Introduction

The manner in which we engage in a conversation about climate change is essential to its success. When people enter into a conversation, they often believe they are well informed and correct. They have found information from sources they trust and arrived at their conclusions using their values and reasoning. Most people don’t want to be wrong; people do not like to be told that they are wrong.

That is where this guide comes in. We assume that we will engage in a sincere conversation about climate change, and that science-based evidence is important. There will not be personal, ad hominem, attacks. Likely, there is dis-information, misinformation, and partial information that comes from the public conversations of climate change, and this guide will assist in dissecting the misinformation.

This brochure considers a list of logical fallacies and examples of each. We find that identifying these logical fallacies helps to advance the conversation. In this way, we can understand and demonstrate the flaws in arguments, and not simply battle with points and counterpoints.

The goal is for people to reach an accurate conclusion on their own, and the next time a person comes across an inaccurate argument about climate change, they can critically evaluate the merit of the argument.

To illustrate the logical fallacies, we use five common arguments that arise in the public discourse about climate change. We identify the fallacies and give a short response.

“We had a very snowy and cold winter, the climate can’t be warming”

Logical fallacies employed: irrelevant appeal & hasty generalization

The statement uses an irrelevant appeal in that it refers to snow, which is, intuitively, an indicator of cold temperatures. Snow is counterintuitive to it becoming warmer. There is a hasty generalization because it is taking an experience of one season in one region and applying it to climate change which is global and averaged over many seasons.

Response: When evaluating climate change, scientists are observing global trends over a 30-year period or longer. It is possible for extreme snow to occur in a single blizzard, a cooler than average season, or a year being cooler than the previous year. However, observations show that averaged over time spans as short as ten years, the Earth’s temperature is persistent in its increase.

“If climate change was scientifically correct, then all scientists would agree”

Logical fallacies employed: circular reasoning & hasty generalization

This argument uses circular reasoning because it presumes that scientific investigation leads to facts about which other scientists cannot reasonably disagree. There is a hasty generalization because it is taking a few instances of opposition, and applying it to the whole community, and confusing individual’s interpretations and preferences with evidence-based conclusions.

Response: Disagreement and questioning is part of the culture of science. Science does not produce facts, it produces knowledge and describes uncertainty. When there is uncertainty, there is room for argument. In debate, uncertainty is amplified to create doubt. Some scientists choose to focus on particular uncertainties, and raise doubt about the body of knowledge. When observations are brought to bear on these, often, isolated uncertainties, they are placed in the context of the whole body of knowledge. Then, the warming of the Earth and its human causes are confirmed.

“The Sun dominates the heating of the Earth, and the Sun is changing all the time. It is warmer when there are sunspots, cooler when there are not”

Logical fallacies employed: irrelevant appeal, false cause, & hasty generalization

The claim uses an irrelevant appeal in that it uses the fact that the Sun is the main heat source for the Earth, and hence, dominates all other influences. It utilizes a hasty generalization because it attributes all of the Sun’s influence to sunspot variability. There is false cause because there is correlation of Earth’s temperature with sunspots, therefore, changes in sunspots must be the primary cause of global climate change.

Response: The Sun is the dominant energy input into the Earth, but the temperature of the Earth is determined by many factors. When we measure the heat budget, we find that trapping of the Sun’s heat by greenhouse gases is strongly related to the temperature at the Earth’s surface. We can measure the influence of sunspot variability, and it is small compared to greenhouse gas increases.

“Climate models and their results are constantly altered, therefore, climate models can’t be trusted”

Logical fallacies employed: irrelevant appeal

The assertion uses an irrelevant appeal in that it refers to alterations in climate models to prove that they are not conclusive. This is also used to suggest scientists are changing things to get the outcome they want.

Response: Scientific investigation is always evolving. Models are tools of that investigation. Models change as scientists accumulate more knowledge. Model changes follow from better observations, increasing the ability to represent Earth’s climate and more rigorous evaluation of predictions. Over a number of decades, models have delivered a consistent conclusion that the Earth will warm.

