


# Introduction to science denial, misinformation, the dangers it poses, and what to do about it

EGU24 – US6 – Wednesday April 17, 2024  
Bärbel Winkler



My short presentation leverages material created by John Cook, founder of Skeptical Science and cognitive scientist working at the University of Melbourne.

The background of the slide is a dark blue to black gradient. It features several interlocking gears of various sizes, some of which are semi-transparent, revealing a faint world map underneath. The text is centered in a clean, white, sans-serif font.

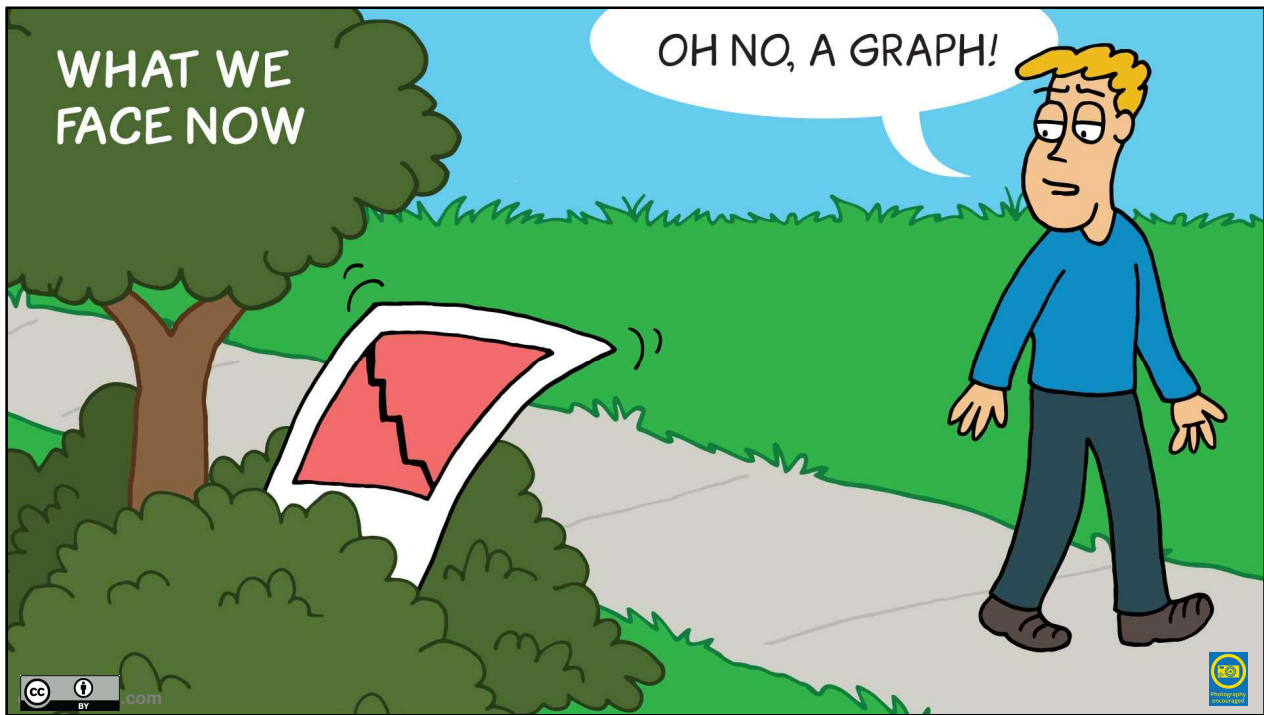
# How do people think about topics like climate change?



