The graphs also suggest that participants in the DBU studies experienced greater movement (pre- to post-test scores) towards acceptance of...
| Question                                                                 | Houghton | Tyndale | DBU1 | DBU2 | DBU2 del. | DBU3 |
|-------------------------------------------------------------------------|----------|---------|------|------|-----------|------|
| Is global warming happening?                                            |          |         |      |      |           |      |
| Z, p                                                                    | -5.22, 0.000 | -5.37, 0.000 | -4.74, 0.000 | -5.81, 0.000 | -5.14, 0.000 | -7.78, 0.000 |
| Is global warming natural or human caused?                              |          |         |      |      |           |      |
| Z, p                                                                    | -3.71, 0.000 | -0.37, 0.360 | -3.19, 0.001 | -2.12, 0.022 | -0.47, 0.319 | -4.60, 0.000 |
| Is there a scientific consensus on global warming?                      |          |         |      |      |           |      |
| Z, p                                                                    | -3.57, 0.000 | -3.22, 0.001 | -4.11, 0.000 | -3.73, 0.000 | -3.32, 0.000 | -3.24, 0.001 |
| How worried are you about global warming?                               |          |         |      |      |           |      |
| Z, p                                                                    | -5.73, 0.000 | -4.15, 0.000 | -4.62, 0.000 | -3.82, 0.000 | -3.98, 0.000 | -5.51, 0.000 |
| How much do you think global warming will harm...?                      | -6.04, 0.000 | -3.87, 0.000 | -3.44, 0.000 | -2.45, 0.008 | -1.11, 0.134 | -4.08, 0.000 |
| Priority of addressing global warming                                  | -5.36, 0.000 | -3.54, 0.000 | -4.24, 0.000 | -4.14, 0.000 | -3.97, 0.000 | -5.74, 0.000 |

* For Houghton, the number of participants fell to 83 for the 3rd question, because of responses left blank. For DBU2, the number went down to 59 and 50 for the 2nd and 3rd questions, and for DBU3, the number went down to 101 and 89 for the 2nd and 3rd questions. In the other three studies, only one or two participants left some responses blank.
global warming than those in the Houghton and Tyndale studies, although with ordinal data it is difficult to see if this greater movement is statistically significant. Also, since DBU scores were lower to begin with, they had more room to move up.

The last research question was to what extent were gains influenced by the Christian frame and identity of the presenter, as opposed to the content or the context of the presentation? We assumed that framing the climate change lecture with Biblical teaching on stewardship and concern for loving our global neighbors (appendix B), and introducing the climate scientist as an evangelical, could be at least partly responsible for the significant gains at the three evangelical institutions. We tested this assumption by removing all Christian content from the recorded lecture and from the introduction of the lecturer and found that it made no difference in pre-post gains of the DBU3 participants (table 2(a)). Only on the fourth question, related to worry, was there a possible significant difference where the group watching the recorded lecture without the Christian frame was actually more worried (although with a \( p = 0.048 \), this correlation is not sufficient to note, when doing a six-fold comparison).

These results took us by surprise. So, we conducted a further analysis of the sub-questions that made up the last two principal questions. The results (table 2(b)) suggest a possible difference between the two groups on one of the sub-questions. The group of participants who watched the recorded lecture with the Christian frame (i.e. Christian stewardship, love for global neighbors, etc) scored higher on this question than the group that watched the recorded lecture without the Christian frame (\( p < 0.009 \), one-tailed test). We are cautious, however, in attributing statistical significance to this as we have now done an eleven-fold comparison of the two groups, and the highest significance level is only 0.009.

