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An investigation into the impact of science communication and cognitive strain on attitudes towards climate change

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An investigation into the impact of science
communication and cognitive strain on attitudes
towards climate change

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Abstract

One of the most dramatic examples of the negative consequence of poor scientific communication is the issue of climate change, contributing to widespread mistrust and misunderstanding of how scientists do their work (Somerville & Hassol, 2011). Several studies have attempted to determine why there is such a discrepancy between the science community and people's opinion of climate change. One such study measured participants' skepticism about climate change before and after reading two newspaper editorials making opposing claims about the reality and seriousness of climate change. Results show significantly more skepticism about climate change after reading the editorial contradicting climate science (Corner, Whitmarsh, & Xenias 2012). Though science communication is a factor in individuals' opinion of climate change, another study from the University of Maine found participants subjected to cognitive strain report more conservative political and social attitudes than the control group (Eidelman, Crandall, Goodman, & Blanchar, 2012). In the present study, we have combined these methods into one investigation to analyze the interaction between cognitive strain, the manner in which science information is presented, and attitudes toward climate change. Data were collected using in-person interviews. Political ideology was measured using the New Ecological Paradigm Scale (NEP, "a measure of endorsement of a "pro-ecological world view" (New Ecological Paradigm Scale, 2012)) and the Social and Economic Conservatism Scale (SECs) (Everett, 2013). Participants were randomly assigned to read one of three editorials, conveying positive, negative, or neutral perspectives on climate change, and the Stroop Test was administered to induce cognitive load in the experimental group. Finally, the Climate Change Skepticism scale (CCSs) was used to determine a participant's attitudes toward climate change. Data were analyzed using the statistical analysis package, SPSS, to compare climate change attitudes between groups. We expected mentally taxed participants and those given the negative editorial to demonstrate significantly more skeptical views of climate change compared to participants not subjected to cognitive strain and those receiving neutral or positive editorials. Results from the present study show no effect of science communication or cognitive strain on attitudes toward climate change.

An investigation into the impact of science communication and cognitive strain on attitudes towards climate change

One of the most dramatic examples of the negative consequences of poor scientific communication is the issue of climate change, which has contributed to widespread mistrust and misunderstanding of how scientists do their work (Somerville & Hassol, 2011). Even though the understanding that climate change is the result of human activity is supported by significant scientific evidence and is well accepted in the scientific community, the general population still shows uncertainty about the complexity and implications of climate change (Berstein, 2001; Doran & Zimmerman, 2009).

Several studies have focused on the role of science communication when attempting to explain this continued debate. Meijers and Rutjens (2014) presented university students with a newspaper article either affirming or questioning beliefs in scientific progress before assessing their attitudes toward climate change and eco-friendly intentions. It was found that reading an article affirming belief in scientific progress created less environmental friendly attitudes and intentions than participants who read an article questioning scientific progress. This suggests a belief that science can and will take care of any threat. Another study measured participants' skepticism about climate change before and after reading two newspaper editorials that made opposing claims about the reality and seriousness of climate change. Significantly, more skepticism about climate change was observed after reading the contradictory editorials (Corner, Whitmarsh, & Xenias, 2012). Results from these studies strongly support the power of science presentation to clarify or confuse the public's understanding of timely topics.

In addition to the impact of science communication, there appear to be factors specific to the individual that can influence our assessment of information. A study from the University of Maine found that participants who experienced cognitive strain reported more conservative political and social attitudes than those who did not (Eidelman, Crandall, Goodman, & Blanchar, 2012). As climate change skepticism is often associated with more conservative political beliefs, this study was interested in investigating the impact of cognitive load on attitudes toward climate change and the kind of interaction it may have with the manner in which scientific information is presented.

