On the Contrary: How to Think About Climate Skepticism*

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1 Introduction

This essay is a overview of the many different scientific, psychological, and communicative issues concerning climate skepticism. First, we begin the essay exploring different types of climate skepticism and the evidence for anthropogenic climate change. Second, we consider the role of consensus and dissent in science and recent discussion of "Merchants of Doubt" and Climategate. Third, we turn to psychological issues concerning and American opinion on the topic, the relevance or irrelevance of scientific literacy to climate skepticism, the role of affect in environmental decision-making, and cognitive biases that inform views regarding climate change. Third, we consider climate communication and how we might most effectively motivate pro-environmental behavior and beliefs.

2 Skepticisms

2.1 Terminology

In scientific debates regarding anthropogenic climate change, we need clear terminology. Unfortunately, terminology can appear prejudicial when it has

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a "moralistic tone" (O'Neill and Boykoff, 2010). As philosophers would say, these can be *thick* concepts which both describe and evaluate (Williams, 2011; Vayrynen, 2013). We will regiment our vocabulary as neutrally we can. I will do so as follows. First, I will focus our discussion on the following claim,

> (*C*) Average global temperatures are increasing in part because of human greenhouse gas emissions.

Anthropogenic climate change includes much more than *C*, but it is crucial for understanding climate skepticism. Second, how we understand the term 'skeptic' is extremely important in debates over *C*. One way of thinking about skeptics is that they form their beliefs in proportion to the evidence. Another way of thinking about skeptics is that they form their beliefs without regard for evidence. The reason we have disparate accounts of skepticism is because it can be a term of praise or derision. This is evidence by those who accept *C* thinking of skeptics as ignoring evidence and those who deny *C* thinking of themselves as closely following the evidence. Given an individual, a belief, and a body of evidence, we can ask, "Is that belief is proportional to the evidence?" For our purposes, we will disambiguate these two uses as follows,

> A *skeptic* believes (or disbelieves) a claim in proportion to the evidence for it.[1]

In this sense, scientists are customarily thought of as skeptics.

> A *contrarian* believes (or disbelieves) a claim regardless of whatever evidence there is for the claim.[2]

Finally,

> A *doubter* is either a skeptic or contrarian.

[1] Instead of a threshold for justified or warranted belief, one could follow Bayesianism and suppose there are degrees of belief. Assuming we can represent degrees of belief as probabilities, one's degree of belief in a claim simply is the probability of that claim given the ascertained evidence. The Intergovernmental Panel on Climate Change (IPCC) uses a Bayesian approach to probability (`http://www.ipcc.ch/ipccreports/tar/wg2/index.php?idp=106`).

[2] I will use the term 'contrarian' for a person who believes or disbelieves a claim regardless of the evidence. The term 'denier' might be used instead but it unfortunately only concerns disbelieving some claim as opposed to what one might positively believe.

For example, if one denies that cigarette smoking is a positive causal factor in developing cancer regardless of the evidence, then one is a contrarian regarding cigarette smoking and cancer. They simply disregard the ascertainable evidence. Given the distinctions drawn, we shouldn't assume that those who challenge *C* are contrarians. It is an empirical matter as to whether they are skeptics or contrarians -- it depends on the relevant beliefs and body of evidence. In this way, our terminology is neutral.

There is a rich debate in philosophy between William James and W. K. Clifford as to whether we should be skeptics (James, 2000; Clifford, 1886). On James' view, sometimes we should not be skeptics. James rejects *evidentialism*. Simply put, evidentialism is the claim that one should believe a claim if, and only if, there is sufficient evidence for it (Conee and Feldman, 2004). Consider a "hypothesis" that God exists and suppose there is no evidence for or against the hypothesis. Insofar as the hypothesis is live versus dead, forced versus avoidable, and momentous versus trivial, then James thought that one is permitted to believe it.[3] If there is no evidence for or against the existence of God and one would be happier believing there is a God, then it permissible for them to do so. W. K. Clifford disagreed with James' pragmatism. He argued that "It is wrong always, everywhere, and for anyone to believe anything on insufficient evidence." His concern was that believing irrespective of the evidence was morally and epistemically irresponsible. For example, the consequences of people forming their beliefs independent of evidence would be disastrous because it would undermine our trust in what each other asserts.

It is important to note that James' voluntarism is circumscribed. If a belief is neither confirmable nor disconfirmable by evidence, then one may believe what one likes regarding it. But James didn't think one could believe whatever one likes with regard to a claim when it is confirmable or disconfirmable. In the case of *C*, we are dealing with claims that are confirmable or disconfirmable. However, there is a Jamesian wrinkle we will discuss below.

2.2 The Evidence

Skepticism regarding *C* is associated with the following statements.

1. Average global temperature is increasing.

[3]For James, the reason why the choice is forced is because he contrasts theism with a mutually exclusive alternative including both atheism and agnosticism.

2. Average global temperature is increasing in part due to human fossil fuel emissions.

3. Average global temperature is increasing in part due to human fossil fuel emissions and the impacts of this increase will be mainly negative.

4. Average global temperature is increasing in part due to human fossil fuel emissions and mitigation of those emissions will not lower average global temperature.

Trend doubters reject (1). Since (3) and (4) individually imply (2), and (2) implies (1), one who rejects (1) rejects the others. This is the most radical rejection. *Attribution doubters* accept (1) but deny it is due to human fossil fuel emissions -- e.g. they say it is due to an increase in solar irradiance. *Impact doubters* accept (1) and (2), but suggest that the impacts are mostly positive. As one example, one might argue that southern Canada would be capable of increased agriculture which is beneficial and generalize considerations like these. *Regulation doubters* agree with (1) - (3) but deny that mitigation could do anything about it. One reason offered is that it is such a serious collective action problem that international agreements reducing our emissions are unachievable. It is also worth noting that (1) - (4) are *factual* claims concerning our climate system. One could accept (1) - (4) but yet we think should not do anything about it. That is, they could agree with the facts but deny certain *normative* claims. It might be argued that nation states have minimal moral obligations to other national states and hence mitigation is unethical. For example, President George W. Bush said in debate with with former Vice President Al Gore Jr.,

> I'll tell you one thing I'm not going to do, I'm not going to let the United States carry the burden for cleaning up the world's air, like the Kyoto treaty would have done.

It important to note that the epistemic profile of doubters can look very similar. Suppose Richard and Fred deny (1) - (4). Further suppose Richard is a skeptic and Fred a contrarian. How would we tell the difference? Suppose we provided both of them with evidence for (1). Richard would change his mind if he were presented with such evidence of increasing global temperatures whereas Fred would not. Thus, the chief difference between skeptics and contrarians concerns counterfactuals like this:

> All things being equal, if one were presented with evidence in favor of a claim which one does not already believe, then they would change their belief in proportion to the evidence.

We can empirically evaluate whether one is a skeptic or a contrarian. If they would change their beliefs in proportion to the evidence, then they are skeptics; if they would not, then they are contrarians.

With regard to *C*, we have three basic empirical questions:

- Is the planet warming up?
- Are we causing the planet to warm up?
- What will happen if we continue to warm the planet up?

