Detecting misleading climate misinformation

THE UNIVERSITY OF MELBOURNE

POSTERA CRESCAM LAUDE

Dr John Cook

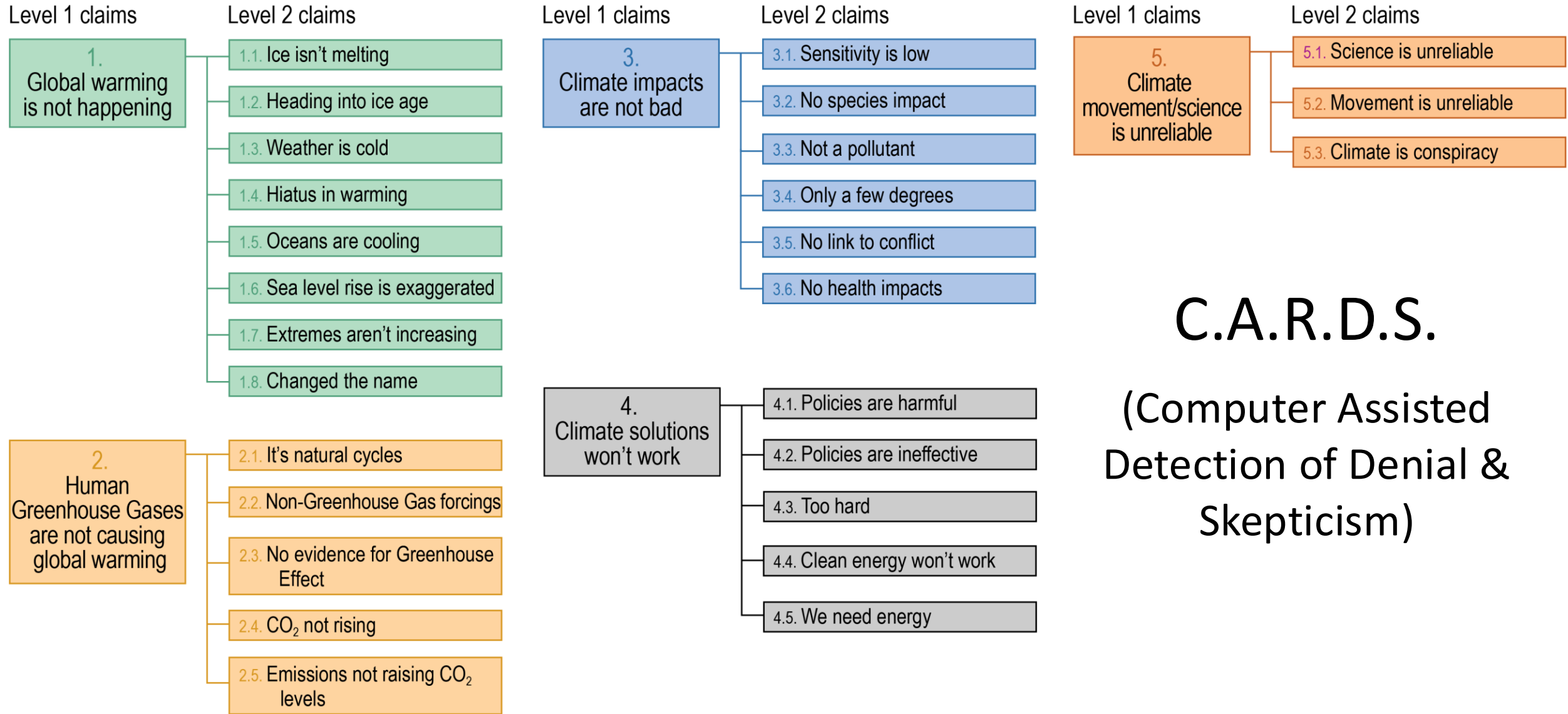Melbourne Centre for Behaviour Change

nature **scientific** reports

Computer-assisted classification of contrarian claims about climate change

Travis G. Coan[1], Constantine Boussalis[2], John Cook[3,4✉] & Mirjam O. Nanko[1]

A growing body of scholarship investigates the role of misinformation in shaping the debate on climate change. Our research builds on and extends this literature by (1) developing and validating a comprehensive taxonomy of climate contrarianism, (2) conducting the largest content analysis to date on contrarian claims, (3) developing a computational model to accurately classify specific claims, and (4) drawing on an extensive corpus from conservative think-tank (CTTs) websites and contrarian blogs to construct a detailed history of claims over the past 20 years. Our study finds that the claims utilized by CTTs and contrarian blogs have focused on attacking the integrity of climate science and scientists and, increasingly, has challenged climate policy and renewable energy. We further demonstrate the utility of our approach by exploring the influence of corporate and foundation funding on the production and dissemination of specific contrarian claims.

Taxonomy of contrarian climate claims

Level 1 claims	Level 2 claims
1. Global warming is not happening	1.1. Ice isn't melting
	1.2. Heading into ice age
	1.3. Weather is cold
	1.4. Hiatus in warming
	1.5. Oceans are cooling
	1.6. Sea level rise is exaggerated
	1.7. Extremes aren't increasing
	1.8. Changed the name

Level 1 claims	Level 2 claims
2. Human Greenhouse Gases are not causing global warming	2.1. It's natural cycles
	2.2. Non-Greenhouse Gas forcings
	2.3. No evidence for Greenhouse Effect
	2.4. CO_2 not rising
	2.5. Emissions not raising CO_2 levels

Level 1 claims	Level 2 claims
3. Climate impacts are not bad	3.1. Sensitivity is low
	3.2. No species impact
	3.3. Not a pollutant
	3.4. Only a few degrees
	3.5. No link to conflict
	3.6. No health impacts

Level 1 claims	Level 2 claims
4. Climate solutions won't work	4.1. Policies are harmful
	4.2. Policies are ineffective
	4.3. Too hard
	4.4. Clean energy won't work
	4.5. We need energy

Level 1 claims	Level 2 claims
5. Climate movement/science is unreliable	5.1. Science is unreliable
	5.2. Movement is unreliable
	5.3. Climate is conspiracy

C.A.R.D.S.

