The **Consensus** Handbook

Why the scientific consensus on climate change is important

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Introduction

Based on the evidence, 97% of climate scientists have concluded that human-caused climate change is happening. This scientific consensus has been a hot topic in recent years. It's been referenced by presidents, prime ministers, senators, congressmen, and in numerous television shows and newspaper articles.

However, the story of consensus goes back decades. It's been an underlying theme in climate discussions since the 1990s. Fossil fuel groups, conservative think-tanks, and political strategists were casting doubt on the consensus for over a decade before social scientists began studying the issue. From the 1990s to this day, most of the discussion has been about whether there is a scientific consensus that humans are causing global warming.

As the issue has grown in prominence, a second discussion has arisen. Should we even be talking about scientific consensus? Is it productive? Does it distract from other important issues?

This handbook provides a brief history of the consensus on climate change. We'll summarize the research quantifying the level of scientific agreement on human-caused global warming. We'll examine what the public thinks about the consensus, and the misinformation campaigns that have sought to confuse people. We'll look at how we should respond to misinformation and how best to communicate the consensus. Lastly, we'll answer some of the objections to communicating the consensus.

The consensus story has several important chapters. Seeing the full story is essential to understanding why scientific consensus is important.

Consensus on consensus

Naomi Oreskes was the first to quantify the level of expert agreement on human-caused global warming in 2004[1]. Analyzing 928 scientific papers on global climate change, she couldn't find a single peer-reviewed paper rejecting human-caused global warming. This was the first research that put hard numbers on the overwhelming scientific consensus, and was featured prominently in Al Gore's award-winning movie, *An Inconvenient Truth*.

> Among peer-reviewed studies examining expert agreement on climate change, there is consensus on consensus.

Since that seminal 2004 paper, a number of other studies have examined the scientific consensus in various ways. These include surveys of the scientific community[2,3,4,5], analyses of public statements about climate change[6], and analyses of peer-reviewed research into climate change[7].

A synthesis of this research – a survey of surveys – concluded that the expert consensus on climate change is between 90 to 100%, with a number of studies converging on 97% agreement[8]. Among peer-reviewed studies examining expert agreement on climate change, there is consensus on consensus.

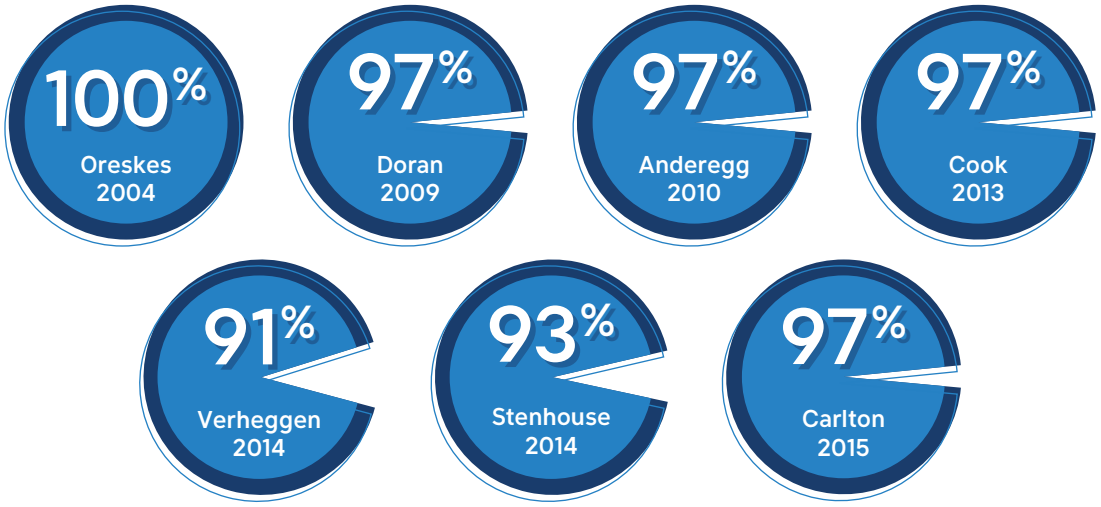

Figure 1: Summary of studies measuring agreement among climate scientists or climate papers on human-caused global warming.

What is a "climate expert"?

Clarifying what is meant by a "climate expert" is important to understand how misinformation campaigns have exploited confusion about experts in order to cast doubt on the consensus. In the context of climate change, most studies define a climate expert as a climate scientist publishing peer-reviewed climate research. For example, the first study finding 97% consensus looked at climate scientists actively publishing climate research[3]. The second study finding 97% consensus looked at scientists who had published peer-reviewed climate papers[6]. Analyses of scientific research have looked at papers published in peer-reviewed journals on the topic of "global climate change" or "global warming"[1,7]. The emphasis is on scientists who have published climate-related scientific research.

Why does the level of expertise matter? As expertise in climate science increases, so too does agreement that humans are causing global warming[8]. However, this link between expertise and consensus has made it possible for misinformers to cast doubt on the scientific consensus by appealing to groups with lower expertise in climate science. This technique is known as "fake experts" – portraying non-experts as subject matter experts in order to cast doubt on scientific consensus.