**Discussion**

We assumed that the participants volunteering at DBU would be more politically conservative than those at Houghton and Tyndale, and our results confirm this. Both the political beliefs (figure 1(a)) and party identification (figure 1(b)) of the participants at DBU were more conservative than those at the other college(s).
Table 2. (a) Tests of significance differences in pre-post gains for the Christian-framed versus non-Christian-framed recorded lecture groups for DBU3, on the six questions about global warming, using the Mann-Whitney U test for ordinal data. One-tailed tests were used \( (p < 0.05^*; p < 0.01^{**}) \). For the last two questions, the mean of the scores on the sub-questions was used. (b) Tests of significance differences in pre-post gains for the Christian-framed versus non-Christian-framed recorded lecture groups for DBU3, on the sub-questions for the last two questions about global warming, using the Mann-Whitney U test for ordinal data. One-tailed tests were used \( (p < 0.05^*; p < 0.01^{**}) \). For the second last question, sub-question (c) was unintentionally omitted from the survey, and thus is not included in this table.

| Survey question | Mean of ranks for the christian-framed recorded lecture group | Mean of ranks for the non christian-framed recorded lecture group | \( U \) | \( p \) |
|-----------------|-------------------------------------------------------------|---------------------------------------------------------------|--------|--------|
| Q1. Is global warming happening? | 53.21 (n = 58) | 57.04 (n = 51) | 1375 | 0.264 |
| Q2. Is global warming natural or human caused? | 52.07 (n = 55) | 49.72 (n = 46) | 1206 | 0.345 |
| Q3. Is there a scientific consensus on global warming? | 45.03 (n = 47) | 44.96 (n = 42) | 986 | 0.496 |
| Q4. How worried are you about global warming? | 50.27 (n = 58) | 60.38 (n = 51) | 1204 | 0.048* |
| Q5. How much do you think global warming will harm …? | 57.14 (n = 58) | 52.57 (n = 51) | 1355 | 0.227 |
| Q6. Priority of addressing global warming | 56.68 (n = 58) | 53.09 (n = 51) | 1382 | 0.278 |

| Survey question | Mean of ranks for the christian-framed recorded lecture group (n = 58) | Mean of ranks for nonchristian-framed recorded lecture group (n = 51) | \( U \) | \( p \) |
|-----------------|-------------------------------------------------------------|---------------------------------------------------------------|--------|--------|
| Q5 How much do you think global warming will harm … | | | | |
| (a) You personally? | 59.19 | 50.24 | 1236 | 0.071 |
| (b) People in the United States? | 56.41 | 53.40 | 1398 | 0.312 |
| (d) Future generations of people? | 52.81 | 57.49 | 1352 | 0.441 |
| Q6 Do you think addressing global warming should be a … priority for each of the following: | | | | |
| (a) You personally? | 57.47 | 52.19 | 1336 | 0.384 |
| (b) Dallas Baptist University? | 56.24 | 53.59 | 1407 | 0.334 |
| (c) Christians in general? | 62.24 | 47.71 | 1107 | 0.009** |
| (d) The US President and Congress? | 51.13 | 59.40 | 1255 | 0.087 |
Since we assumed this to be the case, we also expected that the views of the DBU participants concerning anthropogenic climate change would be less receptive, and that perhaps even the pre-posttest gains, immediately after the intervention, would be less than at Houghton and Tyndale. However, a Wilcoxon signed rank test indicated statistical significance at the \( p < 0.01 \) level for each of the six questions in all five studies, with only two exceptions (table 1). Figure 2 shows these gains for the first four questions. Although DBU participants were initially more skeptical about global warming than those at Houghton and Tyndale, after the intervention their beliefs were almost as high as at the other two universities (figure 1). This is especially true of their acceptance that global warming is happening (Q1, figure 2(a)), is mostly caused by humans (Q2, figure 2(b)), and is something that most scientists agree on (Q3, figure 2(c)). Of course, those who are initially most negative have the greatest room available for gain; but it cannot be assumed that therefore they will achieve the greatest gain, especially if they are more politically conservative. Yet, these results suggest that they did achieve a gain as great or greater than that of the less politically conservative respondents. These results are encouraging for those who give presentations to politically conservative populations of college students. Whether they can be extrapolated to politically conservative adults in general is a question for further research. However, it is a hopeful sign that some groups of politically conservative evangelical adults are not as immune to changing their minds about climate change as perhaps previously thought.