(Computer Assisted Detection of Denial & Skepticism)

Coan et al. (2021)

Climate misinformation in conservative think-tanks
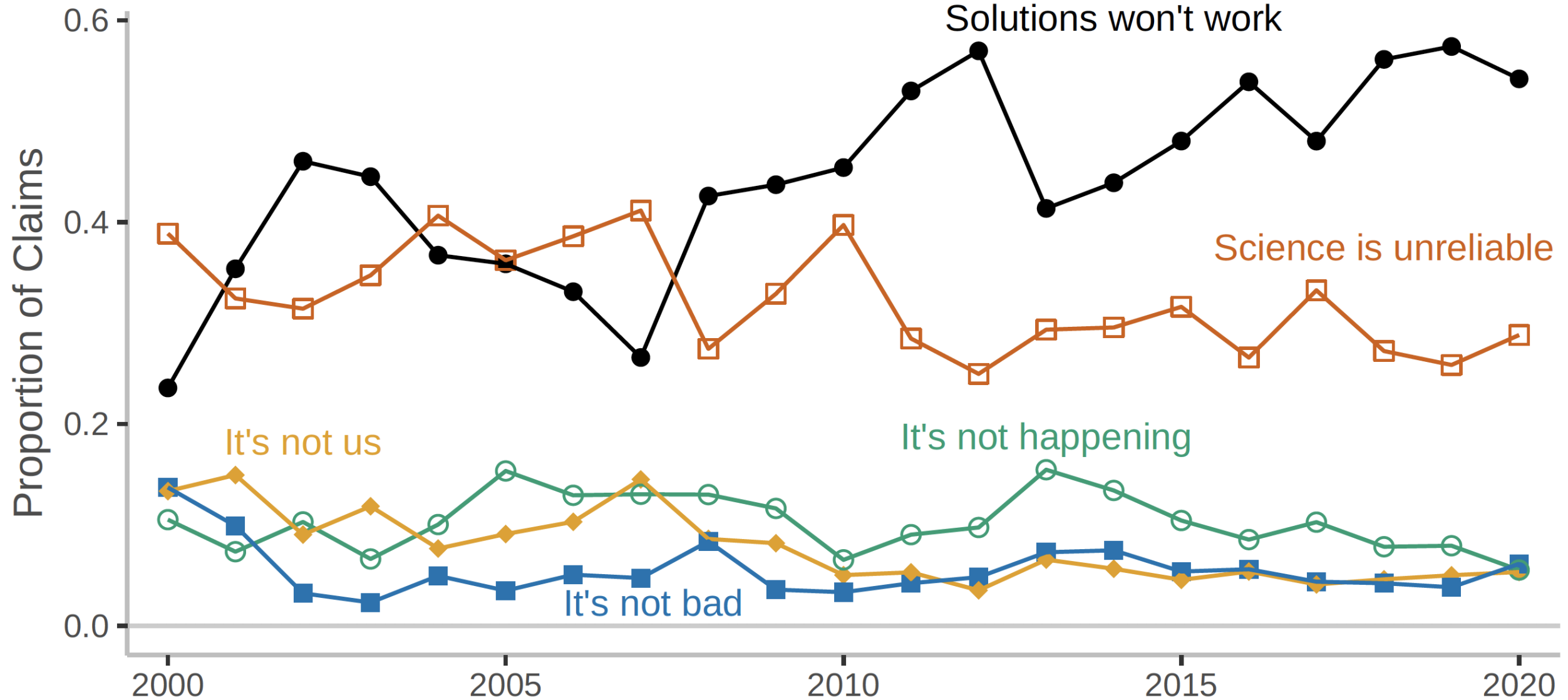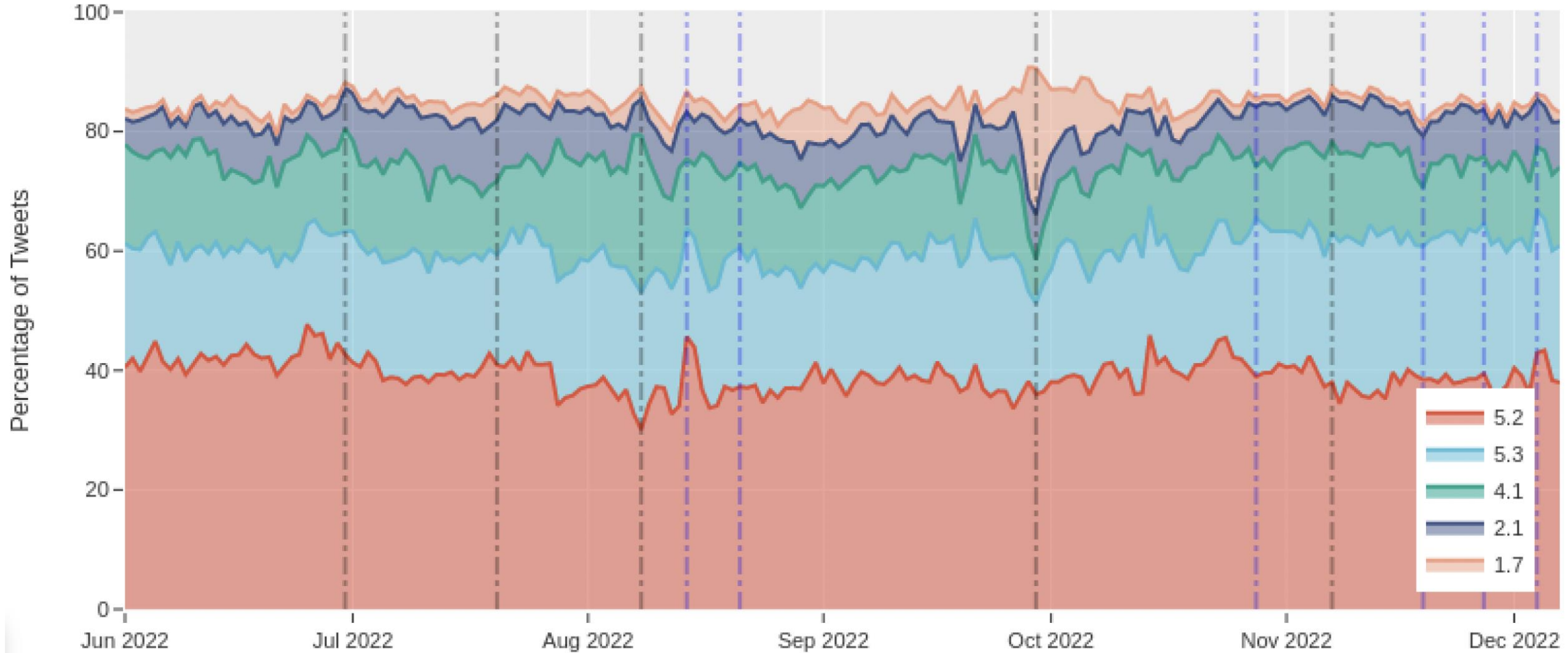
Climate misinformation in climate denial blogs
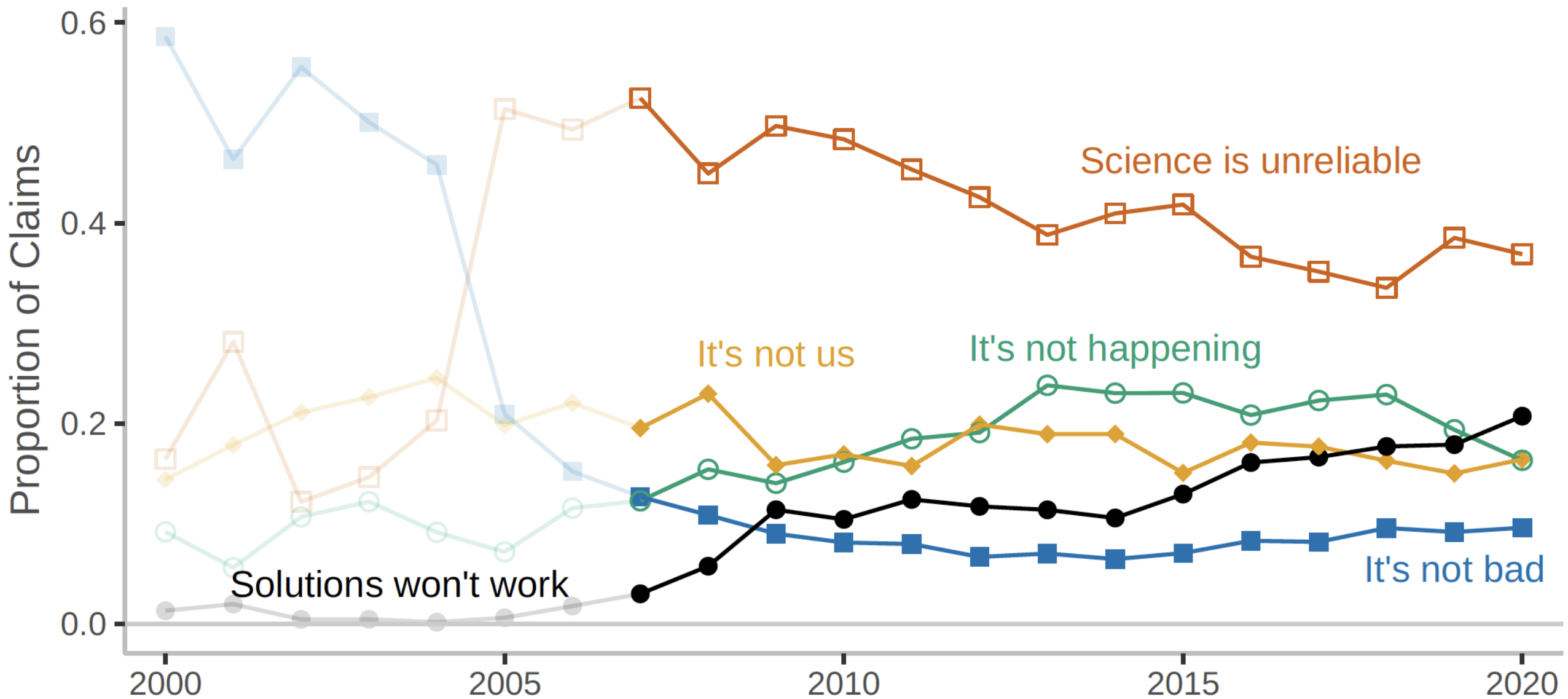
Hierarchical machine learning models can identify stimuli of climate change misinformation on social media