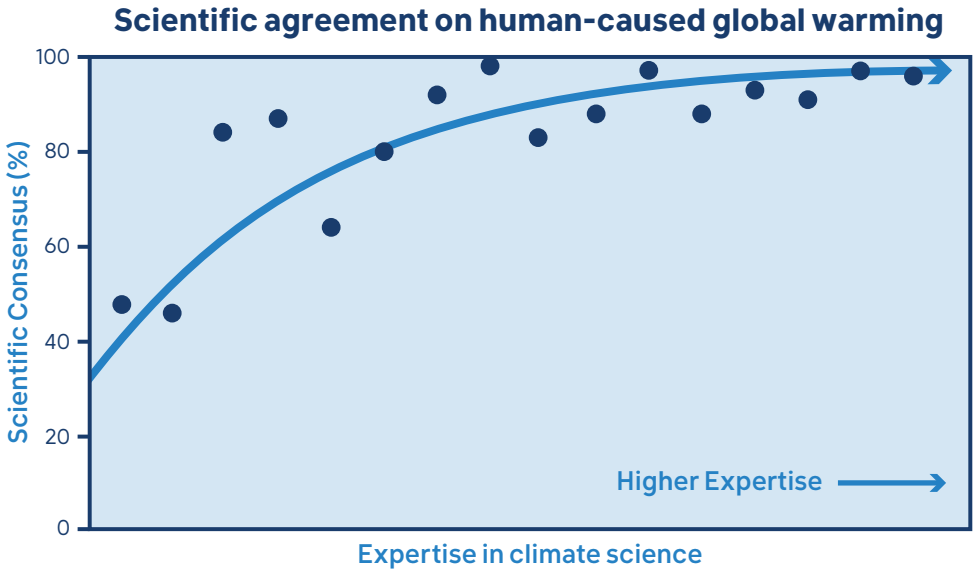

Figure 2: Scientific consensus vs. expertise in climate science. Each dot represents a group of scientists, from economic geologists to climate scientists publishing climate research. Groups with higher expertise in publishing climate research show higher agreement that humans are causing global warming[8].

The consensus gap

Despite many studies confirming the overwhelming scientific agreement on climate change, there is a gaping chasm between the actual 97% consensus and the public's perception of the consensus. On average, people think that around 67% of climate scientists agree that humans are causing global warming. An even more disturbing statistic is that only 13% of Americans are aware that the consensus is over 90%[9].

> ...there is a gaping chasm between the actual 97% consensus and the public's perception of the consensus.

This misconception doesn't just apply to the general public. Even many science teachers aren't aware of the consensus[10]. The unfortunate consequence of this misconception is that many teachers cover climate change by presenting contrarian viewpoints alongside mainstream climate science. As we'll see on Page 8, false-balance treatment of climate change has a misinforming effect.

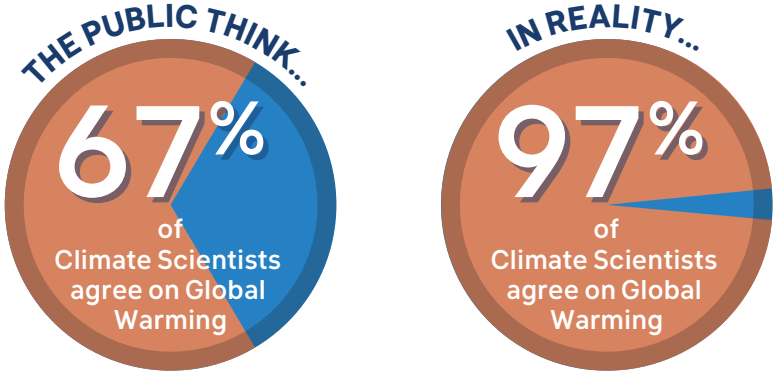

Figure 3: The consensus gap[8,9].

The role of politics and information

Why is there such a large consensus gap? Figure 4 reveals several contributors. First, we see that public perception of consensus varies widely across the political spectrum. The more politically conservative a person, the lower their perceived consensus. This means that political bias plays a large role in lowering perceived consensus.

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But even at the liberal end of the political spectrum, there's a gap between public perception and the 97% consensus. This means that information (either lack of awareness or the influence of misinformation) is arguably an even greater contributor to the consensus gap than political bias. This is not surprising given that misinformation campaigns have persistently confused the public about the consensus for nearly three decades[11, 12]. In fact, the first messages that the public heard about the consensus on climate change came in the form of misinformation.

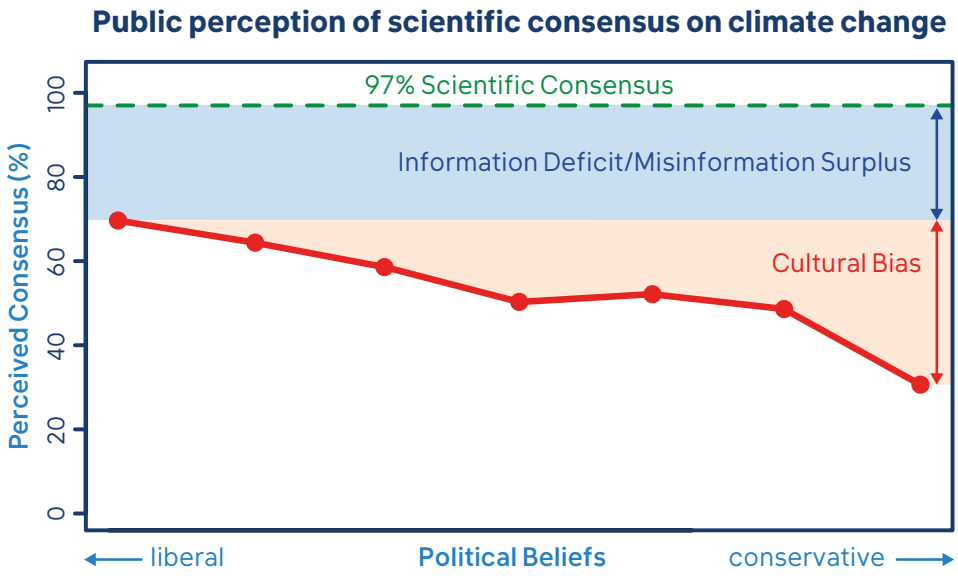


Figure 4: Perceived scientific consensus vs. political ideology measured in 2013[13].

Undermining the consensus

Over a decade before Naomi Oreskes first quantified the consensus, opponents of climate action began to cast doubt on the scientific consensus. The first public messages about the consensus on climate change were that there was no consensus.