The first question is answered in the affirmative by climate scientists.[4] First, global average surface temperature shows a warming of 0.85°C in the period 1880 -- 2012 based several independent sets of data. Nine of the ten warmest years recorded have occurred since 2000, and 2014 was the warmest recorded (Stocker et al., 2014, §2.4). Second, the glacial record since 1800 shows that mean glacier length has been declining at an accelerating rate (Stocker et al., 2014, §4.3). Third, sea level rise has increased; tide gauges show that over the twentieth century sea level rose by about 1.7mm between 1901 and 2010 (Stocker et al., 2014, §3.7). Fourth, there has been sea ice decrease; e.g. annual mean Arctic sea ice extent has decreased from 1979 -- 2012 with a rate very likely between 3.5 -- 4.1% per decade (Stocker et al., 2014, §4.2). Thus, we should not be trend doubters.

The second question is also answered in the affirmative by climate scientists. The first component of the science concerning global climate change is the greenhouse effect which was first discovered by John Tyndall (Tyndall, 1861) though Jean-Baptiste Joseph Fourier had documented the atmosphere's effect of the Earth's temperature (Fourier, 1827). The greenhouse effect occurs

[4]For a excellent collection of the original papers on which current climate science is based, see (Archer and Pierrehumbert, 2011) and for a history of the same science, see (Weart, 2008). Interestingly, doubters of evolution have a "common core" of texts to reference including books by Michael Behe, William Dembski, Michael Denton, Duane Gish, Philip Johnson, and Henry Morris. There is no such "common core" with climate doubters. Their works is spread through multifarious publications both in print and online. However, this collection presents the varieties of climate doubt by the main figures (Moran, 2015).

as incoming solar radiation is reflected by the surface of the Earth and that radiation is trapped by greenhouse gases. The greenhouse gases include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), and water vapor. This effect has been known for quite some time and has been demonstrated experimentally. Atmospheric concentrations of CO_2, CH_4, and N_2O have all increased since 1750 due to human activity as was clearly demonstrated in the case of CO_2 by Charles Keeling (Keeling, 1960). In 2011, they were 391 ppm, 1802 ppm, and 324 ppb respectively exceeding pre-industrial levels by approximately 40%, 150%, and 20%. Amazingly, concentrations of CO_2, CH_4, and N_2O are greater than the highest concentrations found in ice cores for the past 800, 000 years (Stocker et al., 2014, §5.2, 6.1, 6.2).

Suppose one does accept that the Earth is warming but denies that the primary explanation is human fossil fuel emissions. What would the alternatives be? One alternative is orbital variations; i.e. Milankovitch cycles. The Milankovich cycles are caused by changes in the shape of the Earth's orbit around the sun, the tilt of the Earth's rotational axis, and its axial tilt. However, climate scientists deny that these cycles can explain the temperature increase since there is a mismatch of time scale. The orbital variations happen on the order of 100,000, 41,000, and 26,000 years respectively and the warming we have observed is over the last 150 years (Dessler, 2011, §7.3). Another alternative is volcanic activity. It certainly is true that volcanoes can change the Earth's temperature; however, they would have to occur with the right frequency and magnitude and observed volcanic eruptions do not fit the pattern we find. Additionally, as originally shown by Hans Seuss (Suess, 1955), plants prefer ^{12}C to ^{13}C where ^{12}C makes up 99% of the carbon in the atmosphere and ^{13}C makes up 1%.[5] Fossil fuels are derived from ancient plants and thus if the burning of fossil fuels was contributing to increases in CO_2 emissions, we should see the ratio of increase $^{13}C/^{12}C$ which is exactly what we find (Dessler, 2011, §5.5). Last, some hypothesize that solar variation is the driver of temperature increase. However, this is not so for several reasons. First, there has been a 11-year solar cycle measured over past decades but the ocean's thermal inertia is insensitive to it. Second, if increased solar output were warming the atmosphere it would do so uniformly, but in fact the stratosphere (atmosphere above 10 km) is cooling (Dessler, 2011, §7.2). Thus, we should not be attribution doubters.

[5] ^{12}C and ^{13}C are different isotopes of carbon C. The former has six protons and six neutrons whereas the latter has six protons and seven neutrons.

The observed and projected impacts are anthropogenic climate change are on the whole negative though a few are thought to be positive (Intergovernmental Panel on Climate Change, 2014, 1.3.2). These impacts include changing precipitation; melting snow and ice; extinction, migration, distribution, and interactions of terrestrial, freshwater, and marine species; decreasing crop yields; climate-related extreme weather including heat waves, droughts, floods, tornadoes, and wildfires. Thus, we should not be impact doubters.

2.3 The Climate Wager

Let's now turn to the Jamesian wrinkle. C is an empirical claim which as we have seen has strong evidence in its favor. However, it concerns both belief and action.[6] When deciding what to do, we must include what we believe but also what we value. Decision theory (including game and social choice theory) is that framework in which rational decision-making is often formulated. Traditionally, decisions are a function of the probabilities of various ways the world might be and the utilities associated with our preferences or values. It is thought that an action is rational just in case it maximizes expected utility. Consider an extremely simplified decision matrix for C. For ease of exposition, we will use a touch of formalism. Let p be the probability that C occurs and $(1-p)$ be the probability that C does not occur; let u_{AC} be the utility of acting A as to stop C given C occurs, $u_{A\neg C}$ be the utility of acting A as to stop C given C does not occur, $u_{\neg AC}$ be the utility of not acting $\neg A$ as to stop C given C occurs, and $u_{\neg A\neg C}$ be the utility of not acting as to stop C given C does not occur. We thus have the following matrix.

	C	$\neg$C
A	pu_{AC}	$(1-p)u_{A\neg C}$
$\neg A$	$pu_{\neg AC}$	$(1-p)u_{\neg A\neg C}$

Table 1: The Climate Game

[6] A pragmatist like James seems to think of belief as a type of action (Gale, 1999). If James is correct, then the argument below is much easier to make.

Thus, acting as to stop C maximizes expected utility if, and only if,[7]

$$pu_{AC} + (1-p)u_{A\neg C} > pu_{\neg AC} + (1-p)u_{\neg A\neg C}$$

Of course, this matrix is oversimplified since C occurring or not does not represent all of the relevant states of the world for us, and there are a variety of other actions available to us not represented. However, this simple example makes an extremely important point. Suppose contrary to the evidence above, p is extremely low as trend and attribution doubters allege. Nevertheless, the rational course of action may be to act if the utilities associated with not acting are sufficiently bad compared to the utilities associate with acting.

Consider an famous example from Blaise Pascal. Suppose the probability that God exists is close but not equal to zero, the utility of believing God exists given God does exist is $+\infty$ (i.e. heaven), the utility of believing that God exists when God does not exist is a negative finite value, the utility of not believing God exists when God does is $-\infty$ (i.e. hell), and the utility of not believing God exists when God does not exist is a positive finite value. It follows that the expected utiilty of believing is $+\infty$ and the expected utility of not believing is $-\infty$. Pascal argued that even if the probability of God existing is extremely low, the stakes are so great that it is obvious what the rational choice is; one should believe.[8]

To use a more flatfooted example, rational homeowners purchase insurance in the case of a fire. The probability of one's home burning to the ground is extremely low but the utility of it occurring is extremely bad. Hence, if we take it to be rational to purchase home insurance to prevent our homes burning to the ground, would it not also be rational to act as if C is true since it is far more likely? Incidentally, it is no accident that the insurance industry is very much concerned about C since there has been an tenfold increase in economic losses between the 1950s and the 1990s due to extreme weather (Houghton, 2009, 4). Thus, when deciding how we should act, we must be Jamesians and include not just evidence that are beliefs are correct but also the utilities associated with

[7]To determine the expected utility of an action, we multiply the probability and utility of each cell along the row, and then sum across the columns. The action which has the greatest expected utility is the rational one.