Methodology

Participants were recruited using SONA, an online research participant scheduling system ($n=125$, 78% female). SONA is only available to students enrolled in psychology courses, which is disproportionately female, causing our sample to consist mainly of female psychology students. Participants were randomly assigned to six groups (see Figure 2). Informed consent was obtained, and data were collected using a series of paper-based questionnaires. First, participants filled out a general demographic questionnaire, the Social and Economic Conservatism Scale (SECS), and the New Ecological Paradigm Scale (NEPS) (See Appendices B and C). Next, participants received one of three editorials, either supporting climate science, discrediting climate science, or a neutral article about the weather in Dublin (see Articles A, B, and C). After reading the article, participants in the experimental group completed an activity intended to induce cognitive strain- the Stroop test. For this activity, participants were instructed to be mindful of accuracy and speed, trying to achieve as many correct responses within one minute as possible. Finally, all participants completed the Climate Change Skepticism Scale

(CCSS) (See Appendix A). Participants were then debriefed and thanked for their time. Data were analyzed using SPSS.

Results

Kruskal Wallis tests were used for all analyses due to the nonparametric nature of the Climate Change Skepticism Scale. No statistically significant difference was identified in overall CCSS scores by level of cognitive strain, $\chi^2(1)=0.335$, $p=0.563$, with a mean rank score of 61.08 for the non-strained group and 64.83 for the strained group. No statistically significant difference was identified in CCSS scores by level of science communication, $\chi^2(2)=2.331$, $p=0.312$, with a mean rank score of 58.78 for the positive group, 60.30 for the negative group, and 69.89 for the neutral group. No statistically significant difference was identified in CCSS score by level of strain and science communication, $\chi^2(5)=2.727$, $p=0.742$, with a mean rank score of 55.67 for the non-strained positive group, 58.73 for the non-strained negative group, 69.13 for the non-strained neutral group, 61.75 for the strained positive group, 61.88 for the strained negative group, and 70.59 for the strained neutral group. The severe homogeneity of our sample, due to sampling limitations, prompted post hoc investigations of the data based on age, low=18-20, medium=21-23, high=24+. Groups were created based on the age range of all participants such that the low, median, and high groups would be equal in sizes. A statistically significant difference in CCSS scores was identified, $\chi^2(2)=6.993$, $p=0.03$, with a mean rank score of 63.57 for the low group, 67.82 for the medium group, and 40.43 for the high group.

Data were further investigated to determine whether differences exist in responses to specific questions of the CCSS (see Figure 1). A statistically significant difference was found between science communication groups in responses to the question regarding the uncertainty of scientists due to the complexity of climate change, $\chi^2(2)=6.471$, $p=0.039$, with a mean rank score of 56.88 for the positive group, 58.54 for the negative group, and 73.51 for the neutral group. Several statistically significant differences were found between age groups in responses to other specific questions of the CCSS (see Appendix A).

Discussion

Results of the present study show no clear impact of science communication or cognitive strain on participants' overall attitudes toward climate change. The difference identified between levels of science communication was unexpected. The statement, "climate change is too complex and uncertain for scientists to make useful forecasts," was most highly endorsed by the group that read the neutral article, not the negative editorial as would be expected. This anomaly may be due to a priming effect working on the positive and negative groups. Despite these groups reading articles with opposing views, the experience of reading about the climate science may have primed participants' existing knowledge or disposition regarding climate change, influencing responses to the CCSS.

Research has identified an interaction between perceptions of humans' role in climate change and knowledge of concepts related to climate change (Lombardi, & Sinatra, 2012). Climate concepts are taught in a variety of undergraduate courses, on which the faculty places high priority (Kirk, Gold, Ledley, Sullivan, Manduca, Mogk, & Wiese, 2014). Recruiting limitations caused our sample to consist almost entirely of undergraduate Psychology majors, so it would be reasonable to assume a majority of participants have had experience with critical evaluations and exposure to the science of climate change at some point in their college

education. This may have influenced the large majority of non-skeptics observed in our sample, (>75%), and our failure to reject all null hypotheses.