Cristian Rojas [1], Frank Algra-Maschio[2], Mark Andrejevic[3,4], Travis Coan[5], John Cook[6] ✉ &
Yuan-Fang Li [1,4] ✉

Misinformation about climate change poses a substantial threat to societal well-being, prompting the urgent need for effective mitigation strategies. However, the rapid proliferation of online misinformation on social media platforms outpaces the ability of fact-checkers to debunk false claims. Automated detection of climate change misinformation offers a promising solution. In this study, we address this gap by developing a two-step hierarchical model. The Augmented Computer Assisted Recognition of Denial and Skepticism (CARDS) model is specifically designed for categorising climate claims on Twitter. Furthermore, we apply the Augmented CARDS model to five million climate-themed tweets over a six-month period in 2022. We find that over half of contrarian climate claims on Twitter involve attacks on climate actors. Spikes in climate contrarianism coincide with one of four stimuli: political events, natural events, contrarian influencers, or convinced influencers. Implications for automated responses to climate misinformation are discussed.

Proportion of climate misinformation on Twitter (http://sks.to/augmentedcards)
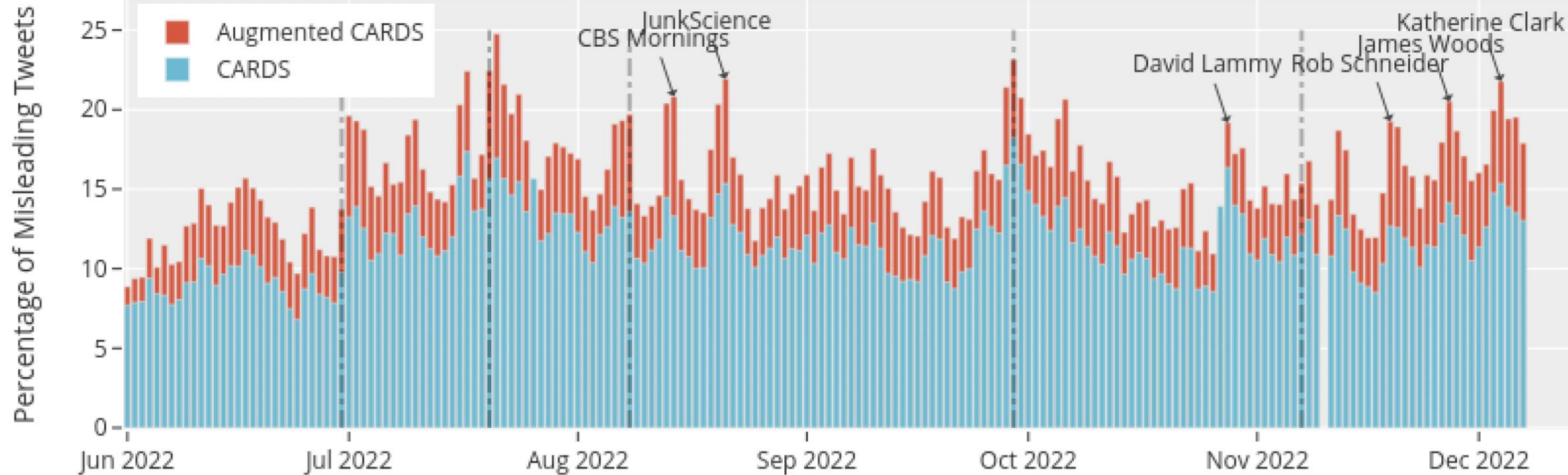