[8]Actually, provider that the probability of God's existence is greater than zero, no matter how small it is, it is rational to believe given the utilities. Pascal's wager is generally considered unpersuasive since the utilities reflect only a Christian God. But, if we can have next to no evidence for such a theology which he himself grants, then why assume those utilities and not others?

the consequences of being correct and incorrect. *Even if* doubters are right that the evidence for C is weak, it does not follow that we should not act as if *C* is occurring given the stakes involved (Haller, 2002).

In this section, first we distinguished between skeptics and contrarians along with different types of doubt regarding anthropogenic climate change. Second, we considered the evidence for *C* and other claims associated with it and found there there is good evidence on their behalf. Third, given that *C* concerns action and not just belief, we considered a pragmatic argument for action even when our confidence in *C* is low. In the next section, we consider issues related to the consensus regarding *C*, the public, and detractors.

3 Consensus and All That

3.1 The Scientific Consensus

The American public is divided over *C*, but climate scientists are not. Several studies have demonstrated this consensus but the most famous of these is Oreskes (2004). Naomi Oreskes argued there is a consensus regarding this claim amongst climate scientists,

> Average surface temperatures are increasing in part because of human greenhouse gas emissions.

She and her assistants surveyed over 928 abstracts of articles in peer-reviewed journals with the search term 'global climate change' through the Web of Science. Each essay was placed in one of the following categories.

1. Those explicitly endorsing the consensus position,
2. Those explicitly refuting the consensus position,
3. Those discussing methods and techniques for measuring, monitoring, or predicting climate change,
4. Those discussing potential or documenting actual impacts of climate change, those dealing with paleoclimatic change, and
5. Those proposing mitigation strategies.

Oreskes found that there were no papers in category (2). That is, she found no essay which disagreed with the claim that "Global climate change is occurring, and human activities are at least part of the reason why."

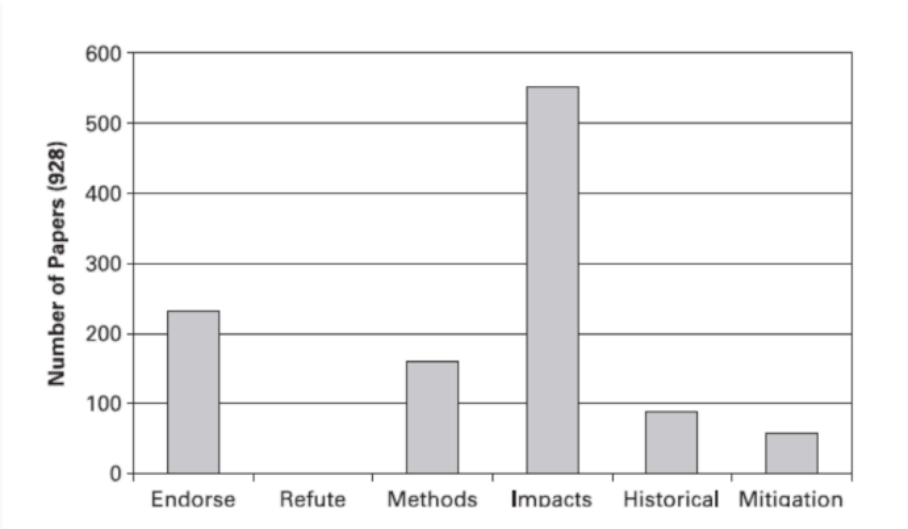

Figure 1: Oreskes' 2004 Consensus Study

Some have criticized the study. Roger Pielke Jr. argued that the study does not represent the variation of belief consistent with the consensus (Pielke Jr, 2005). Climate scientists could agree with regard to Oreskes' focal statement but disagree over much else regarding climate change. Of course that is true, but irrelevant to the study's question. Additionally, one might argue peer-reviewed research paper's consistency with the consensus does not mean the authors accept that consensus. Oreskes provides a persuasive response to this point.

> If a conclusion is widely accepted, then it is not necessary to reiterate it within the context of expert discussion. Scientists generally focus their discussions on questions that are still disputed or unanswered rather than on matters about which everyone agrees. (Oreskes, 2007, 72)

One does not see common descent argued for in the journal *Evolution* since it is taken for granted by evolutionary biologists. If we only included papers that

explicitly accept common descent, one would underestimate the acceptance of evolution. The same point holds with regard to anthropogenic climate change.

Peter Doran and Maggie Zimmerman did another study of the consensus amongst climate scientists (Doran and Zimmerman, 2009). They sent a survey to 10, 257 earth scientists who were geosciences faculty, researchers at state geological facilities associated with local universities, researchers at U. S. research facilities, and U.S. Department of Energy national laboratories (Doran and Zimmerman, 2009, 21). They asked two questions,

- When compared with pre-1800s levels, do think that mean global temperatures have generally risen, fallen, or remained relatively constant?
- Do you think human activity is a significant contributing factor in changing mean global temperatures?

Doran and Zimmerman determined that 90% answered "risen" to the first question and 82% "yes" to the second. When considered only the answers of those who listed "climate science" as their area of expertise and published more than 50% of their recent peer reviewed papers in this area, then 96.2% answered "risen" to the first question and 97.4% "yes" to the second question.

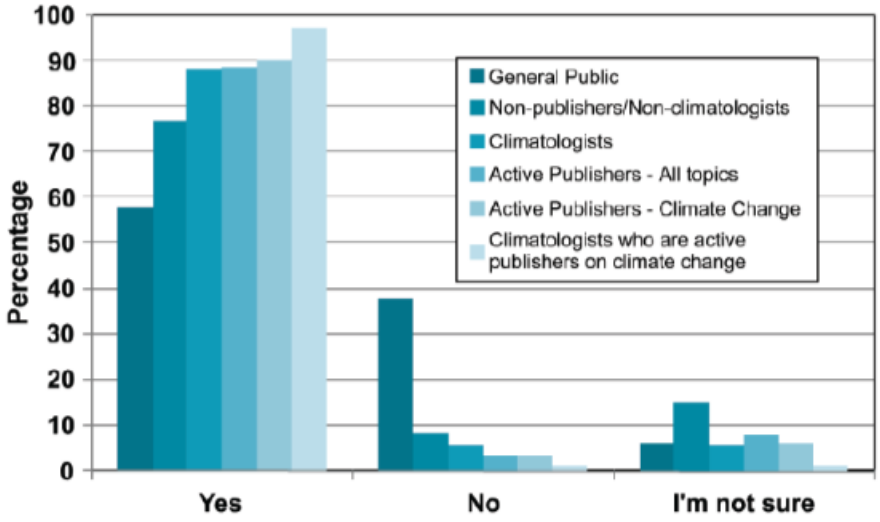

Figure 2: Doran and Zimmerman's 2009 Study

Another study by William Anderegg et. al. selected 908 from 1, 372 climate scientists who had published at least twenty climate science papers and who had signed petitions opposing or supporting the positions taken by the IPCC, or had co-authored one more reports associated with the IPCC (Anderegg et al., 2010). They determined that 97 -- 98% agreed that,

> [I]t is "very likely" that anthropogenic greenhouse gases have been responsible for "most" of the "unequivocal" warming of the Earth's average global temperature in the second half of the 20th century. (Anderegg et al., 2010, 12901)

Finally, John Cook et. al. tried to add quantitative detail to our understanding of the consensus position (Cook et al., 2013). Through a Web of Science search, they considered a variety of claims including the following "explicit endorsement with quantification."