The question on whether global warming was mainly caused by natural or human activities (Q2) resulted in the lowest initial scores and lowest gains (figure 2(b)). Canadian participants (Tyndale) showed almost no gain at all (34%–37%) in their acceptance of this science-based belief, even though it was clearly emphasized in the video lecture. The other four groups showed a significant gain, but DBU2 study participants, who on other questions maintained their gain for at least one month after the study was over, largely reverted to their earlier understanding on this question, a month later. This suggests that participants in at least two of the five studies found this question difficult to understand or the presentation less convincing than on the other points. More work apparently needs to be done in explaining, to this level of recipients, how scientists know that climate change is mostly caused by human activities.

It is encouraging that respondents in all five studies made significant gains in agreeing that most scientists think global warming is happening, and that these gains were preserved one month later, in the DBU2 study (table 1; figure 2(c)). This is a critical finding, as previous research has identified the scientific consensus as a ‘gateway belief’ that increases acceptance that climate is changing and humans are responsible (Van Der Linden et al 2015). Similarly, respondents in all five studies made significant gains in being worried about global warming (table 1; figure 2(c)), which suggests that the intervention was effective in shifting perceptions regarding the personal relevance of this issue to the students.

Before discussing results concerning the last research question, we need to mention a potential bias in the Houghton sample compared with that of the other colleges that could impact the conclusions presented above. Respondents at Houghton had a longer time in which to complete the post-test survey. Although these surveys were emailed to participants immediately after they watched the presentation, they had until 11:00 am the next morning to complete them. In the other four studies, post-test surveys were administered immediately after the lecture. Other aspects of the Houghton study give us some confidence that this may not have produced a significant bias. The fact that the three different experimental groups at Houghton experienced similar pre-post gains, after being exposed to different forms and lengths of the presentation, may suggest that there was some stability to their changing opinions which would not be greatly influenced by whether they responded immediately after the presentation, the same evening, or early the next morning.

The most unexpected result of our research was the null effect when the Christian frame was removed (table 2). The only student response that was affected was in regard to Christian responsibility. Several previous studies had suggested that using Christian experts to communicate climate change to evangelicals may be effective at influencing their climate beliefs (Wilkinson 2010, Carr et al 2012). In those studies, however, participants were members of churches in the Southwest who participated in focus groups or individual interviews, not university students participating in a controlled experiment. The present study disentangles the strength of the impact of a Christian frame on a scientific, factual presentation on climate change for students at an evangelical college. The findings are consistent with research showing the minimal effect of different frames around teaching about climate change (McCright et al 2016), but may also be the result of other factors involved in the experiment. The first is the quality of the lecturer, who has received awards for outstanding climate science communication, and who adopts best practices advocated by social science researchers including emphasizing the use of scientific consensus in addressing climate skeptics and providing detailed information on regional climate impacts relevant to each audience (Kahan et al 2011, Lewandowsky et al 2013, Rosenaau 2015). The second is the fact that the DBU studies were sponsored and introduced by a professor who was well regarded by the students, and who had won the Faculty of the Year award. It is likely that participants considered this professor, their course instructors, and the university to be endorsing the climate change lecture. This may have had the greatest influence on participants’
willingness to consider and accept the information provided; this is consistent with what other researchers have noted (Kahan 2010).

To further test the possibility that the evangelical context of the study, and not the inclusion of a Christian frame to the lecture, has the most influence on the acceptance of global warming by evangelical students, we suggest the following. Students could be solicited for a study at a large secular university, where there is a relatively high concentration of evangelicals, but where the course instructor(s), study sponsor, and many of the students are not evangelical. The participants (both evangelical and non-evangelical) would be randomly divided into two groups, one watching the lecture with a Christian frame, and the other without. Results would show whether evangelical participants in the group with the Christian-framed lecture experienced the same gain as those in the other group. Similarly, with non-evangelical students. Furthermore, if this were done early in the fall, in a full year course, a post-test survey six months later would enable us to look at longitudinal gains by all groups of students.