5.2 Attacks on climate actors   4.1 Climate policy is harmful   1.7 Extreme weather not
5.3 Conspiracy theories   2.1 Climate change is natural   linked to climate change

Climate misinformation spikes on Twitter

Types of misinformation spikes:

1. Political events
2. Natural events
3. Contrarian influencers
4. Convinced influencers

Challenges facing fact-checking

- Paltering: misinformation that uses truthful statements to paint a misleading impression.

- Misleading arguments with hidden premises.

- Policy arguments that are nuanced or involve values.

Logic-checking: a complementary approach to fact-checking

- Logic-checking: identifying the presence of misleading rhetorical techniques and logical fallacies.

- Can address misleading arguments that fact-checking can't, such as paltering, hidden premises, and fallacious policy arguments.

- Can generalize to other myths and even other topics

- Segues seamlessly to logic-based inoculation.

http://sks.to/criticalclimate

3-minute video explainer at sks.to/cafe

Environmental Research Letters

Deconstructing climate misinformation to identify reasoning errors
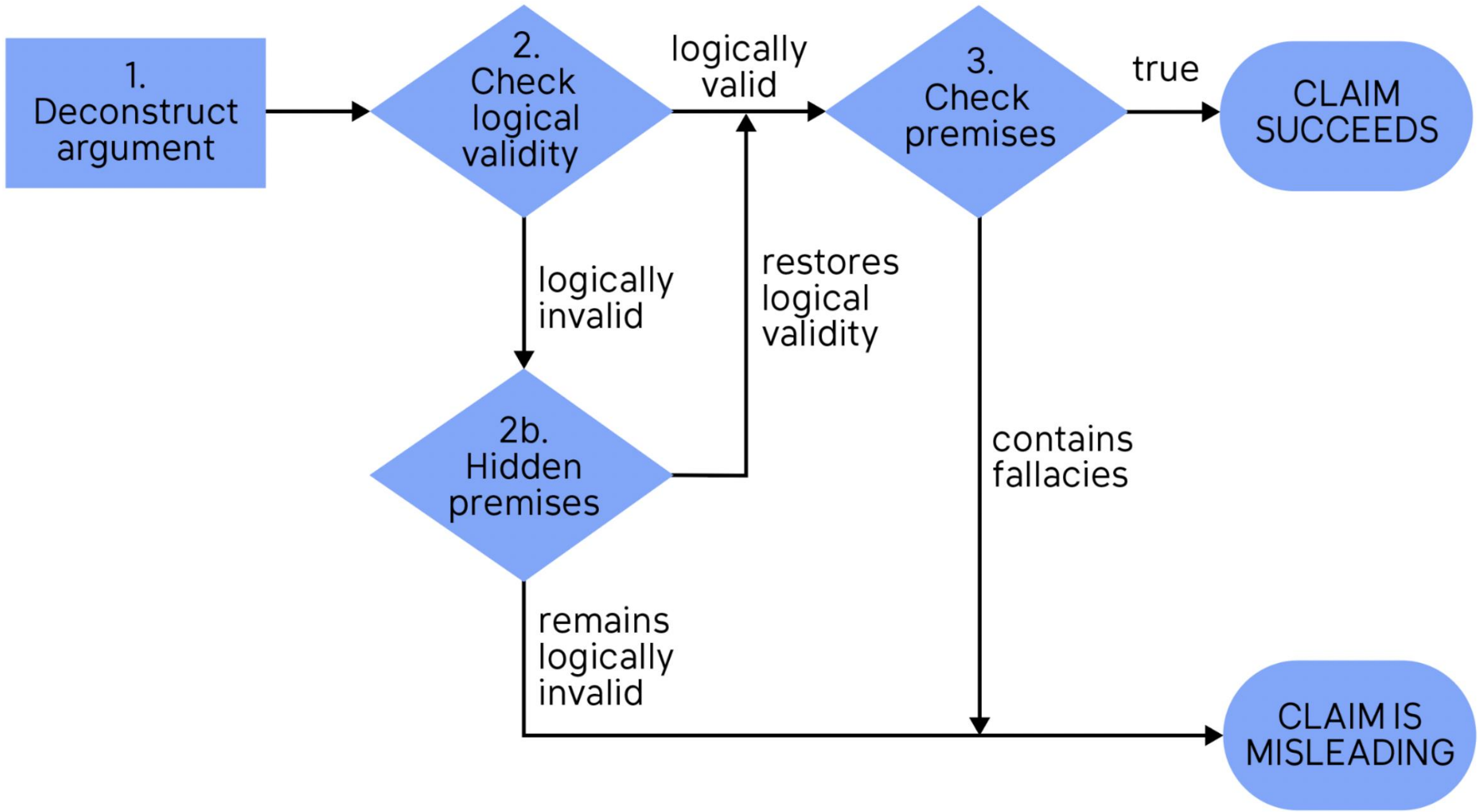
John Cook[1,3] ⓘ, Peter Ellerton[2] ⓘ and David Kinkead[2] ⓘ

Abstract

Misinformation can have significant societal consequences. For example, misinformation about climate change has confused the public and stalled support for mitigation policies. When people lack the expertise and skill to evaluate the science behind a claim, they typically rely on heuristics such as substituting judgment about something complex (i.e. climate science) with judgment about something simple (i.e. the character of people who speak about climate science) and are therefore vulnerable to misleading information. Inoculation theory offers one approach to effectively neutralize the influence of misinformation. Typically, inoculations convey resistance by providing people with information that counters misinformation. In contrast, we propose inoculating against misinformation by explaining the fallacious reasoning within misleading denialist claims. We offer a strategy based on critical thinking methods to analyse and detect poor reasoning within denialist claims. This strategy includes detailing argument structure, determining the truth of the premises, and checking for validity, hidden premises, or ambiguous language. Focusing on argument structure also facilitates the identification of reasoning fallacies by locating them in the reasoning process. Because this reason-based form of inoculation is based on general critical thinking methods, it offers

1. Deconstruct argument

2. Check logical validity

logically valid

logically invalid

3. Check premises

true

CLAIM SUCCEEDS

restores logical validity

2b. Hidden premises

remains logically invalid

contains fallacies

CLAIM IS MISLEADING

MYTH

"The reason why the climate is changing now is climate has always been changing."