> The global warming during the 20th century is caused mainly by increasing greenhouse gas concentration especially since the late 1980s. (Cook et al., 2013, 3)

Of the 11, 944 peer-reviewed climate science, only 75 in total either explicitly endorsed quantitatively or explicitly rejected quantitatively anthropogenic climate change with 87% endorsing the consensus view with 75 in total falling in these two categories. With regard to qualitative endorsement, 96% endorsed the consensus positions. Recently, David Legates have contested this finding (Legates et al., 2013). They write,

> But by taking into account that more than one-third of the 64 abstracts do not, in fact, endorse the quantitative hypothesis in Cook et al. (2013), the true percentages endorsing that hypothesis are 0.3 % and 1.0%, respectively. Accordingly, their stated conclusion is incorrect.(Legates et al., 2013, 309)

But this is a fallacious argument. Cook et. al. asked of those peer-reviewed climate science papers that either explicitly endorse or reject the quantitative statement of the consensus, what percentage endorsed it? Legates et. al. change the question to this: of those papers that either implicitly or explicitly endorse or reject the statement of the consensus, what percentage explicitly endorse the quantitative statement of the consensus? This is an irrelevant comparison.

We can safely conclude from the work of Oreskes, Doran and Zimmerman, Anderegg et. al., and Cook et. al. there is a consensus regarding *C* amongst the experts.

3.2 Dissent in Science

Doubters of *C* correctly note that scientific consensus about a claim does not make or guarantee that it is true. As examples, the majority of scientists believed that the Earth was at the center of the solar system, continents do not drift, and species are not related by common descent. That is, scientists *en masse* believed claims later demonstrated to be false. As climate scientist Richard Lindzen writes,

> With respect to science, the assumption behind consensus is that science is a source of authority and that authority increases with the number of scientists. Of course, science is not primarily a source of authority. Rather, it is a particularly effective approach to inquiry and analysis. Skepticism is essential to science; consensus is foreign.[9]

Philosophers of science have recognized that dissent is fundamental to scientific progress. Different research groups are motivated out of self-interest to defend their hypotheses against incompatible ones of other research groups. Moreover, research groups whose work depends on those hypotheses will be motivated to do the same. The point is that objective inquiry can emerge out of "base" motivations, and dissent is critical to objectivity in science (Kitcher, 1995).

As we have seen there is a consensus amongst the relevant scientists.[10] One might argue that just because there is a scientific consensus concerning *C* doesn't make *C* true. This is true but irrelevant. The consensus matters especially with

[9] `http://marshall.wpengine.com/wp-content/uploads/2013/08/Lindzen-Climate-Alarm-Where-Does-It-Come-From.pdf`

[10] Some doubters argue that there are skeptics with regard to *C*. One purported example is and the "Oregon Petition" created by Arthur Robinson who is President of the Oregon Institute of Science and Medicine, which has over 30,000 signatories. But, it is worth noting that only approximately 9,000 of them have Ph.D.s with the vast majority of those being engineers. Thus, they lack the relevant scientific background to evaluate *C*. It is also notable that Frederick Seitz wrote a cover letter endorsing the content of the petition.

regard to policy-makers rather than climate scientists. Suppose you are a policy-maker working on climate related issues and you ask, should I believe C? You of course have an extremely difficult time evaluating the evidence for C with its tree rings, glacial retreat, ices, satellite measurements, and so forth. The most reasonable way to form your beliefs would be to find expert opinion and proportion your beliefs in accordance.

One way of making this clear is through Condorcet's Jury Theorem. Suppose that truth of an expert's or research group's collective belief regarding Q is probabilistically independent of other such experts. Further suppose that the probability that an expert or group i is correct about Q is p_i. Finally, assume for i, $\frac{1}{2} < p_i < 1$. We can prove that as $i \to \infty$, then $\Pr(Q) \to 1$. That is, as the number of independent experts that agree with Q, the greater the probability that Q is true. Of course, experts and research groups are not strictly speaking independent of one another, but analogues of the Theorem can be proved where statistical dependence is included (Hawthorne, 2001; Ladha, 1992; Estlund, 1994). Hence, if the assumptions of the Condorcet Jury Theorem apply to expert's opinion regarding C, we have an argument that scientific consensus about C amongst climate scientists would be evidence for policy-makers. It is also worth noting that this argument applies to non-expert scientists too -- if you are an economist or evolutionary biologist, you should do the same.

If we suppose then that consensus regarding C is truth-indicative, then policy-makers should proportion their degree of belief in accordance to the expert's degree of belief in C. The IPCC is an organization that represents the expert's degree of belief in this consensus position.[11] It does not conduct research on its own, but collates, evaluates and synthesizes climate science done around the world. A Panel of delegates from the represented countries elect the IPCC Chair and Bureau, and governments and organizations nominate experts that are ultimately chosen by the Bureau. There are three working groups including Working Group I which considers the physical science behind climate change, Working Group II which considers the impacts, adaption, and vulnerability due to climate change, and Working Group III which considers mitigating the climate change that occurs. The working groups each have Coordinating Lead Authors one from a developing and another from a developed country. They coordinate their respective chapters. The Lead Authors work as a team to produce the content in their respective chapters and are supported by Contribut-

[11]The information that is discussed in this subsection can be found here `http://www.ipcc.ch/activities/activities.shtml`

ing Authors whose research is published in peer-reviewed journals. After the authors prepare a first-draft of their chapters, experts are nominated by governments or organizations to evaluate the draft for its completeness and accuracy. The generated comments by these experts are then brought together by the Technical Support Unit, and a second-draft is written, and additionally a draft of the Summary for Policymakers is written. The final draft is submitted for acceptance by the Working Group responsible for it and the Summary for Policymakers is then edited line-by-line for approval. Lastly, the Panel approves the Summary and notes any remaining disagreement.

Each IPCC involves enormous numbers of expert scientists. IPCC Assessment Report Five (IPCC AR5) had over 830 lead authors from 85 countries with 301 of which were from developing nations. There were 179 female authors and 63% of the authors did not participate in IPCC AR4. As one example, Working Group I had 21, 400 comments given on its first-draft by 659 experts and had 31, 422 comments given on its second draft by 800 experts and 26 governments. Similar results occurred with regard to the other Working Groups. This assessment done by the IPCC is remarkable. But we should recognize that other scientific bodies have done assessments and have come to the same conclusions including the American Academy of Science, the American Meteorological Association, the American Geophysical Union, and the American Association for the Advancement of Science.

3.3 Merchants of Doubt

There have been several arguments offered for dismissing doubters and I will consider two. One such argument is given by Ross Gelbspan in his (Gelbspan, 1998). He provides documentation that climate doubters are contrarians since they have been funded by the oil and gas industry and many in this industry deny *C*. As one example, consider Patrick Michaels who is Director for the Center for the Study of Science at the Cato Institute (Gelbspan, 1998, 40-44). Gelbspan claim that Michaels has received more than $115, 000 from coal and energy interests. A quarterly publication *World Climate Review* was founded by Michaels and was funded by the contrarian group Western Fuels Finally, he was paid $100,000 by the electric utility Intermountain Rural Electric Association which also denies *C*. Though this argument is suggestive, one can argue it is a circumstantial ad hominem. Surely Michaels might have been convinced that *C* was false before he was paid to offer his views in public fora. If the Gelbspan argument is to be convincing, one must show Michaels denies *C because* he

received money to do so.