Research investigating undergraduates' attitudes toward and knowledge of climate change shows consistent support for the accepted scientific model but misconceptions regarding the causes and consequences (Guy, Kashima, Walker, & O'Neill, 2014; Wachholz, Artz, & Chene, 2014). Our sample demonstrated strong support for humans' role in climate change, despite attempts to influence opinions with opposing editorials and cognitive strain. We suspect the science communication material may have been perceived as informative, failing to sufficiently persuade participants' attitudes regarding climate change.

The only effect on climate change skepticism identified in this study was age. Individuals 24 years or older demonstrated less skeptical attitudes toward climate change compared to the younger groups (see Figure 1). Individuals that engage in critical evaluations, a hallmark of science-based fields such as psychology, experience a significant shift in judgments toward the accepted model of climate change (Lombardi, Sinatra, & Nussbaum, 2013). Upper level students would be expected to have less skepticism of climate change than younger students with less exposure to the topic. An interesting trend identified between age groups is the genre of questions in which responses consistently differed. Though the sample consists mainly of non-skeptics, participants' responses to questions regarding the uncertainty of climate science differed by age. Participants in the oldest group demonstrated more support of climate science and human's role in the changing climate than the younger groups.

Conclusion

This experiment was designed to investigate factors that influence how people form their attitudes, specifically towards climate change. The authors acknowledge several limitations that influenced the outcome of the experiment including the homogenous pool of participants and failed attempts at straining the experimental group.

More than 75% of participants were female, between 18-31 years of age, with the largest group being 21 and 22. In future experiments, a wider demographic of participants is crucial to gain a larger group of skeptical and non-skeptical participants for experimental manipulations.

Skepticism of climate change decreased with age, suggesting education influences ones' open-mindedness to controversial topics. Future research should also investigate participants' exposure and knowledge of climate change prior to the experiment. Previous exposure to climate change topics may have a greater influence on attitudes than age or amount of education, though they are often associated

Another limitation was the duration of the Stroop test. Participants were given one minute to perform the Stroop test before completing a 17-question survey about climate change. In future studies, researchers need to find a more effective way to strain participants so the effect does not wear off before the end of the questionnaire.

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Appendices

Appendix A

Climate Change Skepticism Scale (CCSS)

Please rate each of the following statements according to the extent in which you agree or disagree. Please circle your response. Rate your response on a scale:

Strongly Agree ... Agree...Neutral ...DisagreeStrongly Disagree

1. Climate change is too complex and uncertain for scientists to make useful forecasts.
2. Claims that human activities are changing the climate are exaggerated.
3. The media is often too alarmist about issues like climate change.
4. I do not believe climate change is a real problem.
5. Floods and heat waves are not increasing, there is just more reporting of it in the media these days.
6. Climate change is just a natural fluctuation in Earth's temperatures.
7. It is too early to say whether climate change is really a problem.
8. There is too much conflicting evidence about climate change to know whether it is actually happening.
9. Too much fuss is made about climate change.
10. The evidence for climate change is unreliable.
11. Many leading experts still question if human activity is contributing to climate change.
12. I am uncertain about whether climate change is really happening.
13. There is solid evidence that the Earth is warming because of human activities.
14. Recent floods and heat waves in this country are due to climate change.
15. I am convinced that climate change is really happening.
16. Experts are agreed that climate change is a real problem.
17. Changes in climate over the last 100 years are mainly caused by human activities.

Appendix B

New Ecological Paradigm (NEP) Scale

Please rate each of the following statements according to extent in which you agree or disagree.

Please circle your response Rate your response on a scale:

Strongly Agree ... Agree...Neutral ...DisagreeStrongly Disagree

1. We are approaching the limit of the number of people the Earth can support.
2. Humans have the right to modify the natural environment to suit their needs.
3. When humans interfere with nature it often produces disastrous consequences.
4. Human ingenuity will insure that we do not make the Earth unlivable.
5. Humans are seriously abusing the environment.
6. The Earth has plenty of natural resources if we just learn how to develop them.
7. Plants and animals have as much right as humans to exist.
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
9. Despite our special abilities, humans are still subject to the laws of nature.
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated
11. The Earth is like a spaceship with very limited room and resources.
12. Humans were meant to rule over the rest of nature.
13. The balance of nature is very delicate and easily upset.
14. Humans will eventually learn enough about how nature works to be able to control it.
15. If things continue on their present course, we will soon experience a major ecological catastrophe.