P1 Climate has changed naturally in the past.

P2 The climate is currently changing.

CONCLUSION
Current climate change is naturally-caused.

1. Deconstruct the claim

MYTH

"The reason why the climate is changing now is climate has always been changing."

P1 Climate has changed naturally in the past.

P2 The climate is currently changing.

HP The past driver of climate change must be the same as the current driver of climate change.

CONCLUSION
Current climate change is naturally-caused.

1. Deconstruct the claim   **2.** Identify hidden premises

MYTH

"The reason why the climate is changing now is climate has always been changing."

P1 Climate has changed naturally in the past.

P2 The climate is currently changing.

HP The past driver of climate change must be the same as the current driver of climate change.

CONCLUSION
Current climate change is naturally-caused.

SINGLE CAUSE FALLACY
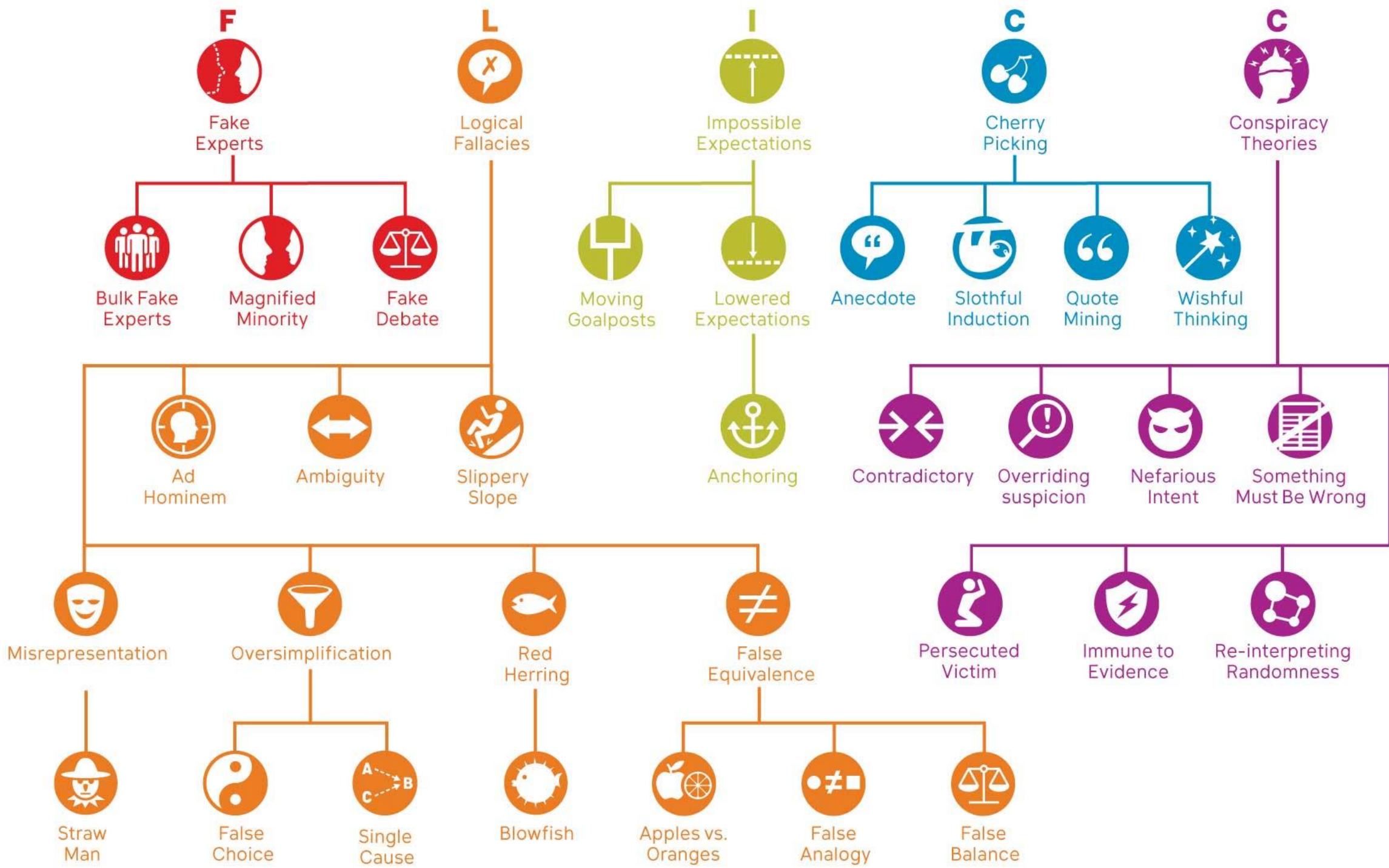
Assumes that only one factor drives climate change (natural causes) when other factors (human activity) can also drive climate change.

1. Deconstruct the claim **2.** Identify hidden premises **3.** Identify fallacies in premises

F

Fake Experts

- **Bulk Fake Experts**
- **Magnified Minority**
- **Fake Debate**

L

Logical Fallacies

- **Ad Hominem**
- **Ambiguity**
- **Slippery Slope**

Misrepresentation
- Straw Man

Oversimplification
- False Choice
- Single Cause

Red Herring
- Blowfish

False Equivalence
- Apples vs. Oranges
- False Analogy
- False Balance

I

Impossible Expectations

- **Moving Goalposts**
- **Lowered Expectations**
- **Anchoring**

C

Cherry Picking

- **Anecdote**
- **Slothful Induction**
- **Quote Mining**
- **Wishful Thinking**

C

Conspiracy Theories

- **Contradictory**
- **Overriding suspicion**
- **Nefarious Intent**
- **Something Must Be Wrong**

- **Persecuted Victim**
- **Immune to Evidence**
- **Re-interpreting Randomness**