More recently, Naomi Oreskes and Erik Conway have chronicled the history of climate denial (Oreskes and Conway, 2010). Their story centers around the George C. Marshall Institute founded in 1984 and scientists whose careers were built around Cold War nuclear weapons. Robert Jastrow was an astrophysicist who headed the Goddard Institute of Space Studies, William Nierenberg who as a nuclear physicist who worked for the Manhattan Project and directed Scripps Institute of Oceanography, and Fred Seitz a physicist who was president of the U. S. National Academy of the Sciences and worked on the atomic bomb. In the 1980s, they worked together on U. S. President Ronald Reagans' Strategic Defense Initiative. Since many believed that the "Star Wars" program would destabilize the Cold War, 6, 500 American scientists and engineers signed a petition boycotting funds for the program. Jastrow, Nierenberg, and Seitz began writing articles, opinion pieces, and white papers defending the program -- all three had strong anti-communist and pro-free market views. In 1979, Seitz began to work for the R. J. Reynolds Tobacco Corporation as a consultant in which he distributed more than $45 million to scientists for research that could cast doubt on the negative effects of cigarettes. After 1989, a new target was found; they had environmentalists in their sights. The "watermelons" (green on the outside and red on the inside) would then be subject to the same strategies. The Marshall Institute would drum up skepticism regarding acid rain, DDT, the ozone hole, and anthropogenic climate change. The techniques involved cherry picking data, stressing "balanced" opinions, and highlighting scientific uncertainty. Oreskes and Conway do not claim that there were financial incentives that motivated them directly. Rather, they claim that the deception arose due to a "free market fundamentalism" and its commitment to deregulation.

We can see this specifically in the work of Fred Singer who was a nuclear physicist employed by the Reagan administration to cast doubt on acid rain. In the 1990s he worked with Nirenberg and Seitz to challenge scientific opinion about the ozone hole and climate change. Additionally, he began to work for the Philip Morris tobacco company arguing that second-hand smoke was not bad for our health. The Environmental Protection Agency authored a report claiming that passive smoke was carcinogenic and an independent scientific panel reviewed the evidence and concurred. Singer and lawyer Kent Jeffreys challenged the EPA's report writing,

> If we do not carefully delineate the government's role in regulating

> dangers, there is essentially no limit to how much government can ultimately control our lives. (Oreskes and Conway, 2010, 249)

Jeffreys himself was affiliated with the Cato Institute and the Competitive Enterprise Institute. Both are think tanks with a mission of defending freedom, free markets and deregulation. With the U. N. Framework Convention on Climate Change and the Kyoto Protocol, we see an ever expanding group of think tanks who spread doubt regarding anthropogenic climate change.

Oreskes and Conway's claim then is that because these scientists doubted consensus positions across distinct scientific issues and yet held the same deregulation, pro-free market positions, the driver of their opinions was almost entirely political and not scientific. Put differently, it is extremely improbable for them to take the same doubting and deregulation positions across independent scientific issues if the political ideologies were not doing most of the work.

3.4 Climategate

Climate doubters have argued that climate scientists themselves have been guilty of deceit and distortion. The most discussed instance is "Climategate." During November 2009, the Climate Research Unit (CRU) of the University of East Anglia was hacked with 1, 073 emails made public. CRU is known for its global record of instrumental temperature measurements and for publishing reconstructions of pre-1850 temperatures based on tree rings. Doubters claimed that CRU scientists had engaged in deceitful and faulty science. In order to appreciate what occurred, let's consider three examples of emails that were leaked.[12] Climate scientist Phil Jones writes,

> I've just completed Mike's Nature trick of adding in the real temps to each series for the last 20 years (ie from 1981 onwards) and from 1961 for Keith's to hide the decline.

Some believed that this was an admission by Jones of attempting to hide the recent decline of temperatures. However, the phrase 'Mike's Nature trick' refers to a technique for integrating recent instrumental data and reconstructed data. Moreover, 'decline' refers to decreasing reliability of inferring temperatures

[12]One can find the most discussed emails here: `http://www.telegraph.co.uk/news/earth/environment/globalwarming/6636563/University-of-East-Anglia-emails-the-most-contentious-quotes.html`

from tree ring data after 1960, which is known as the "divergence problem" in the scientific literature. Thus, an attentive reading of the email and scientific discussion removes doubt regarding Jones' email.

A second email is from climate scientist Kevin Trenberth. He writes,

> The fact is that we can't account for the lack of warming at the moment and it is a travesty that we can't.

Some take this email to reference the fact that global warming has ceased. However, again it is clear from context that he is discussing a paper he had published regarding the difficulty of tracking energy flows in the climate system that lead to short term cooling trends.

As one last example, in 2003 aerospace engineer Willie Soon and astronomer Sallie Baliunas published a paper in the journal *Climate Research* that argued after reviewing over two hundred climate proxy studies that the twentieth century is not the warmest of the last millennium. Rather, the Medieval Warming Period between 800 -- 1300 and the Little Ice Age of 1300 -- 1900 were. Phil Jones wrote an email to Michael Mann saying,

> I think the skeptics will use this paper to their own ends and it will set paleo back a number of years if it goes unchallenged. I will be emailing the journal to tell them I'm having nothing more to do with it until they rid themselves of this troublesome editor, a well-known skeptic in NZ. A CRU person is on the board but papers get dealt with by the editor assigned by Hans von Storch.

Climate scientist Michael Mann wrote back,

> This was the danger of always criticising the skeptics for not publishing in the "peer-reviewed literature." Obviously, they found a solution to that -- take over a journal! So what do we do about this? I think we have to stop considering "Climate Research" as a legitimate peer-reviewed journal. Perhaps we should encourage our colleagues in the climate research community to no longer submit to, or cite papers in, this journal. We would also need to consider what we tell or request of our more reasonable colleagues who currently sit on the editorial board...

Some doubters argued that Jones and Mann were attempting to stifle the peer-review process and prevent papers challenging *C* from being published. However, Soon and Baliunas' paper has been sharply criticized since they did not quantitatively analyze the data and their definition of 'climate anomaly' had nothing to do with temperature which was flawed given the topic of the paper. Subsequently, five editors of *Climate Research* resigned from the board (which comprised one half of the editorial board). The editor-in-chief Hans Von Torch ultimately claimed that the review process had failed to uncover serious methodological flaws in the paper and that criticisms of it were correct.[13]

Given these emails along with a few others and the controversy that swirled around them, various institutions independently investigated them and Pennsylvania State University, the United Kingdom's House of Commons Science and Technology Committee, and the National Science Foundation all found that there was no wrongdoing. Most importantly however, suppose that these emails revealed deception and fabrication on the part of these scientists. This would not impugn the arguments we mentioned above in favor of *C* nor the consensus that was discussed above.

In this section, we first considered the scientific consensus regarding *C*. Second, we looked into the "merchants of doubt." Finally, we explored the controversy surrounding Climategate. We can know considered the psychological issues surrounding *C*.

4 Psychology

4.1 American Public Opinion

Let's now consider what Americans actually believe with regard to *C*. In the most recent Gallup poll, Americans clustered into three groups, *concerned believers*, *mixed middle*, and *cool skeptics*.[14] Concerned believers are those who attribute climate change to human actions and are worried about it. Cool skeptics are those who are not worried about climate change and believe it is due to natural changes. The mixed middle are those who are mixed with regard

[13]For more information on this debate, see http://chronicle.com/article/Storm-Brews-Over-Global/27779/ and http://www.gpo.gov/fdsys/pkg/CHRG-108shrg92381/html/CHRG-108shrg92381.htm

[14]http://www.gallup.com/poll/168620/one-four-solidly-skeptical-global-warming.aspx

to concern, cause, and effects. Pollsters found that as of 2014, 39% of Americans are concerned believers, 36% are in the mixed middle, and 25% are cool skeptics.