Conclusion

This study finds that a single lecture can significantly alter acceptance of climate science, concern regarding its impacts, and support for action among undergraduate students at evangelical institutions in the US and Canada—both immediately following the lecture, as well as up to a month afterwards. Other studies have found similar changes, but this study’s participants were all evangelicals, committed to deeply religious views about the Bible, and yet still able to be moved on climate change. Further, the net gains of the most politically conservative student population, DBU, were as high or higher than those at the other institutions, even though initial beliefs about climate change were significantly lower, implying that those with the lowest initial agreement may have the potential to be moved the furthest. This is significant given the large percentage of evangelicals in the United States, most of whom are politically conservative.

Although a significant number of evangelical organizations already exist that support concern about climate change, they are apparently not having the impact of some other conservative evangelical organizations, such as the Cornwall Alliance, which resolutely opposes this view. This study suggests a need for a new, broadly evangelical alliance to be formed, strongly supported by academics, business people, and religious and church leaders, to take the lead and focus on this urgent issue, to speak with one voice especially to the 25% of evangelicals in the United States.

Appendix A. Climate change survey (coded for data entry)

A. What is your 2-digit birth month? (e.g. ‘08’ for August)

B. What are the first two letters of your mother’s Maiden name? (e.g. ‘BL’ for Bloom). If you do not know, enter ‘UN’

C. What are the first two letters of your city of birth? (e.g. ‘DA’ for Dallas)

1. What is your gender?
   a. Female
   b. Male

2. What is your current year at DBU? [Or Houghton College or Tyndale]
   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? (Select all that apply)
   [This was slightly different for each college]
   a. Business and Accounting
   b. Communication
   c. Education
   d. Humanities (Art, English, Writing, and Languages)
   e. Intercultural Studies
   f. Music
   g. Natural Sciences and Mathematics
   h. Social Sciences (History, Political Science, Psychology, Sociology, 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? [This was slightly changed for the Canadian college]
   a. Wesleyan/Holiness (Salvation Army, Christian & Missionary Alliance and Free Methodist)
   b. United Methodist
   c. Baptist
   d. Charismatic/Pentecostal
   e. Nondenominational
   f. Other Evangelical
   g. Mainline Protestant (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? [or Canada]
   a. Yes, and I have never resided outside the US except for brief trips of less than one year
   b. Yes, and I have resided outside the US 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? [These options were different for Canada, which has a multi-party system.]
   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 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.
    i. Strongly Agree
    ii. Somewhat Agree
    iii. Unsure
    iv. Somewhat Disagree
    v. Strongly Disagree
    b. The free market system may be efficient for resource allocation but it is limited in its capacity to promote social justice.
    i. Strongly Agree
    ii. Somewhat Agree
    iii. Unsure
    iv. Somewhat Disagree
    v. Strongly Disagree
    c. The preservation of the free market system is more important than localized environmental concerns.
    i. Strongly Agree
    ii. Somewhat Agree
    iii. Unsure
    iv. Somewhat Disagree
    v. Strongly Disagree
d. The free market system is likely to promote unsustainable consumption.
   i. Strongly Agree 1
   ii. Somewhat Agree 2
   iii. Unsure 3
   iv. Somewhat Disagree 4
   v. Strongly Disagree 5

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.