# Identifying Reasoning Fallacies in a Comprehensive Taxonomy of Contrarian Claims about Climate Change

Abstract

While climate change grows as an environmental and societal emergency, misinformation about climate change continues to hinder necessary action and democratic decision-making. An important step in neutralizing climate misinformation is identifying the rhetorical techniques and logical fallacies used to distort climate science and confuse the public. We expand on previous critical thinking research, developing a detailed methodology for deconstructing and analyzing real-world misinformation. We apply our extended methodology to a comprehensive taxonomy of contrarian climate claims, finding reasoning fallacies in all the analyzed claims. Slothful

Claim	Type	General argument structure	Hidden premise	Denial technique
1.1.1. Antarctica isn't melting	2	P1: Antarctica is cooling. P2: Sea ice is increasing. C: Global warming is not happening	P3: Cooling is the only driver of sea ice gain therefore global warming is not happening	P1: Cherry picking P2: Slothful induction P3: Impossible expectations P4: Single cause
1.1.2. Greenland isn't melting.	2	P1: Parts of Greenland's ice sheet are not melting. C: Global warming is not happening.	P2: All parts of ice sheets must be melting under global warming.	P1: Cherry picking P2: Single cause, Impossible expectations
1.1.3. Arctic isn't melting	3	P1: In the short term, Arctic sea ice hasn't changed much. C: Arctic sea ice is fine.	P2: If Arctic sea ice maximum extent hasn't changed much in the short-term, then Arctic sea ice is fine in the long-term.	P2: Cherry picking

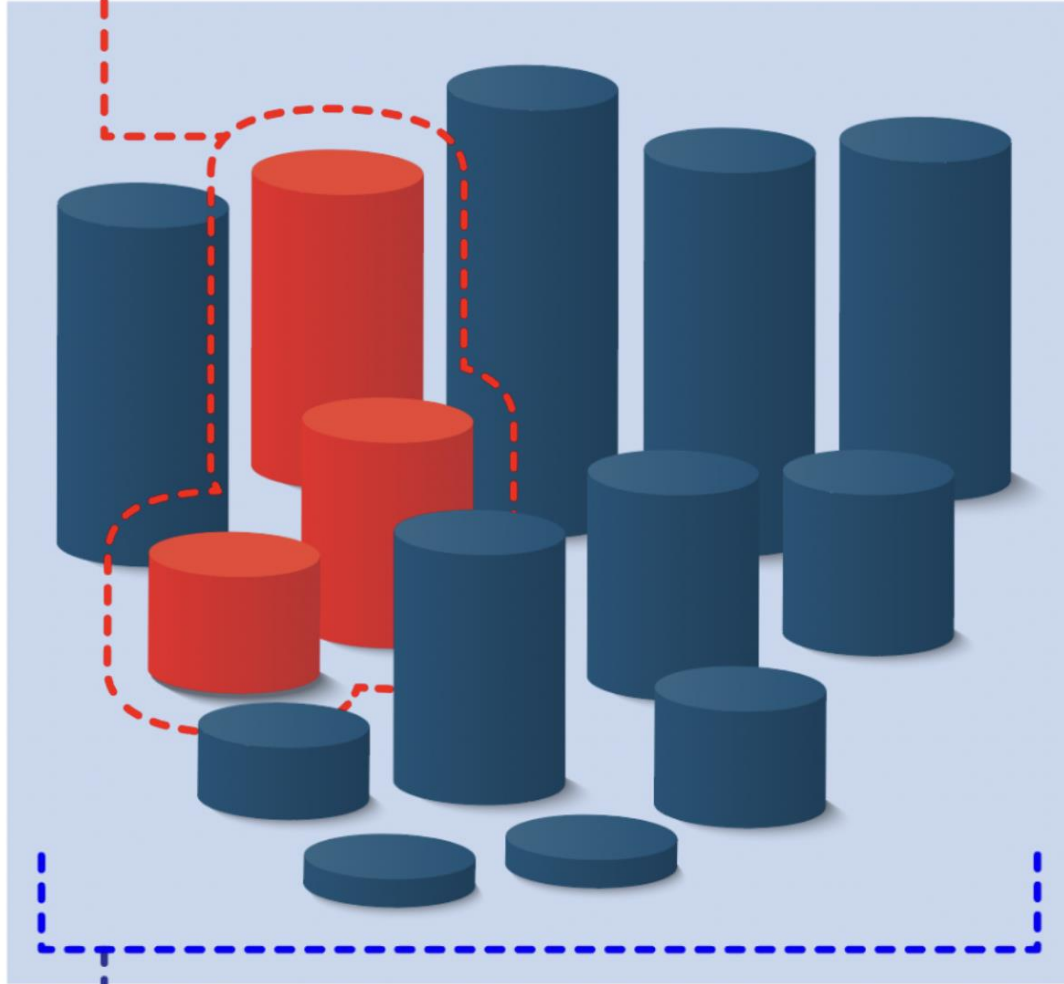Prevalence of fallacies in contrarian claims
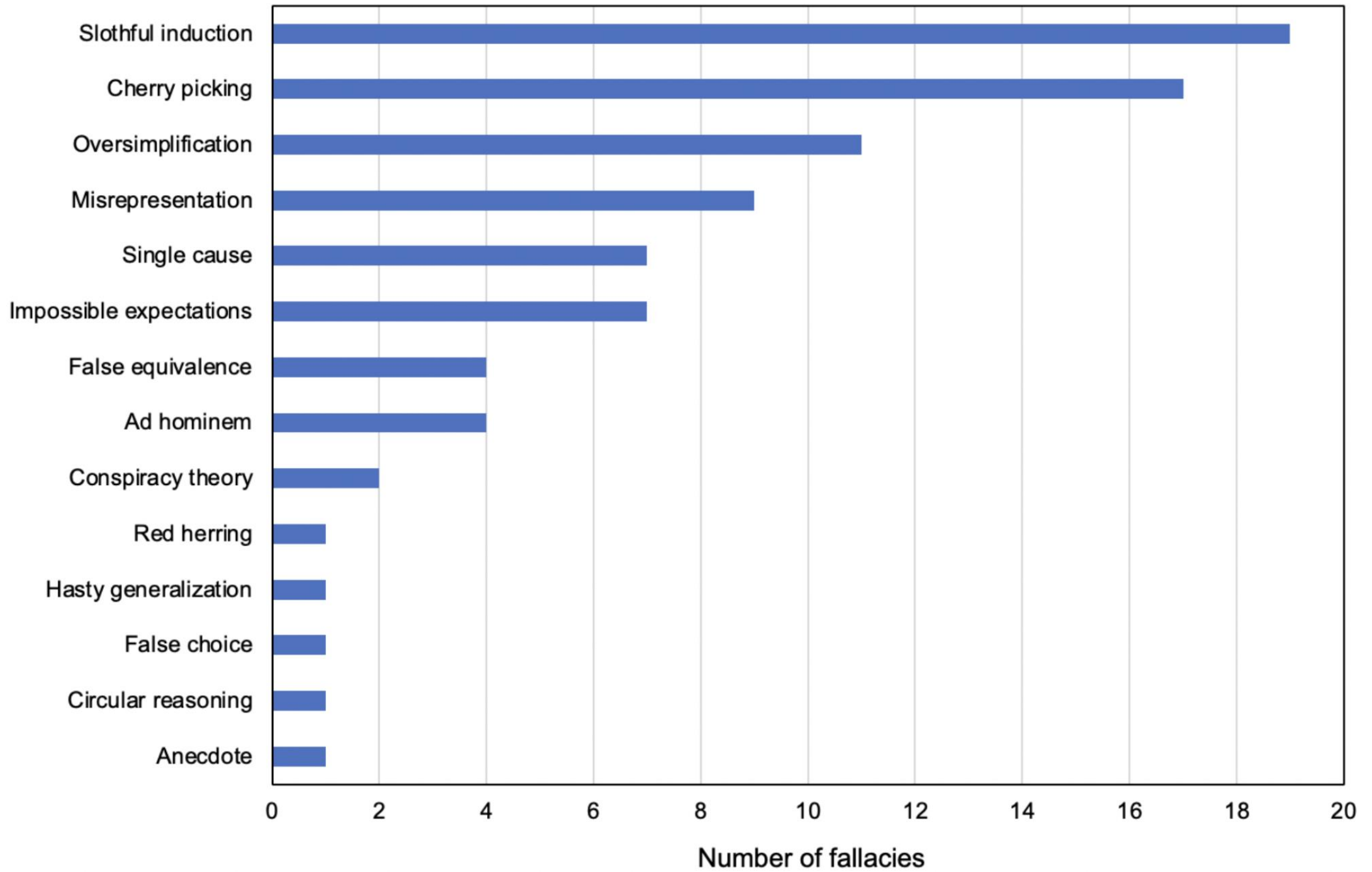
a) Misleading treatment of scientific evidence