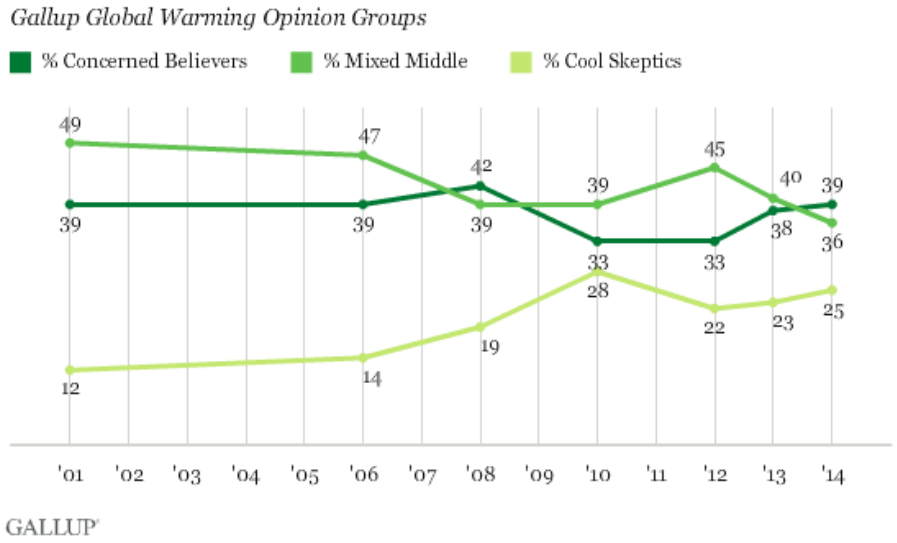

Figure 3: Gallup Global Warming Opinion Groups

It fascinating that the percentage of cool skeptics has increased, the mixed middle has decreased, and the concerned believers have remained relatively constant over the last fourteen years. Interestingly, the pollsters found that the opinion groups differed by gender, age, and politics. Concerned believers are more likely to be women than men; cool skeptics are even more likely to be male. The majority of concerned believers are younger than 50 whereas the majority of cool skeptics are older than 50. Finally, 76% of concerned believers are Democrats or lean towards the Democratic party and 80% of cool skeptics are Republicans or lean towards the Republican party. The last interesting feature of this poll is that the educational differences between concerned believers and cool skeptics are negligible.

	Concerned Believers	Mixed Middle	Cool Skeptics
High School$\leq$	37	48	35
Some College	29	28	30
College Graduate	14	12	17
Postgraduate	19	10	18

Table 2: Gallup Global Warming Opinion Groups -- Demographic Profile

As we shall see, these data and others like them will be important for our discussion below.

4.2 Scientific Literacy and Cultural Cognition

One might assume that *if* the public understood climate science better, then they would accept C. Such an assumption would be incorrect according to the work of Dan Kahan et. al. (Kahan et al., 2012). They attempted to test two hypotheses regarding public opinion regarding C; the *science comprehension thesis* and the *cultural cognition thesis*.

> (*SCT*) People fail to appreciate climate change because they lack scientific comprehension.
>
> (*CCT*) People fail to appreciate climate change because they identify risks through their social groups (i.e. conforming of beliefs to those that predominate within one's group).

With 1, 540 subjects, they were asked to rank climate change risk on a scale of 0 -- 10. Additionally, they distinguished between two social groups, *hierarchical individualists* and *egalitarian communitarians*.

> (*HI*) They think authority is tied to those with conspicuous social rankings and denies collective interference with such authorities.
>
> (*EC*) They favor less regimented forms of social organizations and greater collective attention to individual need.

Kahan et. al. reasoned that if *SCT* is correct, then increasing scientific literacy and numeracy will increase concern regarding climate change. Likewise, if *SCT* is correct, then cultural cognition should decrease with the most literate and

numerate even amongst hierarchical individualists. Finally, if *CCT* is correct, then hierarchical individualists will show less concern for climate change than egalitarian communitarians. However, as respondent's science-literacy scores increased, concern with climate change decreased. There was also a negative correlation between numeracy and climate change risk.

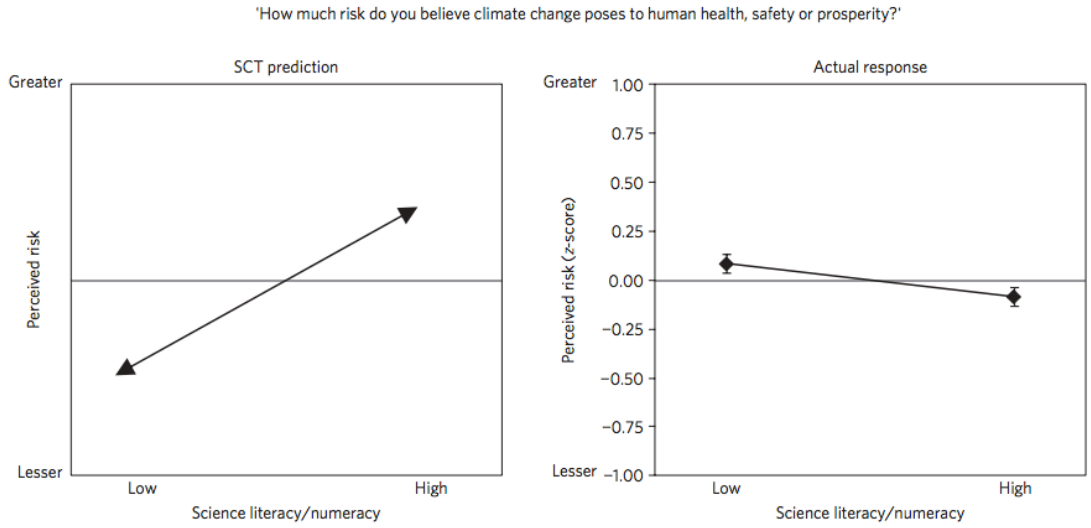

Figure 4: Kahan et. al. Scientific Literacy Study

Among *EC*, literacy and numeracy were positively correlated with concern. Among *HI*, they are negatively correlated with concern.

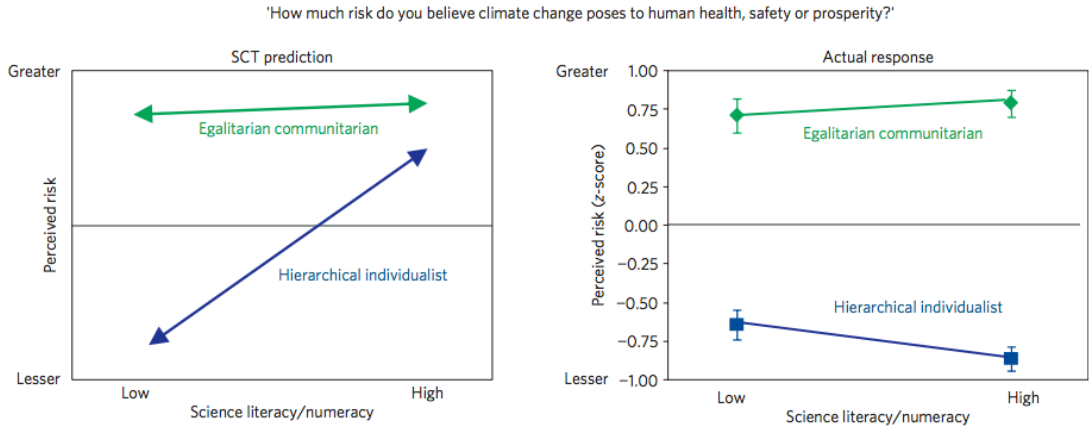

Figure 5: Kahan et. al. Scientific Literacy Study

Kahan et. al. write,

> For the ordinary individual, the most consequential effect of his beliefs about climate change is likely to be on his relations with his peers. A hierarchical individualist who expresses anxiety about climate change might well be shunned by his co-workers at an oil refinery in Oklahoma City. A similar fate will probably befall the egalitarian communitarian English professor who reveals to colleagues in Boston that she thinks the scientific consensus on climate change is a hoax. (Kahan et al., 2012, 3)

Given that we materially depend on others and we have no impact on climate change, then it is moral reasonable for people to form their beliefs about climate change in accordance their community.