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. Do not know 5

14. [If yes to #13] How sure are you that global warming is happening?
   a. Extremely sure 9
   b. Very sure 8
   c. Somewhat sure 7
   d. Not at all sure 6

15. [If no to #13] How sure are you that global warming is not happening?
   a. Extremely sure 1

16. Assuming global warming is happening, do you think it is…
   a. Caused mostly by human activities 3
   b. Caused mostly by natural changes in the environment 1
   c. Caused by both human activities and natural changes 2
   d. None of the above because global warming is not happening
   e. Other

17. Which comes closest to your own view?
   a. Most scientists think global warming is happening 3
   b. Most scientists think global warming is not happening 1
   c. There is a lot of disagreement among scientists about whether or not global warming is happening 2
   d. Do not know enough to say

18. How worried are you about global warming?
   a. Very worried 4
   b. Somewhat worried 3
   c. Not very worried 2
   d. Not at all worried 1

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
      i. A great deal 4
      ii. A moderate amount 3
      iii. Only a little 2
      iv. Not at all 1
   b. People in the United States [or Canada]
i. A great deal 4
ii. A moderate amount 3
iii. Only a little 2
iv. Not at all 1

c. People in developing countries
i. A great deal 4
ii. A moderate amount 3
iii. Only a little 2
iv. Not at all 1

d. Future generations of people
i. A great deal 4
ii. A moderate amount 3
iii. Only a little 2
iv. Not at all 1

21. Do you think addressing global warming should be a low, medium, or high priority for …

a. You personally
i. Low 1
ii. Medium 2
iii. High 3

b. Dallas Baptist University [or Houghton College or Tyndale]
i. Low 1
ii. Medium 2
iii. High 3

c. Christians in general
i. Low 1
ii. Medium 2
iii. High 3

d. The US President and Congress? [Or the Prime Minister and Parliament]
i. Low 1
ii. Medium 2
iii. High 3

Appendix B. Summary of Recorded Lecture:

This is a summary of the 44 min recorded lecture made for Houghton College, February 2015, and used for the Tyndale and DBU1 and DBU2 studies, with very slight changes to some geographical references. The video was edited down to 38 min for the DBU3 study, by removing all Biblical and Christian references. The parts that were removed, the introduction, conclusion, a sentence in question 3, and two sentences in question 4, are placed in brackets. The first two columns give the timing.

| Time   | Time | Content |
|--------|------|---------|
| 38 m   | 44 m |         |

0:00 [Introduction: Climate Change—Facts, Fictions, and Our Faith] Introduction: people disagree about climate change. What’s real and what’s not? [As Christians, what does any of this have to do with our faith?]

A favorite Bible verse: 'Now faith is the substance of things hoped for, the evidence of things not seen' (Hebrews 11:1 KJV). Science is the opposite. 'Now science is the substance of things here and now, the evidence of things we can observe.' Global warming is not a matter of faith, but of science, the systematic study of the world through observation and experiment. So you do not 'believe' in global warming, you do not believe that humans are affecting the climate. You ask, 'What is the evidence for global warming and for the affect of humans on climate?'

2:16 Question 1. Is climate changing?

Weather is short-term, what happens in a certain place at a certain time. Climate is the long-term average of weather over at least 20–30 years. We cannot just look at one place to see if climate is changing; we have to look around the whole world. And we cannot just look at temperatures trends for a few years, but over climate scales of 20–30 years

One experiment placed people randomly in a warm or cold room. Those in the warmer room were more likely to say that the Earth’s climate was changing than those in the colder room. This shows how sensitive we are to our environment

When we look at the US, we see that not only are global temperatures going up, we have longer growing seasons and more frequent heat waves, like the one in Australia a few years ago. We see increases in precipitation, because the warming results in more evaporation of water into our atmosphere, which then falls as rain or snow.

We also see higher ocean temperatures resulting in more energetic hurricanes. Other examples: the center of blueberry production has shifted north from Maine to Quebec; Cherry trees in Kyoto, Japan, and Washington, DC, are flowering weeks earlier than they have for a thousand years. We also see increasing crop failures around the world, as well as melting glaciers. In fact, responses to warming temperatures are seen in more than 26 500 physical and biological systems around the world.