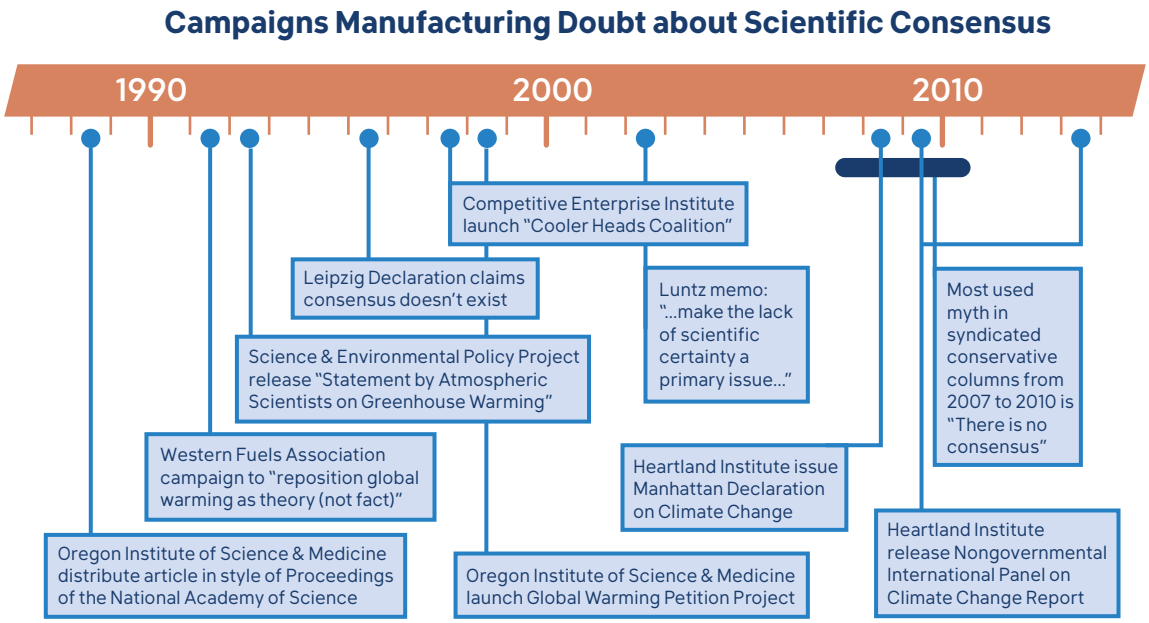


Figure 5: A timeline of misinformation campaigns casting doubt on the consensus on climate change.

As well as government-based misinformation, the fossil fuel industry were active in generating misinformation, using techniques that the tobacco industry had honed decades earlier[14]. In 1991, the Western Fuels Association spent over half a million dollars on a public relations campaign to "reposition global warming as theory (not fact)" [15 p.139].

One of the most prominent and potent misinformation campaigns against the consensus is the Global Warming Petition Project, launched in 1998. It is an online petition featuring over 31,000 Americans who have signed a statement claiming that humans aren't disrupting the climate. However, this petition uses the technique of fake experts (introduced on page 3); 99.9% of the signatories are not climate scientists (and many are not scientists, while others aren't real people). Further, while 31,000 seems like a lot, even if they were real scientists, they would represent only 0.3% of the 10 million Americans with a science degree.

Despite its fatal flaws, the Petition Project is both popular and effective in misinforming people. An experiment testing six common myths about climate change found that the Global Warming Petition Project was the most damaging in reducing acceptance of climate change[16]. An analysis of social media posts in 2016 found that the most shared climate article featured this petition[17].

More recent misinformation efforts by the fossil fuel industry, conservative think tanks, and other conservative writers have continued to attack the consensus. From 2007 to 2010, the most common argument in conservative op-eds about climate change was that there was no consensus[12].

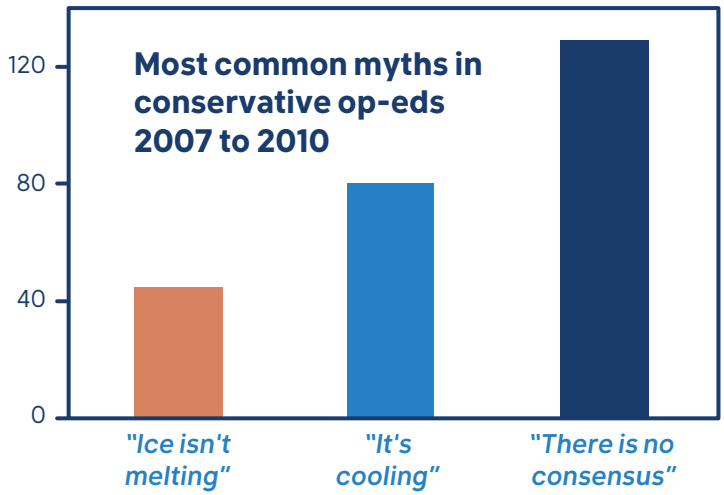


Figure 6: The three most common claims in conservative op-eds about climate change published from 2007 to 2010[12].

Undermining the existence of the scientific consensus has been a major strategy of opponents of climate action since 1990 and continues to be a dominant theme. Consensus misinformation can take many forms, including emphasizing uncertainty[38] and signed declarations. Another form of misinformation worth further examination is false-balance media coverage.

False-balance media coverage

One of the most insidious, albeit often inadvertent forms of climate misinformation is false-balance media coverage, where contrarian voices are given equal coverage with climate scientists. This stems from the journalistic norm assuming there are always two sides to an issue, thus giving mainstream and contrarian voices equal representation. As a result, a few dissenting scientists are given similar attention to the 97% of scientists who are convinced that humans are causing global warming.

Analysis of media coverage from 1988 to 2002 showed that newspapers often presented false balance media coverage of climate change[18]. While the situation has improved in prestige-press coverage[19], the tabloid press has shown no signs of improvement[20]. Similarly, 70% of U.S. TV coverage of climate change presents a false balance[21]. In short, much of what people learn about climate change from the media involves well-established scientific truth presented alongside groundless assertions.

What impact does this have? When people see two sides arguing a complicated scientific issue, they come away with the impression of an ongoing 50:50 debate. False-balance media coverage reduces the public's understanding across a range of issues[22,23,24]. When it comes to climate change, false-balance media coverage has been shown to lower perceived consensus[25].