One implication of this study is that often scientific literacy can provide one with skills for arguing against claims one already denies for moral reasons. As we shall see, we have good reason to think that moral judgments are based at least in part on our emotions, and are subject to a variety of cognitive biases that are difficult to combat.

4.3 Emotion and Moral Psychology

What is the nature of moral judgment? Sentimentalists claim that moral judgments essentially involve emotions. Rationalists deny this. If sentimental-

ism is correct, then has important implications for how we view disagreement amongst the American public over climate change since it is a moral issue. We first will consider the evidence for a sentimentalist moral psychology. There is a great deal of evidence that emotions co-occur with moral judgments.

First, neuroimaging studies show that brains areas correlated with emotion are active during moral judgment (Greene and Haidt, 2002; Heekeren et al., 2003; Sanfey et al., 2003; Moll et al., 2003; Singer et al., 2006). When subjects were asked to consider moral sentences versus neutral sentences; were offered inequitable versus equitable payoffs in the ultimatum games; or violations of social rules like spitting food at dinner as opposed to spitting due to choking; the parts of subject's brains associated with emotion were far more active than in the non-moral cases. Likewise, Greene et. al. (2001) showed using fMRI that emotions were involved in "trolley cases." Consider the following two cases.

> Switch problem: A runaway trolley is headed for five people who will be killed if it continues on it present course. However, you can hit a switch, which turn to trolley to a different track killing one bystander. Should you hit the switch?
>
> Footbridge problem: A trolley threatens to kill 5 people. You are standing next to very large stranger on a footbridge above the track. However, the only way to save the five is to push the one onto the track. Should you push them?

Most people say "Yes" and "No" respectively. Why? Customarily, the Footbridge case involved *killing a bystander*, whereas the Switch case involves *letting a bystander die*, and the former is thought always to be worse than the latter. Greene et. al.'s hypothesis is that pushing someone is emotionally more salient than merely flipping a switch (Greene et al., 2001, 2106). In one of the experiments conducted, they constructed sixty dilemmas some of which were moral and others non-moral. They then sorted those moral cases into "moral-personal" and "moral-impersonal." Nine participants responded to each of the sixty dilemmas while undergoing fMRI scans. Those areas of the brain associated with emotion were significantly more active in "moral-personal" than in "moral-impersonal" cases (Greene et al., 2001, 2107).

Second, if a subject's disgust is aroused, they judge actions to be morally worse. The arousal of disgust can even be aroused unconsciously (Schnall et al., 2008). Schnall et. al. asked subjects to morally evaluate stories while sitting a

desk which was clean or very dirty (e.g. has an old pizza box, chewed pencils, and a dirty cup). Subjects's moral judgments were much more harsh at the dirty desk in comparison to the tidy one. As another example, Wheatley and Haidt (2005) hypnotized subjects to be disgust whenever the words 'take' or 'often' were heard. When those words were heard, their moral judgments associated increased in severity.

Third, psychopaths cannot distinguish between moral and conventional transgressions due to emotional deficits (Blair, 1995). Moral norms are authority independent, general, and bad to violate, and conventional norms are authority dependent, specific and are not particularly bad to violate (Turiel, 1983). Blair found psychopaths have extreme difficulty discerning the difference between moral and conventional norms. Psychopaths also suffer deficits in affect. Thus, Blair and others have hypothesized that psychopath's failure to pass the moral/conventional task is that they lack certain emotions or affective capacities. Hence, they lack the ability to offer moral judgments.[15]

Fourth, when we are morally dumbfounded, we do not change our opinions (Haidt, 2003). Consider Haidt's cannibal story,

> Jennifer works in a medical school pathology lab as a research assistant. The lab prepares human cadavers that are used to teach medical students about anatomy. The cadavers come from people who had donated their body to science for research. One night Jennifer is leaving the lab when she sees a body that is going to be discarded the next day. Jennifer was a vegetarian, for moral reasons. She thought it was wrong to kill animals for food. But then, when she saw a body about to be cremated, she thought it was irrational to waste perfectly edible meat. So she cut off a piece of flesh, and took it home and cooked it. The person had died recently of a heart attack, and she cooked the meat thoroughly, so there was no risk of disease. Is there anything wrong with what she did?

Subjects when asked claimed eating human flesh is morally wrong. However, subjects could not give reasons that were not defeated by features of the case. Still, they would not change their minds. They were morally dumbfounded.[16] Moral judgments are more a product of emotion than reason.

[15]For critical response to this argument see Aharoni et al. 2012; Roskies 2003.

[16]For an interesting critical response to Haidt's work see Railton (2014).

It is clear that emotions are associated with moral judgment and this includes judgments regarding environmental issues (Ferguson and Branscombe 2010; Harth et al. 2013; Harrison and Mallett 2013; Mallett 2012; Mallett et al. 2013 however see Täuber et al. 2015). As one example, consider the study by Rees et al. (2014). Guilt, like shame, is self-directed emotion which occurs when one culpably violates a norm that generates reparative behavior. With guilt, the object of the emotion is one's action; with shame, the object of the emotion is one's self (Tangney and Dearing, 2003). Rees et. al. randomly assigned participants to either the experimental human-caused or the control naturally-occurring condition. First, guilt was more highly pronounced with regard to the human-caused manipulation than then naturally-occurring manipulation. Second, willingness to sign a petition regarding environmental pollution was higher amongst the human-caused condition (88.1%) than the naturally-occurring condition (70.9%). Moral emotions like guilt are clearly relevant to motivating pro-environmental behavior.[17]

4.4 Cognitive Biases

Starting with Herbert Simon and extending through the work of Daniel Kahneman and Amos Tversky, psychologists have argued that we make decisions using heuristics and those heuristics are subject to cognitive biases. Biases of the sort they described are very relevant to thinking about climate change.

The *availability heuristic* concerns our tendency to only consider options that easily come to mind (Tversky and Kahneman, 1974; Greenberg et al., 1989; Gardner and Stern, 2002). For example, it is much easier to consider extinction of polar bears as opposed to changes in albedo. Hence, the options we conceive of can be unrepresentative. The *anchor and adjustment heuristic* concerns how we anchor options with an example ranking the others in light of it (Tversky and Kahneman, 1974). For example, if we think of climate mitigation as requiring an extreme carbon tax, then mitigation will seem extreme. So, the severity of an option depends on our anchoring. The *loss aversion heuristic* concerns the fact that for some good or service, we are more strongly averse to losing it as opposed to gaining it (Kahneman and Tversky, 1979). This heuristic is related to the *the framing effect heuristic* in which the same information is associated with

[17]There are two provisos worth mentioning about the studies. First, the environmental issues included air pollution, fossil fuel consumption, and waste dumps which might not pertain to the effects of human-caused climate change alone. Second, the target population was one from Germany which might not export to the United States.

aversion or preference depending on framing (Tversky and Kahneman, 1981). The *temporal discounting heuristic* concerns our tendency to prefer rewards that occur sooner rather than later (Hendrickx and Nicolaij, 2004).