Appendix C

Social and Economic Conservatism Scale (SECS)

How positive or negative do you feel about each issue on a scale of 0 to 100, where 0 represents very negative, and 100 represents very positive?

Please circle your response. (0= Very Negative 50= Neutral 100= Very Positive)

1. Abortion 0 10 20 30 40 50 60 70 80 90 100
2. Welfare benefits 0 10 20 30 40 50 60 70 80 90 100
3. Tax 0 10 20 30 40 50 60 70 80 90 100
4. Immigration 0 10 20 30 40 50 60 70 80 90 100
5. Limited government 0 10 20 30 40 50 60 70 80 90 100
6. Military and national security 0 10 20 30 40 50 60 70 80 90 100
7. Religion 0 10 20 30 40 50 60 70 80 90 100
8. Gun ownership 0 10 20 30 40 50 60 70 80 90 100
9. Traditional marriage 0 10 20 30 40 50 60 70 80 90 100
10. Traditional values 0 10 20 30 40 50 60 70 80 90 100
11. Fiscal responsibility 0 10 20 30 40 50 60 70 80 90 100
12. Business 0 10 20 30 40 50 60 70 80 90 100
13. The family unit 0 10 20 30 40 50 60 70 80 90 100
14. Patriotism 0 10 20 30 40 50 60 70 80 90 100

Articles

Article A

The screenshot shows the 'about travel' website. The main article is titled 'The Irish Weather' with the subtitle 'Be Prepared for Four Seasons in One Day!'. The author is listed as 'By Bernd Siege, Ireland Travel Expert'. Below the title, there are social media sharing icons for Facebook, Twitter, Pinterest, Google+, and Email. A navigation bar at the bottom of the article lists links for 'Australia Weather', 'Ireland', 'New York Weather', 'Daily Weather Forecast', 'Ireland Vacation Packages', 'Weather in Dublin', and 'Temperature'.

The Irish weather has had some bad press ... like the rumour that the usual way to tell the difference between winter and summer in Ireland being to measure the temperature of the rain ... or so the saying goes. While it is true that there are no major temperature differences between the seasons and that rain is likely every second day, the Irish weather is manageable.



The Irish weather forecast - expect stark changes between bright sunshine and dark gloom. ... © Bernd Siege 2014

Temperatures

Temperatures will rarely go below 32°F and only occasionally above 68°F - with June, July and August being the warmest months, January and February the coldest. Extremes are not unknown though. The summer of 2006 was the hottest on record for ages. On the other hand rare freezing spells tend to bring the country to a grinding halt and even a sprinkling of snow will have most drivers panicking.

More Information

If you need more detailed weather data why not use the following pages dedicated to the main geographic areas of Ireland?

- [Weather in Donegal and Ireland's North](#) - measured and recorded at Malin Head, the very extreme end of Ireland.
- [Weather in Mayo and Ireland's West](#) - measured and recorded in Belmullet.
- [Weather on Valentia Island and in Ireland's Southwest](#) - as this is measured and recorded on Valentia Island, temperatures and winds on the mainland may be milder.
- [Weather in Dublin and on Ireland's East Coast](#) - measured and recorded at Dublin Airport, temperatures in the city centre itself may be much higher, while those in the nearby Wicklow mountains may be far lower ...

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Article B

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We are as certain about climate change as we can be about anything

As in economic forecasts, medical diagnoses, and policy making, uncertainty runs through climate science like the lettering in sticks of rock. For some, the mere presence of uncertainty in climate models is reason enough to doubt them. But uncertainty is not an enemy of science that must be conquered – it is the stimulus that drives science forward.