Cherry picking actively focuses on convenient evidence while ignoring inconvenient evidence. E.g., "glaciers are growing."
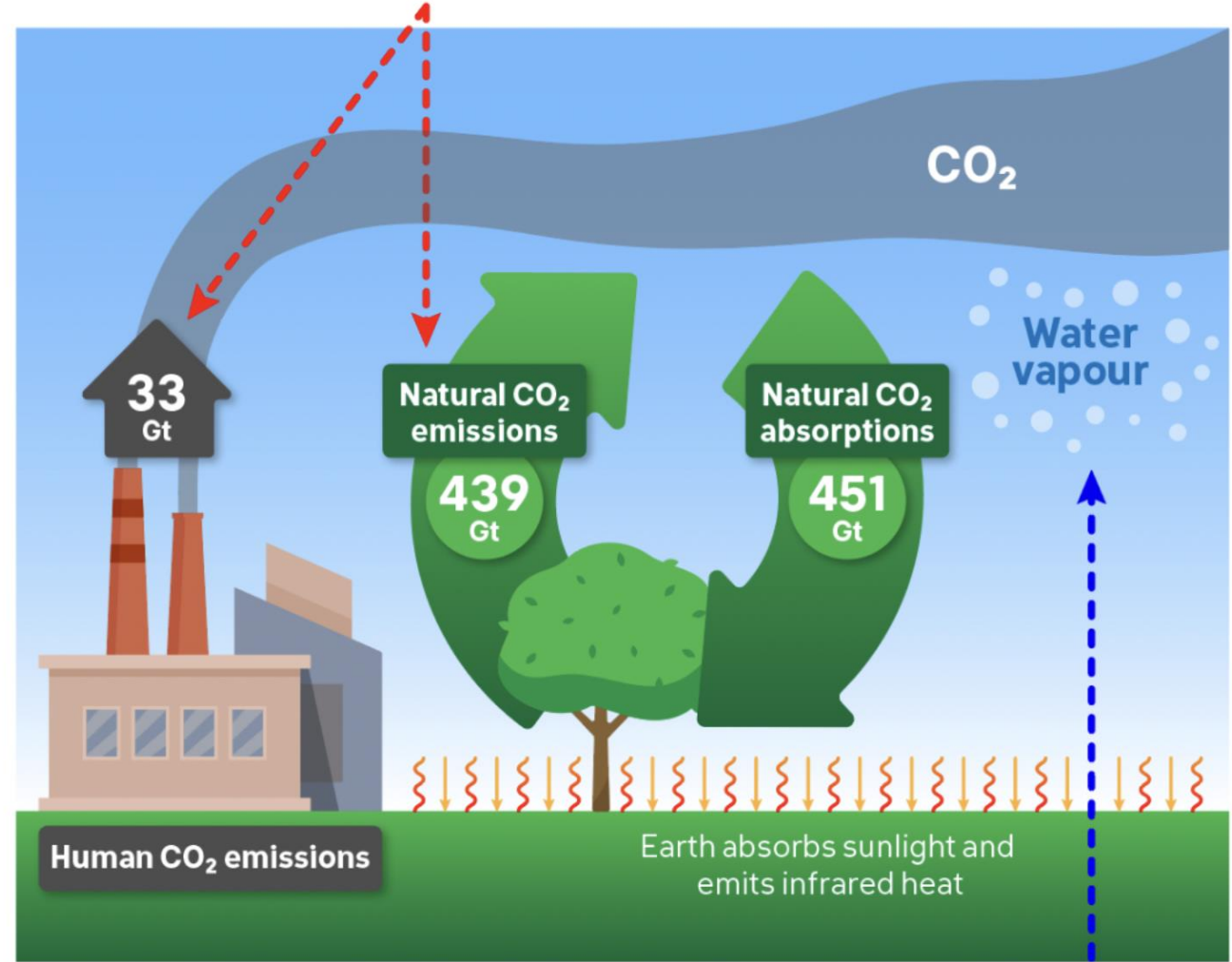
Slothful induction passively ignores inconvenient evidence. E.g., "there's no evidence we're causing global warming."

b) Misleading treatment of scientific systems

Oversimplification makes true statements that are misleading because they miss out important elements of a system. E.g., "nature emits more CO_2 than humans."