How should the media cover climate change?

Covering climate change is a challenge for journalists. On the one hand, they should strive to maintain objectivity and balance. On the other hand, giving contrarians equal coverage with mainstream scientists when there is a scientific consensus misleads the public about the state of the science.

One way to present conflicting viewpoints without misleading is by presenting weight-of-evidence or weight-of-experts information. These approaches acknowledge multiple sides to a debate while also evaluating which side is supported by evidence and a scientific consensus[26]. This approach has been found to foster more accurate beliefs while also acknowledging contrarian viewpoints[27,28]. Media organizations such as the BBC have resolved to avoid false-balance coverage by consideration of due weight[29].

Visual exemplars such as a photo of scientists representing the state of scientific understanding are an effective way to communicate weight-of-evidence information[30]. However, too much information can overwhelm people – one study found combining weight-of-experts information with comments from scientists from each side made it hard for readers to distinguish between majority and minority views[23]. Consequently, it's more effective to provide a straightforward (ideally visual) summary of the state of expert agreement.

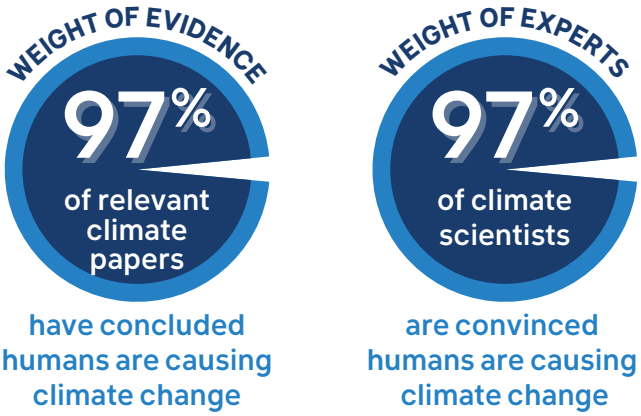


Figure 7: Weight-of-evidence[7] or weight-of-experts[2,3,6] visualisations.

To debate or not to debate

Debate is crucially important to climate science and in the case of human-caused climate change has already occurred over decades. The process of scientific debate is open to anyone—although it does require that participants subject their ideas to the scrutiny of the peer-review process, which is fundamental for the advancement of scientific knowledge[31]. However, contrarians refuse to participate in scientific debates: they do not present their views at scientific conferences, and have a negligible presence in the peer-reviewed literature. Instead, they demand special treatment by bypassing the usual scientific process and presenting unvetted ideas to the public.

How should one respond if invited to publicly debate mainstream climate science? Requests to "debate" climate science or the timing of climate impacts are for propaganda purposes and should be avoided. Agreeing to participate in such debates run the risk of misinforming the public by conveying the false impression that the scientific community is undecided on basic facts like human-caused global warming.

In contrast, debates over solutions to climate change are worthwhile. One response to an invitation to debate is to inform the organisers of the danger of misinforming the public by debating established science, and that a more appropriate and constructive debate topic is climate solutions. If the organisers persist in hosting a problematic debate, a further option is to issue a public statement explaining that you had advised the organisers not to go ahead due to the problematic nature of the event, but they went ahead regardless.

Impact of misinformation

Misinformation about the consensus has persisted for decades. What impact does this have on public perceptions of climate change? Misinformation affects people in several ways.

First, misinformation causes many people to believe false information. A study testing the effect of misleading statistics found that providing just a handful of misleading numbers was effective in lowering acceptance of climate change[32]. Another study tested six different pieces of climate misinformation and found that attacks on the consensus were the most effective in lowering acceptance of climate change[16].

Second, misinformation can cancel out the impact of accurate information. When people are presented with conflicting pieces of information, the two can cancel each other out[16,25,33]. In other words, misinformation doesn't just cause some people to believe falsehoods, it can stop them from believing the facts.

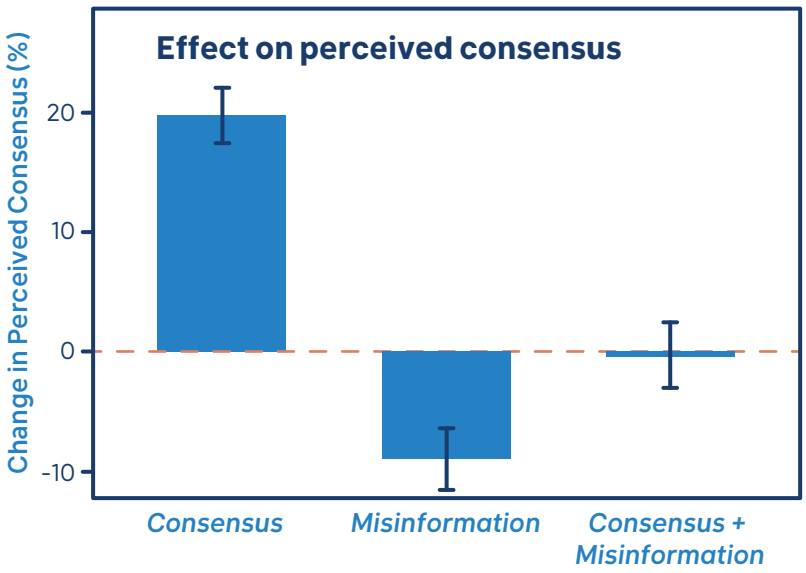
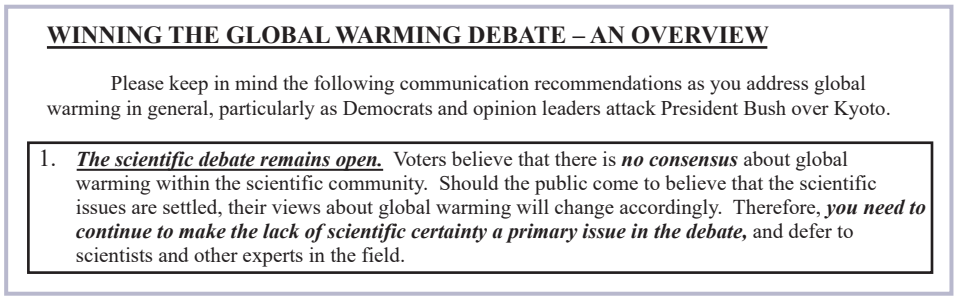


Figure 8: The effect of different types of messages about climate change. The first bar shows the positive effect of a 97% message. The second bar shows the negative effect of misinformation. The third bar shows how consensus information and misinformation cancel each other out[16].