The Intergovernmental Panel on Climate Change (IPCC) is a body of international climate scientists whose responsibility it is to produce Assessment Reports of peer-reviewed climate science. In order to be included in an Assessment Report, a piece of peer-reviewed science must be agreed on by all authors – that is, only papers on which there is a consensus get included in the Report. That means the studies that are included have been peer-reviewed twice, and the conclusions of the IPCC are thus naturally cautious. So, when they announce that there are 90% certain that humans are causing global warming and that the consequences will be overwhelmingly negative, it should be enough to convince anyone that climate change is real.

There is very little uncertainty about whether humans are causing climate change – the uncertainty relates to how bad the consequences will be. The good news is that scientists are particularly adept at acknowledging, identifying and modelling uncertainty. If there's one group of people who have thought long and hard about uncertainty, it's climate scientists – and their considered opinions are the best evidence we have

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Article C



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Site UK Web

If we can't predict the weather, how can we predict the climate?

The UK Met Office has in recent years become something of a laughing stock. Its much-derided forecast that Britain would enjoy a "barbecue summer" in 2009 was only the latest of a string of predictions that proved wildly off-target. These short-term forecasts which are often so comically wrong are produced with the aid of the same super-computer used to provide predictions of what the world's climate will be like in 100 years' time.

In fact, accurate satellite, balloon and mountain top observations made over the last three decades have not shown any significant change in the long-term rate of increase in global temperatures. Average ground station readings do show a mild warming of 0.6 to 0.8C over the last 100 years, which is well within the natural variations recorded in the last millennium. The ground station network suffers from an uneven distribution across the globe; the stations are preferentially located in growing urban and industrial areas ("heat islands"), which show substantially higher readings than adjacent rural areas ("land use effects").

Perhaps it is time we scrapped the expensive Met Office computers, and the dodgy ground station readings and focussed on trying to improve our predictions about the weather next week. We are a long way off being able to say anything at all reliable or useful about the climate of next century.