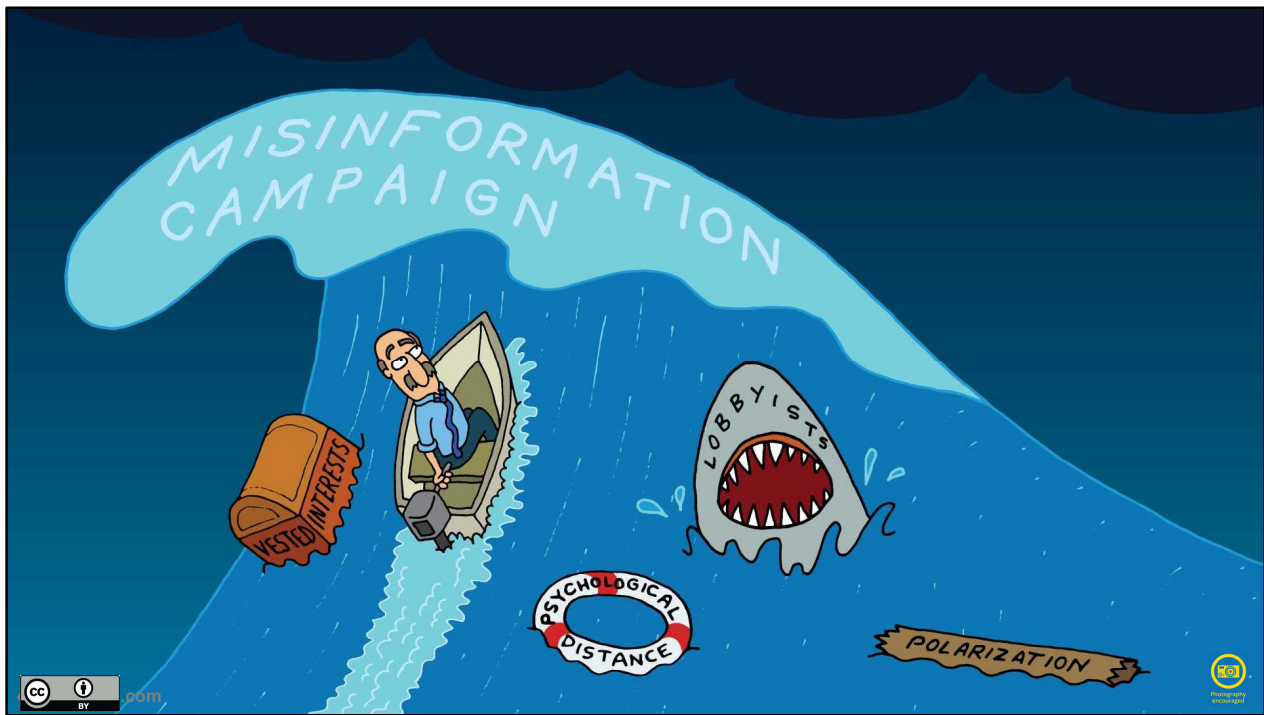
Let me start with a short detour to look at how people think about climate change.



Unfortunately, we don't do this very well. Over millions of years, our brains have evolved to avoid life threatening dangers like predators jumping out of bushes. We survived by quickly detecting and avoiding immediate dangers.



In contrast, global warming is a slow-motion disaster happening on a global scale. Our brains aren't built to respond to planetary crises stretched out over decades and far removed in time and space for many of us.



This provides fertile ground for a massive wave of mis- and disinformation about climate change. Vested interests, political polarization, the global nature of climate change, as well as misinformation add up to a perfect psychological storm, preventing people from accepting the reality of climate change.