Why attack consensus?

In 1998, the American Petroleum Institute along with other industry groups and conservative think-tanks teamed together to publish the "Global Climate Science Communications Plan" report. They surveyed over 1000 Americans and found that casting doubt on scientific agreement reduced concern about climate change. Their strategy was simple yet effective – recruit a handful of scientists to hit news organizations with a steady stream of misinformation. By exploiting the journalistic norm of covering both sides, the goal was to confuse the public through false-balance coverage of climate change.

Around the same time, political strategist Frank Luntz was conducting market research into how Republican politicians who opposed policies to stop global warming should talk about climate change [31]. He found that if people thought the experts disagreed about human-caused global warming, their opinions on climate policy would change accordingly. Luntz recommended casting doubt on the scientific consensus to win the policy debate. The (ethically dubious) merits of this communication strategy have been confirmed by subsequent research finding that when people are told that experts disagree, their support for environmental policy goes down [34].



WINNING THE GLOBAL WARMING DEBATE – AN OVERVIEW

Please keep in mind the following communication recommendations as you address global warming in general, particularly as Democrats and opinion leaders attack President Bush over Kyoto.

1. ***The scientific debate remains open.*** Voters believe that there is ***no consensus*** about global warming within the scientific community. Should the public come to believe that the scientific issues are settled, their views about global warming will change accordingly. Therefore, ***you need to continue to make the lack of scientific certainty a primary issue in the debate,*** and defer to scientists and other experts in the field.

Excerpt from the Luntz memo.

A gateway belief

Over a decade after fossil fuel groups and political strategists discovered the important role of perceived consensus and systematically began to undermine it, social scientists began to catch up. The first studies came in 2011 and 2013, finding that perceptions about scientific agreement are linked to support for climate policy and acceptance of science more generally [35, 36]. Later research built on this line of work, advancing the "Gateway Belief Model", which confirmed that what people think about expert agreement influences a range of other key climate attitudes, including whether global warming is real, caused by humans, resulting in serious impacts and importantly, whether we should act to solve it [37].

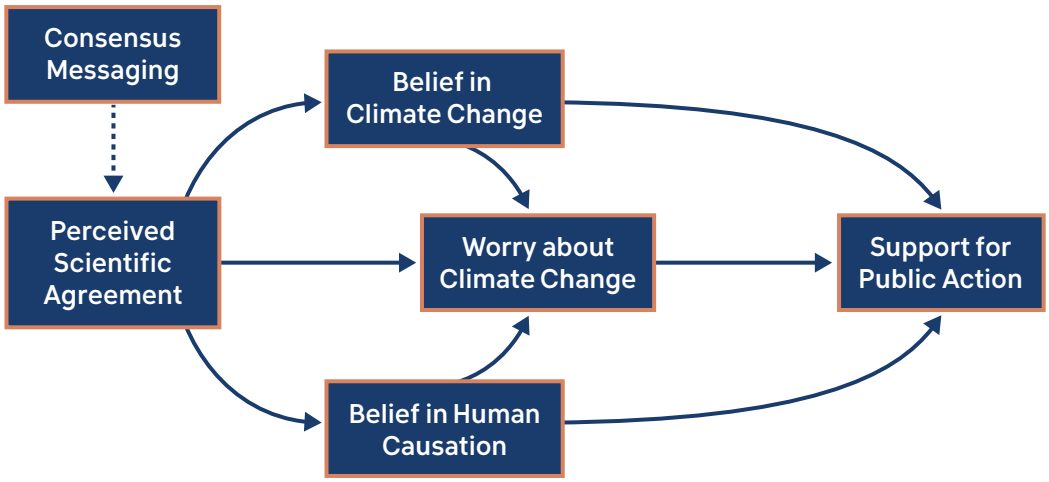


Figure 9: Perceived consensus as a gateway belief [37].

The status of perceived consensus as a gateway belief to acceptance of (climate) science has since been confirmed by a number of independent studies [35, 38, 39, 40]. This includes experiments finding that highlighting the 97% consensus increases acceptance of climate science [13, 36, 41, 42, 43].

Based on this research, communication experts have urged scientists to communicate the overwhelming agreement on human-caused global warming in order to address the misconception that scientists still disagree [44]. Informing people about the consensus is not a magic bullet that solves everything, but it is a powerful tool for helping people to understand climate change and reach appropriate conclusions about it.

The powerful role of heuristics: wisdom of the crowd

People simply don't have the time, energy (or infinite brain capacity) to become an expert on every topic they encounter. So they employ mental short-cuts or heuristics, either consciously or unconsciously, to help them make decisions. Much research has shown that heuristics do a fairly good job at helping people arrive at sound decisions [45], particularly in situations that are complex and uncertain.

> "...a useful heuristic is relying on the opinion of experts to guide one's views on complicated issues.

For example, a useful heuristic is relying on the opinion of experts to guide one's views on complicated issues. This approach makes a lot of sense – no one has time to research every issue they encounter and thus we have to defer to expert opinion. We are also often influenced by the opinion of other people, including peers and experts. Importantly, research has shown that group verdicts can be very accurate, and under certain conditions, more accurate than the individuals within the group. This socially-derived wisdom is known as the "wisdom of the crowd" [46, 47] and makes good sense on an intuitive level too. For example, we often feel better about getting a second, independent opinion when faced with a serious dilemma. It is therefore for good reason that humans pay very close attention to the opinions and judgments of others, and when an entire group of specialists all agree on something, that sends an important signal. In fact, relying on a select "crowd" of experts has been found to be both popular and reliable [48]. It makes sense mathematically too: Condorcet's Jury Theorem tell us that when judgments are aggregated independently (more or less), and when the probability of each individual being "correct" is 50% or higher (e.g. in the case of experts), adding more votes to the majority consensus will increase the likelihood that the consensus is correct [49].