6:35 8:50 Question 2. Why is climate changing?

Only when we have examined and discounted the natural suspects for a changing climate (i.e. changing solar output, natural cycles, etc), can
we attribute climate change to people. If the Sun were responsible for global warming, the solar energy output would be going up. In fact, it was going up a little until the 1970s; but since then it has been going down, while the Earth’s temperature has been going up faster than ever. Could it be a natural cycle like El Niño? Natural cycles just move heat back and forth between the atmosphere, and oceans, between the north and the south. They do not create or destroy it. If the atmosphere were getting warmer because of a natural cycle, then something else, most likely the oceans, would be getting cooler. In fact, the heat content of the oceans is increasing even more than the atmosphere, 20 times more. So the warming we see in the atmosphere is only ‘the tip of the iceberg’ of global warming.

What about a natural cycle caused by changes in the shape of the Earth’s orbit around the Sun (becoming more elliptical or more circular, or Earth’s axis changing its tilt)? These cycles caused the ice ages, by changing where the Sun’s energy falls on the Earth. When we look at the data, however, warming from the last Ice Age peaked 8000 years ago, and since then the Earth has been cooling, until the Industrial Revolution. Starting with the Industrial Revolution, the burning of fossil fuels—coal, oil, natural gas—resulted in carbon dioxide being released into our atmosphere. (We have great records of all the fossil fuels we have used.) Why is this important?

The Earth has a natural greenhouse effect, a natural blanket of carbon dioxide and methane that traps reflected heat given off by the Earth and warms it up enough for life. This natural blanket keeps the Earth almost 60 °F warmer than it would be otherwise, so that it can sustain life. The problem is we are adding an extra blanket by burning fossil fuels. Over the past 200 years we have increased the amount of carbon dioxide in our atmosphere by 43% and we have more than doubled our level of methane. This extra blanket is causing our global warming.

This science of the greenhouse effect is very old. Fourier discovered this natural blanket in the early 1800s. Tyndale proved in the mid 1800s that burning coal added to the blanket. Arrhenius (1859–1927) calculated how much the Earth would warm if we continued putting more carbon dioxide into the atmosphere. Callendar (1898–1964) was the first person to actually measure how much the Earth was warming because of human activity. And Keeling (1928–2005) was the first person to start measuring atmospheric levels of carbon dioxide at Mauna Loa, Hawaii. This is how old climate science is, and that is why we are so certain about this.

What about announcements in newspapers such as, ‘Climate Science is not Settled?’ The public believes that only about 55% of climate scientists agree on global warming. The reality is that over 97% of climate scientists agree, not only that climate change is real, but that humans are the primary cause of climate change today. Of 14 000 peer-reviewed climate change articles, 1991–2012, only 24 rejected global warming. Research has shown that scientists tend to be the opposite of alarmist; they actually make their information more conservative than they should be. If you have any more questions, see www.skepticalscience.com

Question 3. Why should we care?

Not just because of polar bears, or because it will only matter to future generations; climate change is happening right now and right here. We’re seeing more downpouring of rain, stronger snowstorms, stronger hurricanes, and more frequent heat waves. Our civilization is built on the assumption that climate is stable. This assumption governs everything we do, how we build our homes and roads, etc. ‘This assumption has been valid for most of Western civilization, but it is no longer valid today.’

The problem is, some news sites say that more carbon dioxide is good for us; ‘global warming is fine, say scientists.’ References to this take us to organizations, such as the Heartland Institute, which is a public policy think tank, not a research institute for climate scientists. In the 1990s, the same group downplayed a link between smoking and lung cancer. Today they question climate change, and a large part of their funding comes from the oil and gas companies. Climate scientists, however, look at thousands of pieces of real data from around the world and what they see is something different.