Different cognitive heuristics and biases are relevant to how we think and act regarding climate change. Our pro-environmental behaviors depend on the options we consider, their anchoring, their being represented as losses or gains, and how close or remote their impacts in time are. As we saw, how we view the climate change depends not simply on how much information we possess. The cognitive heuristic and biases go deep and we do not make poor decisions simply because of the absence of information (Nisbet and Mooney, 2009).

Our best account of moral psychology suggests several things. First, motivating pro-environmental behavior requires we present considerations people care about; otherwise they will lack motivation for behavioral change. Second, we must be on guard for cognitive biases. Arguments for action regarding climate change should relate to what really moves us in the short run concerning losses anchored in non-extreme ways with appropriate framing.

In this section, we considered recent work on American's opinions regarding *C* and the irrelevance of scientific literacy on the public's opinion regarding climate change arguing that cultural cognition was far more relevant. Second, we examined the evidence for a sentimentalist moral psychology in which emotion plays a much larger role than "reason" in moral judgment. Third, we considered various cognitive biases that affect our opinions on myriad topics but most certainly climate change. If we are to address doubts regarding *C* it will involve a lot more than climate science.

5 Communicative Strategies

We have come to several conclusions. First, the American public has polarized views of *C*. Second, the polarization is not due to scientific incompetence and hence is not to remedied by increasing scientific literacy. Third, moral judgments are are dependent on emotions and are affected by cognitive biases. Thus, how can one change public opinion to be responsive to the scientific consensus? How do we motivate the public morally regarding *C* (Gardiner, 2011; Jamieson, 2014)?

Climate change is an interdisciplinary subject of course. One area of inquiry which is directly relevant to our topic is rhetoric and communications.[18]

[18]There is quite a bit written on climate communication. Some recent books that are

We will first start by considering mistakes in climate communication that should be avoided. Then we will consider how we can respond to climate contrarians. Last, we will consider positive strategies to try to communicate about *C* in more effective ways.

The American Psychological Association suggests that there are several impediments to motivating pro-environmental behavior regarding climate change. First, uncertainty, and the public's lack of understanding of it, gets in the way of "green behavior." Second, most people do not believe the message of risk from scientists and the government. Third, a minority of people deny anthropogenic climate change. Fourth, after study of more than 3, 000 people in 18 countries demonstrated that many people believe our environmental conditions will get worse in the next 25 years; however, this framing may incline people to think that the relevant changes can be made later. Fifth, people often believe that their actions are inefficacious with regard to anthropogenic climate change. Sixth, we are creatures of habit and ingrained behaviors can only be changed slowly and are extremely resistant to change.

With regard to contrarians, there are several strategies that are recommended by Susanne C. Moser and Lisa Dilling. First, we must be familiar with the arguments and strategies of contrarians. For example, contrarians routinely confuse weather and climate. Weather concerns the conditions of atmosphere variables over a short period of time in relatively small spatial scales, and climate is how the atmospheric variables change over relatively long periods of time over relatively large spatial scales. Second, debates over *C* largely concern value conflicts and not science per se. Hence, it is best to remove science from the discussion and focus on the relevant normative issues. Third, contrarians because of their indifference to evidence, are best engaged in limited and focused ways. Skepticism as we have seen is healthy but contrarianism is not. We should focus on the mixed middle. Lastly, debates over *C* and whether they can be "won" depend on how the debate is framed. Hence, it is crucial to frame the debate in terms that do not prejudice the audience against *C* at the outset. Moreover

work examining are Hulme 2009; Norgaard 2011; Markowitz and Shariff 2012; Marshall 2014; Moser and Dilling 2006. There are also many very worthwhile online resources including the the following: http://guide.cred.columbia.edu/pdfs/CREDguide_full-res.pdf,http://www.apa.org/science/about/publications/climate-change.aspx,http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1407958, andhttp://www.isse.ucar.edu/communication/docs/Environ_32-46a.pdf,http://www.climateaccess.org/sites/default/files/Climate%20Crossroads%20Guide.pdf.

there are many different ways to frame climate change and so we have to attend to our audiences.

I now want to mention several strategies for trying to change public opinion. These are strategies recommended by those who study effective communications but the degree to which they will succeed is unclear. First, effective communication regarding *C* requires that one knows their audience. For example, in order to be trusted by a group one speaks to, it is best to be a member of that very group. If one is speaking to evangelical Christians about *C*, then one will be trusted more so if one is an evangelical Christian (e.g. Sir John Houghton or Katharine Hayhoe). Second, it is important to get the attention of one's audience by choosing a relevant frame. Some individuals respond to risk and thus framing *C* in terms of risks will more attention grabbing than alternative frames. But, some are more influenced by focusing on benefits and thus one might focus on profits of alternative energy instead. Third, we should translate scientific claims into concrete experiences specifically making the scientific claims place-based. If we are in Oregon, one can talk about the everlessened snowpack in the Cascades and the effects that will have. Third, we must be wary of the overuse of excessive emotional appeals. If we instill excessive fear in an audience, this can paralyze listeners. Additionally, if *C* concerns changes that are extremely difficult to achieve for individuals as opposed to collectives, they will feel impotent. If we couple extreme fear with impotence we are bound to fail only adding to "climate fatigue." Fourth, we need to address scientific uncertainties since the public often has a naive view of science. Specifically, they often assume that scientific theories make precise predictions that are simply confirmed or disconfirmed. This means that model projections regarding 2050 or 2100 which are increasingly more complex at smaller scales is simply very difficult for them to understand. Thus, it is important to address uncertainties up front since this can undercut their confidence for poor reasons and instead focus on what we know. Fifth, it is crucial to engage the social identifies of the groups one engages. As an example, amongst evangelical Christians 'environmentalism' is a negatively valenced word. It connotes pantheism and "treehuggers." Thus, green Christians simply avoid the term and have replaced it with notions of stewardship and "creation care." Sixth, insofar as individuals need to change their behavior, those changes need to be as easy as possible to make. Consider a college student who can contribute some of their fees to carbon offsets. We might have an "opt-in" policy by which they have to select this option or we might have an "opt-out" policy which uses those fees unless the student selects for this not to occur. The latter is far more effective because

it asks less of the student.

This is not a complete list of strategies for communicating and achieving change regarding people's beliefs and behavior regarding *C*. We live in a time in which we find ourselves desperate for ways to motivate change. The elements of this list are also not mutually exclusive. Motivating change regarding *C* will be more effective when as many of these strategies are employed as possible.

6 Conclusions

In this essay, we have covered many different topics. First, we began with different types of skepticism, regimented our terminology, examined the evidence for anthropogenic climate change, and pragmatic arguments for action even when we are uncertain. Second, we considered issues concerning the scientific consensus and role of dissent, the "merchants of doubt," and Climategate. Third, we turned to psychological issues regarding cultural cognition and the relative unimportance of scientific literacy, moral psychology, cognitive biases, and climate communication. Climate change is truly an interdisciplinary topic and thinking about how to think about climate skepticism is not easy. On the contrary, contrarians require us to bring all of our tools to the discussion.

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