••• Communication best practices

There are a variety of ways to convey the overwhelming agreement among climate scientists, and a number of studies have tested different approaches. One study that tested numeric versus non-numeric statements about the level of scientific agreement found that numeric statements were more effective[42]. For example, the statement "97% of climate scientists have concluded that human-caused climate change is happening" elicited estimates of the consensus that were 15 percentage points higher than the statement "An overwhelming majority of climate scientists have concluded that human-caused climate change is happening".

Another study tested different ways of framing consensus such as using verbal and visual analogies (i.e., "if 97% of doctors concluded that your child is sick, would you believe them?"). They found that while metaphors are useful, a pie-chart that visually communicated the 97% consensus was the most effective, particularly among conservative audiences[37].

Figure 10: Pie-chart infographic from The Consensus Project, a website launched to communicate the results of Cook et al. (2013)[7].

Asking people to estimate the level of agreement prior to telling them about the 97% consensus is another useful approach. This "estimation and reveal" technique has been found to be more effective than simply communicating the consensus[42].

More generally, communication experts recommend the following approach to enhance the effectiveness of science communication: simple clear messages, repeated often, by a variety of trusted voices[44,50]. This approach is echoed by Frank Luntz, the political strategist who recommended that opponents of climate action attack the scientific consensus[51]:

> *"You say it again, and you say it again, and you say it again, and you say it again, and you say it again, and then again and again and again and again, and about the time that you're absolutely sick of saying it is about the time that your target audience has heard it for the first time."*

Opponents of climate action have followed the advice of Luntz and persistently attacked the consensus for nearly three decades. From a messaging campaign point of view, it is a sound strategy if one wishes to decrease public support for climate action. Fortunately, it is possible to defang that strategy.

Inoculating against misinformation

A number of studies illustrate the importance and efficacy of communicating the 97% consensus. However, when consensus information is combined with misinformation about the consensus, the two cancel each other out[16]. This helps explain why public opinion has not shifted as much as it might have over the years – persistent misinformation about the consensus has reduced the effectiveness of communicating the scientific consensus. How might we resolve this stalemate?

One answer comes from inoculation theory: a branch of psychological research that takes the idea of physical vaccination and applies it to knowledge[52]. By exposing people to misinformation along with a clear warning that it is misinformation can help people become more resistant to such misinformation.

An inoculating text consists of two elements: a warning that people might be misled, and preemptive counter-arguments explaining the techniques used to distort the facts. Preemptively refuting misinformation has been found to be more effective than debunking the misinformation after people receive it[38]. When it comes to misinformation, prevention is better than cure[53].

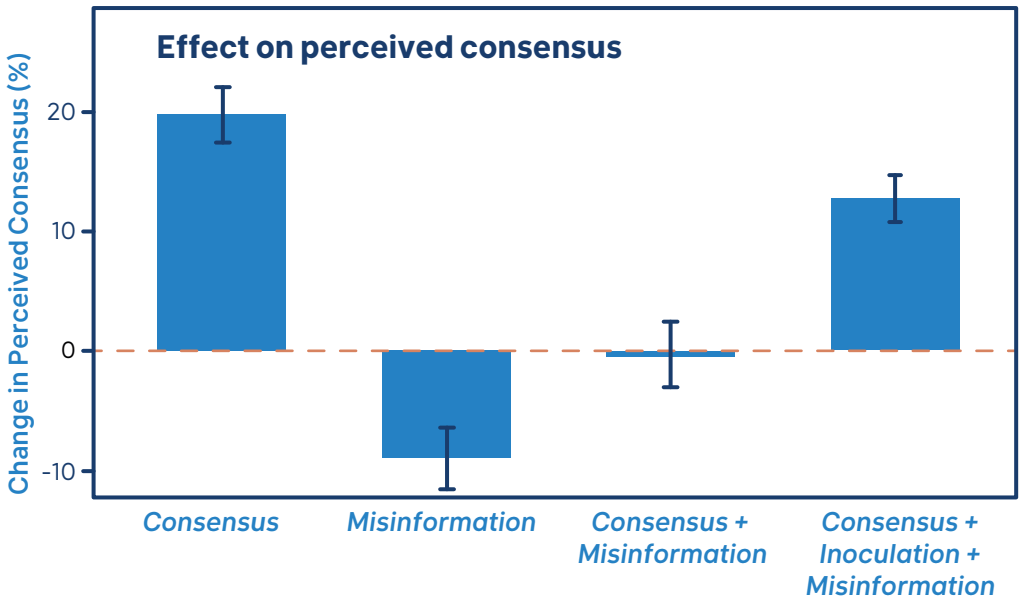


Figure 11: The effect of different types of messages about climate change. This figure is an amendment of Figure 8, now with a fourth bar showing the effect of inoculating people before showing them misinformation.

Several approaches to inoculation have been shown to be effective in supporting the scientific consensus on climate change. One study found that providing people with explicit forewarning about the type of misinformation they might encounter largely counteracted the effect of the misinformation[16]. Another study found that explaining the techniques of misinformation in general terms without specifically mentioning the misinformation is also helpful[25].

In addition, another study found that warning people that science shouldn't be politicized, along with a statement about the consensus, was successful in neutralizing misinformation about new energy technologies[38]. Similarly, simply communicating the 97% consensus before false-balance media coverage was successful in neutralizing the negative influence of such misinformation[25].

Satire is a powerful form of inoculation. One example is a comedy video by John Oliver that parodies how televised debates about climate change reinforce the false balance problem. They produced a satirical weight-of-experts response, with 3 contrarian scientists debating 97 mainstream scientists as a "statistically representative climate change debate". Watching this video has been shown to increase people's acceptance of global warming and perceived consensus[39].