# Why is mis- and disinformation a problem and can be dangerous?

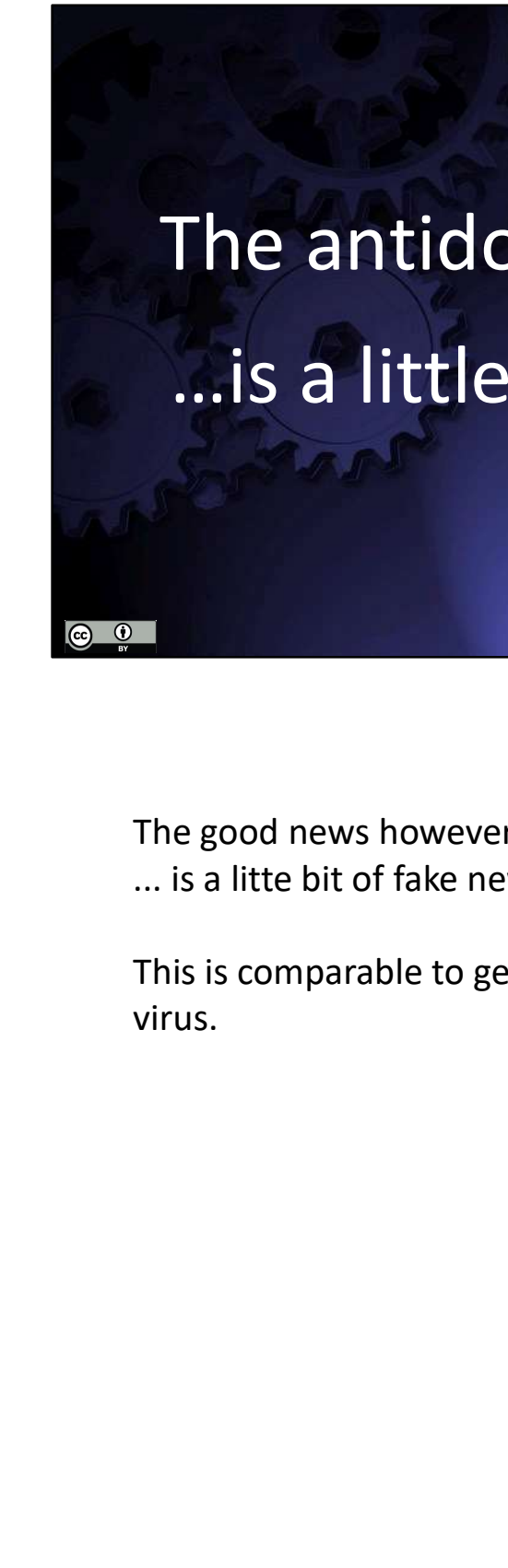


Why is mis- and disinformation a problem and can even be dangerous?



Studies have identified a big problem, namely that misinformation can cancel out facts when people are exposed to both and cannot easily reconcile this contradicting information. This can lead to them disengaging and believing neither.





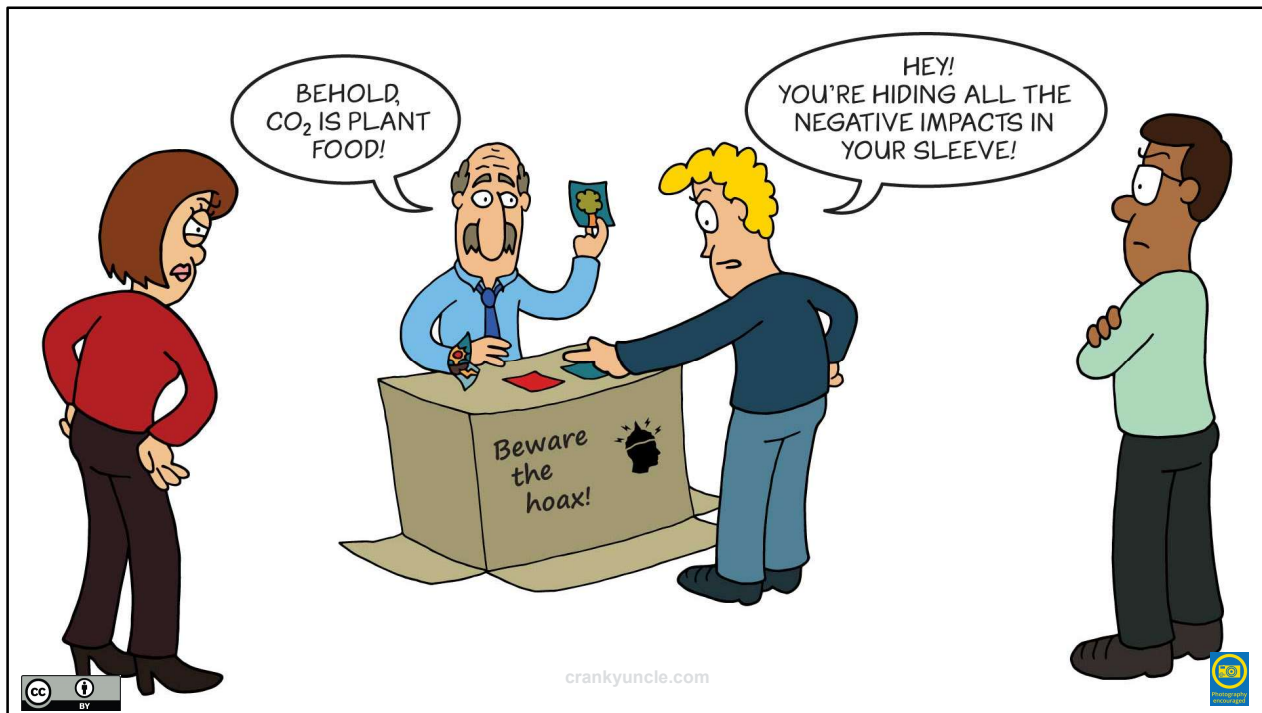
The antidote to fake news...  
...is a little bit of fake news.