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Figures

Figure 1

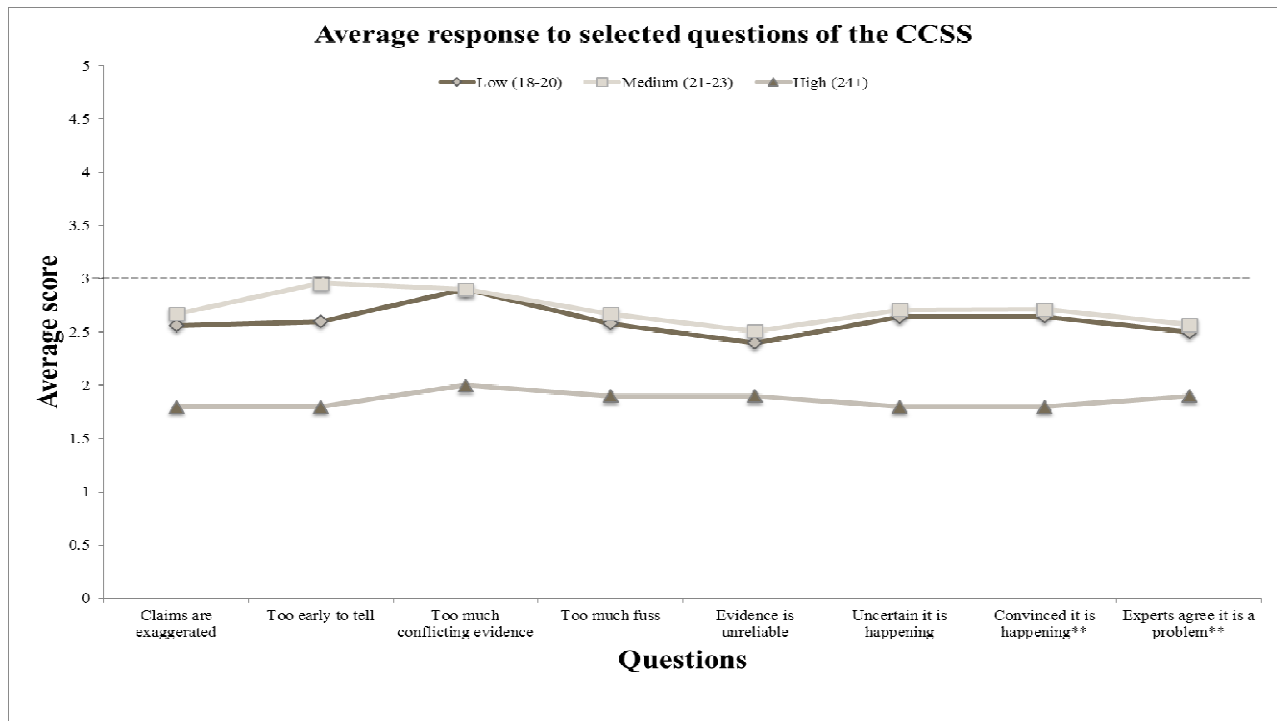


Figure 1: Average responses by age group to selected statements of the Climate Change Skepticism scale (0=strongly disagree, 5=strongly agree). Statements were selected according to significant differences between groups. (*Denotes $p < .05$)

Figure 2

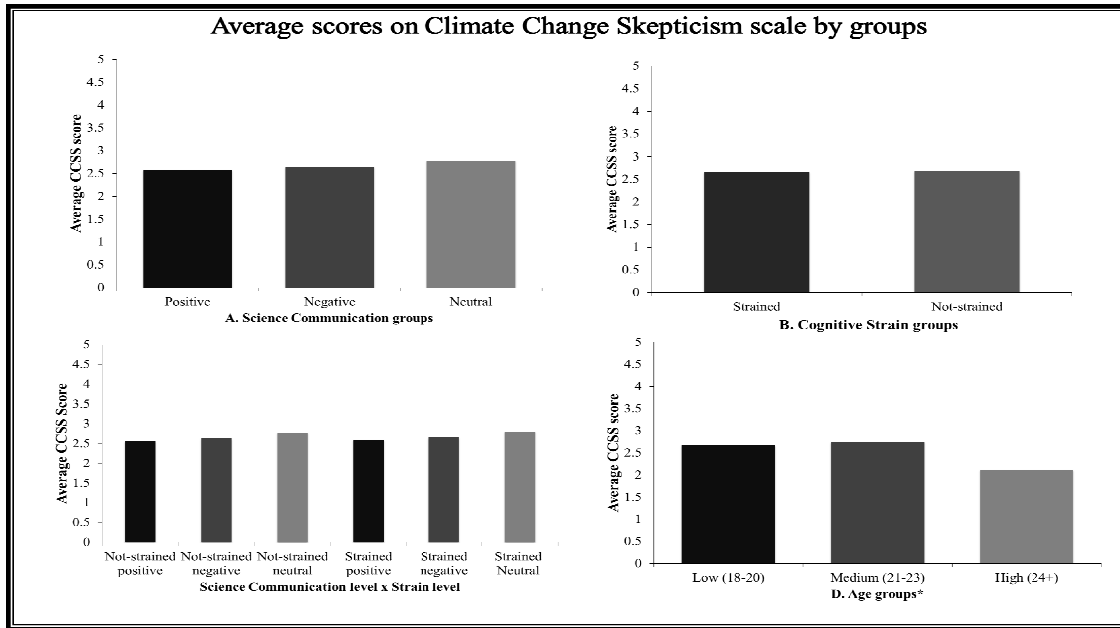


Figure 2: Average score on Climate Change Skepticism scale by A) level of science communication, B) level of cognitive strain, C) level of science communication and cognitive strain, and D) age.
 *Denotes statistically significant difference between groups, $p < .01$