Deconstructing misinformation

To create an effective inoculation message, it helps to start with a strong understanding of how misleading arguments are constructed. This requires a critical thinking approach to argumentation, in order to detect the reasoning fallacies in a misleading argument[54].

Arguments are made up of one or more starting assumptions, or premises, leading to a conclusion. To reliably detect where an argument goes wrong, one needs to deconstruct the argument into its constituent premises and conclusion. This then allows one to determine whether all the premises are true, and if so, whether the premises logically lead to the conclusion. This process allows one to detect the fallacies included within a false argument, which can then be used in an inoculating text.

For example, the Global Warming Petition Project claims that there is no expert consensus on climate change based on two premises: a large proportion of science graduates dissent, and these dissenters are climate experts. By deconstructing the claim into its constituent parts, we are able to identify that both premises are false. The first premise uses the magnified minority fallacy: 31,000 is a tiny proportion of the total number of U.S. science graduates. The second premise relies on fake experts: almost all signatories have no expertise in climate science.

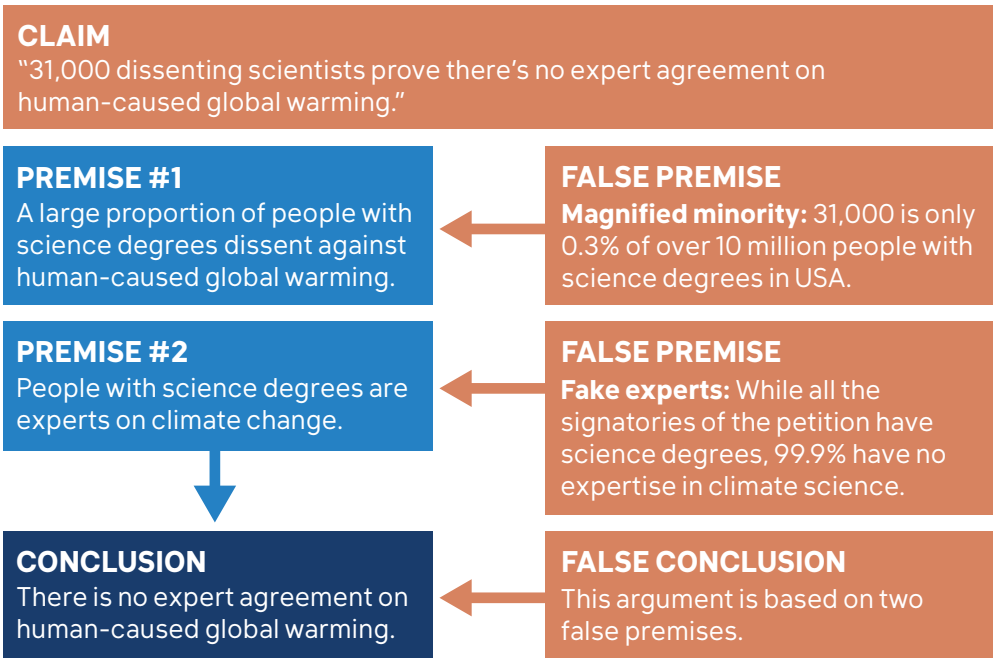


Figure 12: Structure of the claim that there is no scientific consensus, based on the Global Warming Petition Project.

Critiques of consensus messaging & rebuttals

Opponents of climate action have used the insights of audience research and communicated "there is no consensus" for nearly three decades. While social scientists have also realized the important psychological role of perceived consensus, some scientists and others have raised objections about efforts to communicate the scientific consensus. These objections are worthy of rebuttal, because they typically ignore relevant evidence on how people think about scientific matters[55].

The false dichotomy between consensus & policy

One argument against consensus communication is that it distracts from policy discussion[56]. This "either/or" choice between consensus or policy is a false dichotomy. Consensus messaging complements rather than competes with policy discussion. Establishing that experts agree there's a problem serves as a stepping-stone to discussing how to solve it[57]. In actual fact, therefore, consensus messaging *permits* discussion of policy rather than prevent it.

> The 97% consensus offers a lot of bang for one's communication buck.

In contrast, misinformation that casts doubt on the consensus is designed to delay climate policy discussions. This was identified early by opponents of climate action who directed their focus on confusing the public about the consensus in order to reduce support for climate action. Consensus misinformation is a "lever for inaction".

Consensus messaging is designed to remove a distraction designed to delay climate policy. The "consensus vs policy" false dichotomy runs the risk of causing the very outcome it seeks to avoid.

The effectiveness of consensus messaging

A number of studies show that consensus messaging is a powerful communication tool (see page 14). Simply communicating the current state of scientific agreement (97%) not only raises perceived consensus, it also has a positive influence on acceptance that global warming is real, human-caused, and is a serious problem. Most importantly, it increases support for climate policy. The 97% consensus offers a lot of bang for one's communication buck.

However, another objection to consensus messaging is that public perception of the consensus hasn't changed over the last decade. As scientists have been communicating the consensus over this period, the argument goes that consensus messaging doesn't work[58, 59].

This argument, however, is false on several points. First, public perception of the consensus is shifting. A number of independent surveys find that perceived consensus has been steadily increasing since 2010[60, 61, 62].