Why do we care? We’re seeing increased risks of heat waves, and other impacts on our health. The heat wave in Paris a few years ago resulted in 70 000 extra deaths. Heavy precipitation is increasing, causing flooding. It is also increasing lake effect snow, such as in upper state New York (referring to the heavy snow storm that took place just before the presentation). We have also seen how hurricanes are getting stronger, such as Super Storm Sandy. Climate change does not cause these storms, but increases their severity, because of warmer waters and rising sea levels. Climate change is giving our weather a ‘steroid shot.’ Around the world, billion dollar disasters are on the rise. Why care? ‘Climate change will affect our quality of life, our resources, and our economy.’

[But it is not just about us. For those of us who believe that we’re told to ‘love others and care for others,’ there’s more to it.] When we compare who has caused the most carbon dioxide
with which countries will suffer the most from its impact, it just is not fair. Those bearing the brunt of the impact are most vulnerable. In the US, we might lose part of the everglades in Florida, but millions of people in Bangladesh will lose their rice growing areas because of sea level rise. Here, we might lose our glaciers in Glacier National Park, but millions of people in Lima Peru will lose their water supply because of melting glaciers in the Andes. For more on this, see the documentary, *Years of Living Dangerously*. It puts a human face on this problem, as it takes us around the world. You can get it on iTunes, or see some of it free on YouTube. So why care? 'Our faith says, climate change is affecting our neighbors, who we are told to love.'

**Question 4. What can we do about this problem?**

Our choices do matter. We have seen some climate change already, but only a fraction of what we will see if we continue on the same pathway, depending on coal, oil, and natural gas for our primary energy sources. And, as we learn from the book and movie *Merchants of Doubt*, information is often released that is intended to confuse us. Of course, what we are asking for is a huge change in the fabric of society, as large as the change from slavery to today. We hear taxes, restrictions, regulations, etc. [So this is my second favorite Bible verse: 2 Timothy 1:7, 'God has not given us a spirit of fear, but power, love, and a sound mind.' So fear-mongering is not coming from God.] What type of choices do we have? John Holdren has said, 'We basically have three choices: reduce, prepare, and suffer. We’re going to do some of each. The question is 'what the mix is going to be.' It is going to be some of each of these. But the more we reduce, the less we will have to suffer. What does this look like? Building floating villages in the Netherlands, to prepare for rising sea levels. Building modern wind turbines in Texas to replace aging oil wells. But what about China? They are now the top country in wind producing energy, and the second top country in solar energy production, after Germany. But the US has not excuse: Texas alone has enough solar potential to power the world, if it was all harnessed. So, rather than worrying about the future, we can have hope. [We can move forward with the resources God has given us, to care for others, to make sure that others have access to the advantages that we have.]

So, as individuals, what can we do? The number one thing is to measure our carbon footprint, just as the first thing we do if we want to lose weight is to step on the scales. (Various carbon footprint calculators are available on the web.) Some carbon calculators will also give us a list of things we can do to reduce our carbon emissions, such as finding new ways to get to school, or replacing light bulbs. About half the carbon emissions in the United States are controlled by our choices. But, there are still things outside our control. But we live in a democratic society, where we can stand up and say what we feel. Citizens Climate Lobby presents a way for each of us to get together with others to tell the people we’re voting for that we care about this issue.

**Conclusion**

'Faith and science are completely different—yet they are also complementary and essential to understanding and responding to the challenges that face us today, climate change being one of the most urgent of these.' Nearly all of us would agree that:

- God created the Earth and it is good
- Adam was (and through him, we were) given the responsibility to care for God’s creation
- Respecting God’s creation is a sign of our respect for God
- Loving others is how we express Christ’s love to the world
- The only thing that counts is faith expressing itself through love (Galatians 5:6)

So why should we care? We have been given a new heart: 'Love the Lord your God with all your heart, and all your soul, and all your mind.' This is the first and greatest commandment. And the second is like it, 'Love your neighbor as yourself.' (Matthew 22:37–39). Doing something about climate change is an opportunity to care, not just about God’s creation, but about people He has made.

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