“We know that the global climate has gone through many large-scale changes in the past. The current global warming we are experiencing is no different”

Logical fallacies employed: irrelevant appeal, undistributed middle & hasty generalization

The statement uses an irrelevant appeal in that it refers to climate changes from the past, suggesting mysterious non-human causes. Second, it uses an undistributed middle, because it asserts that that because natural phenomena have caused climate change before, then all climate change must be caused by natural phenomena. Finally, it uses a hasty generalization because it takes the information of natural phenomena causing past climate changes, and does not acknowledge the new information we have - that the increase in anthropogenic atmospheric carbon causes the currently observed warming.

Response: Scientists are not saying that global climate change occurs only because of humans or that is hasn’t changed before. Scientists use the scientific method to quantify and describe past changes. Likewise, scientists quantify, describe, and project current and future changes. These studies show that changes in greenhouse gases occurred during these past changes. The current warming is also associated with greenhouse gases changing, and we, humans, are the primary causes of the greenhouse gas increases. We move carbon dioxide from geological stores to the atmosphere by burning.
Logical Fallacies

It is human nature to try to influence people with appeals to reason, ethics, and emotion. In political arguments and debate, we seek to win points, and rely on techniques that exploit gaps in knowledge. We, often, rely on Confirmation Bias, searching for and interpreting information in a way that supports pre-existing beliefs. We are susceptible to confirmation bias, and we need to confront it in both the arguments we make and the arguments we hear. With knowledge of some of the most common logical fallacies, we can avoid falling into, or creating, confirmation bias.

Circular Reasoning: presuming ones conclusion, A → A; gives the illusion of a deductive step (Ex.) “She is a college graduate because she completed the requirements for her degree.”

False Dichotomy: reducing a set of several possibilities to only two (Ex.) “If Jeff is not working more than 60 hours a week, then he is not a hard worker.”

False Cause: presuming that correlation implies causation; X follows Y a lot, so Y must cause X (Ex.) “I am always hungry after I get ready in the morning. I brush my hair every morning when I am getting ready. Brushing my hair makes me hungry.”

Equivocation: using a word in two different senses/meanings in the same context, hoping the audience won’t notice the “mirror trick” (Ex.) “Noisy children are a headache. Aspirin makes headaches go away. Therefore, aspirin makes noisy children go away.”

False Equivalent: making two opposing arguments appear equivalent; an “in between” case of false cause and equivocation (Ex.) “Dogs are friendly. Wolves are Dogs. Wolves are friendly.”

Hasty Generalization: jumping to a conclusion without sufficient information (Ex.) “My mother smokes cigarettes every day, and she doesn’t have lung cancer. Smoking does not cause lung cancer.”

Irrelevant Appeal: invoking true facts that superficially appear to bolster a point (Ex.) “Susan has gotten A’s in all of her other classes, there is no way she would get a C in math.”

Non Sequitur: similar to irrelevant appeal, except making no effort to “simulate” relevance even superficially; usually seeking to distract from an unfounded assertion via humor, fear, or affection (Ex.) “Jane is a good and honest person, so she must be a very good scientist.”

Undistributed Middle: presuming because there are similarities then there are no differences (Ex.) “All dogs are animals. All wolves are animals. Dogs are Wolves.”

Summary

In all of these cases, the suggested responses are based on evidence that comes from observations and calculating a budget of factors that heat and cool the Earth. The responses are based on an understanding the scientific method – observing nature and developing testable explanations. Then, challenging those explanations with more observations.

When we challenge the form of argument, then we practice inoculation, which is a method to reduce the influence of misleading arguments.

For More Information:

An excellent collection of challenges and responses relevant to climate change science is provided by

Skeptical Science
https://www.skepticalscience.com

One final note:

Do not get discouraged if your conversation partner does not come to agree with your understanding by the end of the discussion. Sometimes, your success comes from the bystanders who are not participating in the discussion, but are still listening to it.

Please send comments, clarifications, complaints, and corrections to rbrood@umich.edu

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