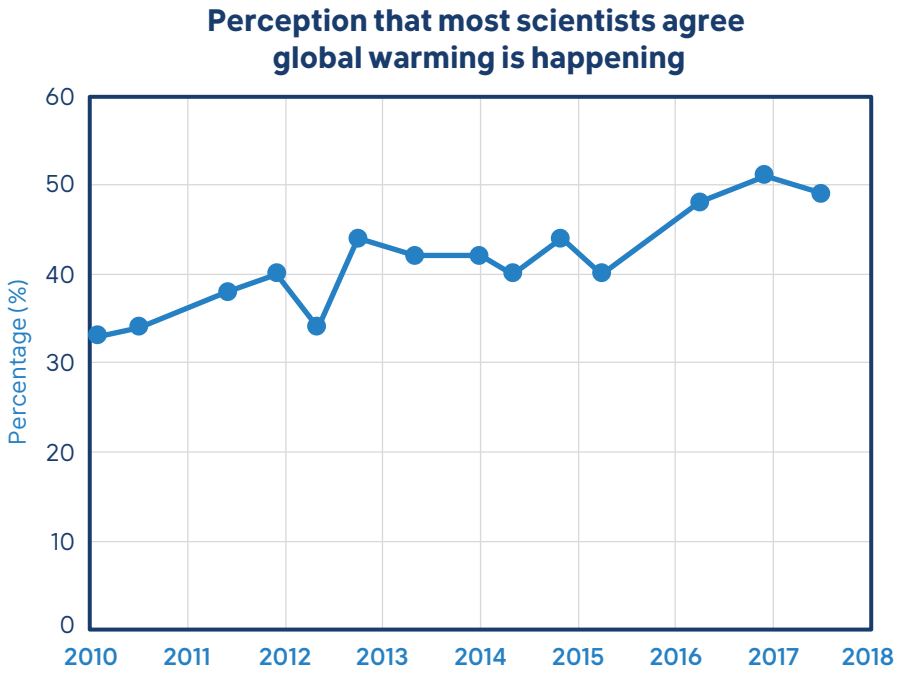


Figure 13: Public perception of scientific consensus from U.S. national representative surveys[62].

Second, this argument ignores the role of misinformation in reducing the effectiveness of consensus messaging. Page 10 showed that misinformation can cancel out the influence of consensus information[16]. Attacking the consensus has been one of the most common arguments used by climate contrarians[12]. This underscores the need to not only continue to communicate the 97% consensus but also to inoculate people against misinformation casting doubt on the consensus.

Neutralizing political ideology

A third objection to communicating the consensus is that it is a polarizing message[58]. While one study found a small proportion of conservatives react negatively to consensus information[13], the majority of studies testing consensus messaging find that either consensus neutralizes the influence of political ideology[16,25,36,37,43] or works equally well across the political spectrum[41,42]. People's perception of the scientific consensus is a so-called "meta-cognition", a belief about what other people believe. It is therefore relatively less threatening for people to simply change their beliefs about what other people think than it is to overhaul one's deeply held worldview. However, we know that changing one's beliefs about what the experts think ultimately leads to subsequent changes in private beliefs (page 12). In short, we can think of perceived consensus as a non-identity threatening gateway cognition.

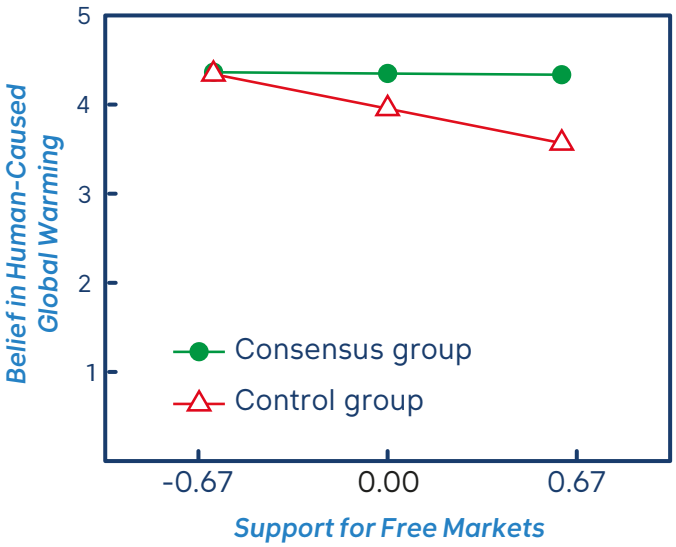


Figure 14: Effect of consensus message across political ideology. While a control group shows the biasing influence of political ideology, this influence is neutralized after receiving a consensus message[36].

Political ideology is important but not the full picture. Figure 4 (page 5) shows two contributors to the consensus gap: political bias and information deficit/misinformation surplus. Consequently, science communicators should employ two channels of science communication: addressing both cultural values and information deficit[63].

Conclusion

There is strong support – in both theory and research findings – for the value of communicating the full extent of the scientific consensus about human-caused climate change in simple, clear numeric terms. As a result of sustained misinformation campaigns, few members of the public currently understand the extent of the consensus – a damaging misconception that reduces support for climate action. Moreover, efforts to inform people about the consensus have shown to be effective, and help people reach accurate conclusions about climate change. Lastly, efforts to inoculate members of the public against the misinformation campaign about the scientific consensus appear likely to help neutralize the harmful effects of that campaign.

Because successful science communication campaigns typically feature "simple clear messages, repeated often, by a variety of trusted voices," the community of individuals and organizations seeking to help the public and policymakers better understand – and make better decisions about – climate change should demonstrate the patience, perseverance, and communication discipline necessary to set the record straight about the scientific consensus on human-caused climate change.

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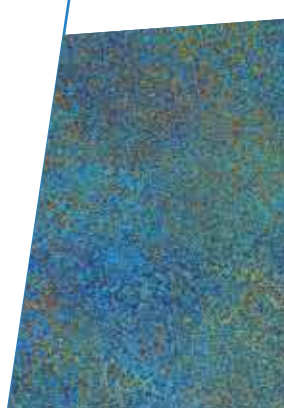

Based on the evidence, 97% of climate scientists agree that humans are causing global warming. However, only 12% of the American public are aware that the consensus is over 90%. Why the gaping chasm between the overwhelming consensus and public perceptions?

For three decades, opponents of climate action have sought to cast doubt on the scientific consensus. Their focus on consensus is due to a single, important reason: perceived consensus is a gateway belief that influences a range of attitudes and beliefs about climate change.

Scientists and communicators need to understand the psychology of consensus and the misinformation campaign that attempts to exploit this psychology to reduce public support for climate action.

The Consensus Handbook is written by scientists who have studied the psychology of consensus. It examines the misinformation campaigns attacking the consensus and explains how we can close the consensus gap.