CO_2

Water vapour

33 Gt

Natural CO_2 emissions
439 Gt

Natural CO_2 absorptions
451 Gt

Human CO_2 emissions

Earth absorbs sunlight and emits infrared heat

Misrepresentation makes false statements about elements of a system. E.g., "water vapour has a greater warming effect than CO_2."

Detecting Fallacies in Climate Misinformation: A Technocognitive Approach to Identifying Misleading Argumentation

Francisco Zanartu, John Cook, Markus Wagner, Julian Garcia

Abstract

Misinformation about climate change is a complex problem that requires holistic and interdisciplinary solutions at the intersection between technology and psychology. One proposed solution is a "technocognitive" approach, involving the synthesis of psychological and computer science research. Psychological research has identified that interventions in response to misinformation require both fact-based (e.g., factual explanations) and technique-based (e.g., explanations of misleading techniques) content. However, little progress has been made on documenting and detecting fallacies in climate misinformation. In this study, we apply a previously developed critical thinking methodology for deconstructing climate misinformation, in order to develop a dataset mapping different types of climate misinformation to reasoning fallacies. This dataset is used to train a model to detect fallacies in climate misinformation. The fallacies that are easiest to detect include fake experts and anecdotal arguments. Fallacies that require background knowledge, such as oversimplification, misrepresentation, and slothful induction, are relatively more difficult to detect. This

Text_example	Fallacy	Claim
Climate change is governed by hundreds of factors, or variables, and the very idea that we can manage climate change predictably by understanding and manipulating at the margins one politically-selected factor (CO2), is as misguided as it gets.	impossible expectations	5.1
Clearly, absorption and re-radiation of the sunshine in the upper atmosphere at this wavelength cools the Earth and is going to cause additional cooling as the concentration of CO2 increases.	misrepresentation	2.3
I truly believe that there was a major glacial period about 400 million years ago when the carbon dioxide levels in the atmosphere were about 10 times greater than they are today.	false equivalence	2.1.4
In short: heat flows from hot to cold but there is no physics corresponding to a flow from cold to hot analogous to "backradiation". Heat can radiate from a hot to a cold body, but not from a cold to a hot.	misrepresentation	2.3
My argument has always been that I can find no evidence of a contribution from manmade greenhouse gases to the warming of ocean heat content data (depths of 700 meters) since 1955, and that there is no evidence that anthropogenic greenhouse gases contributed to the warming of sea surface temperatures of the global oceans during the satellite era.	slothful induction	2.3
Last year, 130 skeptical German scientists co-signed an Open Letter of protest to German Chancellor Angela Merkel, asserting, among other things, that a "growing body of evidence shows anthropogenic CO2 plays no measurable role" in Earth's climate.	fake experts	5.1.1
The geologic record does not support dangerous CO2-driven planetary warming either. CO2 has played no role in the dramatic climate change of the ice ages, or at any other time over the past 500 million years, said University of Ottawa Earth Sciences Professor Ian D. Clark.	single cause	2.1.4
Only in unverified computer models cited by the IPCC does CO2 drive climate change.	slothful induction	5.1.4
CO2 has played no role in climate change of the ice ages, said University of Ottawa Earth Sciences Professor Ian D. Clark.	fake experts	2.3
Tthe temperature distribution of the atmosphere is a natural result of thermal equilibrium and conservation of energy. The dry lapse rate can be calculated precisely without any reference to greenhouse gases (GHGs), and the wet lapse rate can be calculated precisely simply by factoring in latent heat release from water vapour to the dry lapse rate. This proves that GHG radiation does not determine nor have any effect upon the temperature distribution of the atmosphere, whatsoever.	misrepresentation	2.3
Carbon dioxide has continued to rise, while global temperatures appear to have stopped rising in 1998 having stabilized below the 1998 level and might even now be starting to fall.	cherry picking	1.4
He suggests that its warmth which tends to produce more CO2, rather than vice versa which, incidentally is the story of the past recoveries from ice ages.	false choice	2.3.3
My concern as a climatologist was that too many pieces didn't fit or were ignored in the complex weather systems that, on average, are climate. Most troubling initially was the effective omission of water vapor as a greenhouse gas.	misrepresentation	5.1.4
The global climate warming is not solely affected by the CO2 greenhouse effect. The best example is temperature obviously cooling however atmospheric CO2 concentration is ascending from 1940s to 1970s.	single cause	2.3.3
The idea that CO2 has been an important driver of global temperature over the last 400,000 years is not supported by the evidence.	slothful induction	2.1.4
As indicated by the bold black line, there was an increase from 1900 to 1935, followed by a slight decrease from 1935 to 1985, i.e. in a time when CO2 emissions were rising strongly worldwide.	single cause	2.3.3
Professor emeritus of biogeography Philip Stott of the University of London explained the crux of the entire global warming debate when he rebutted the notion that CO2 is the main climate driver.	fake experts	2.3

actual \ predicted	ad hominem	anecdote	cherry picking	conspiracy theory	fake experts	false choice	false equivalence	impossible expectations	misrepresentation	oversimplification	single cause	slothful induction
ad hominem	0.78		0.03	0.11				0.03	0.03			0.03
anecdote		0.92									0.04	0.04
cherry picking	0.03		0.77			0.03			0.03	0.03	0.03	0.06
conspiracy theory	0.14			0.82		0.05						
fake experts					1.00							
false choice	0.14					0.71						0.14
false equivalence	0.13						0.38	0.25			0.25	
impossible expectations								0.86	0.10			0.05
misrepresentation				0.05				0.14	0.68	0.09		0.05
oversimplification			0.05						0.05	0.70		0.20
single cause		0.09	0.06			0.06		0.03			0.66	0.09
slothful induction	0.04		0.12			0.08		0.04	0.08	0.04	0.04	0.56

Table 7: Normalised confusion matrix (actual labels on y-axis, predicted labels on x-axis)

Debunk misinformation with a "truth sandwich"

FACT
Lead with a "sticky" fact

MYTH
Warn before you mention the myth

FALLACY
Explain how the myth misleads

FACT
Finish by reinforcing the fact

http://sks.to/db2020

The Debunking Handbook 2020

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Detecting claims   http://sks.to/cardspaper

Generative debunking   http://sks.to/gendebunk

Twitter misinformation   http://sks.to/augmentedcards