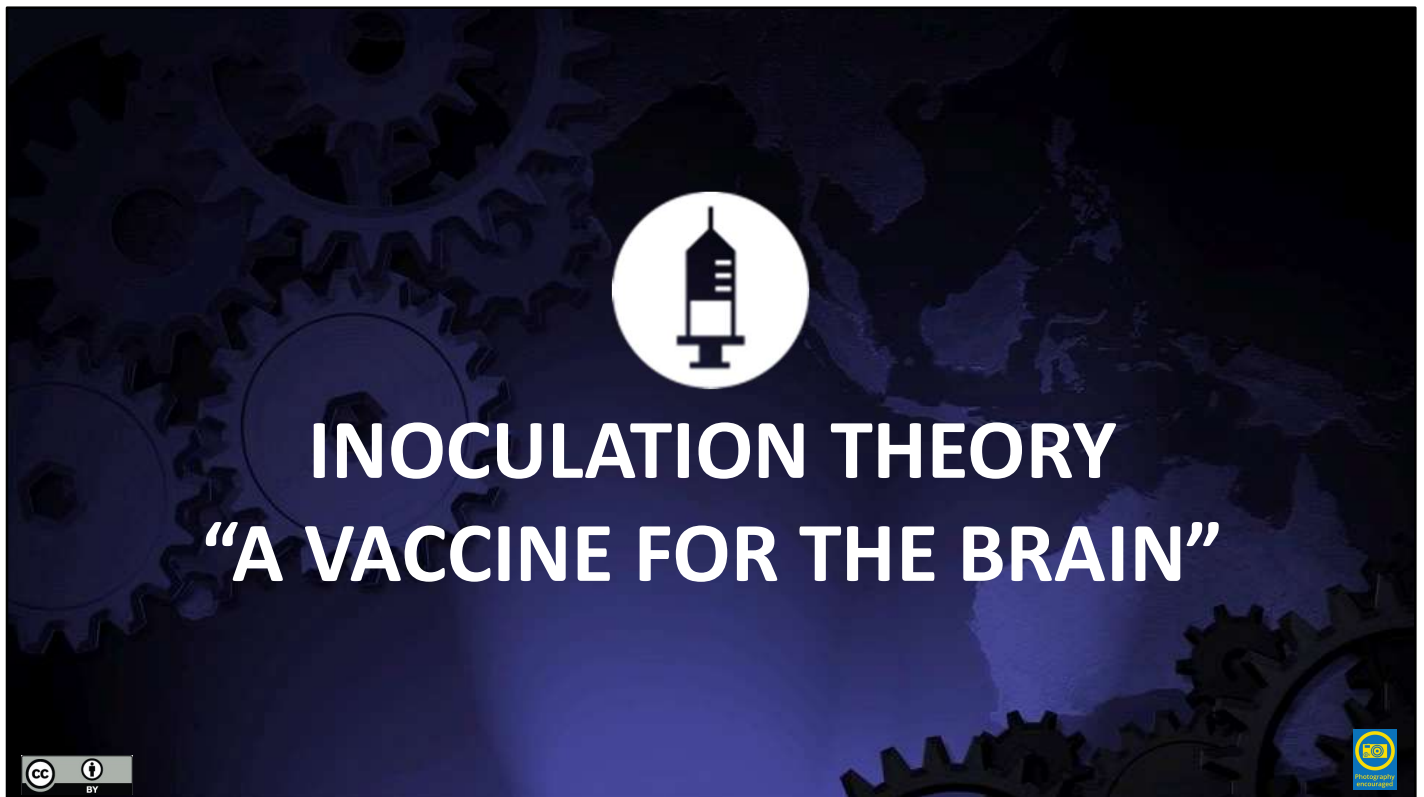
The good news however is, that the antidote to fake news ....  
... is a litte bit of fake news!

This is comparable to getting a flu shot with an inactive strain of a virus.





Recognising this problem provides the answer of how to respond to misinformation. We need to help people discern the difference between fact and fiction when faced with conflicting information. We can do this by explaining the techniques used to distort the facts. This is like exposing the sleight of hand behind a magician's trick. Once people see the technique behind a misleading argument, the misinformation loses its influence.



This is called Inoculation theory

You warn people of the threat of the misinformation and you also give them countarguments and explanations of why the misinformation is wrong.

## The 5 techniques of science denial (FLICC)



Science denial has five tell-tale techniques. They can be summarized with the acronym FLICC.

## The 5 techniques of science denial (FLICC)

 Fake Experts

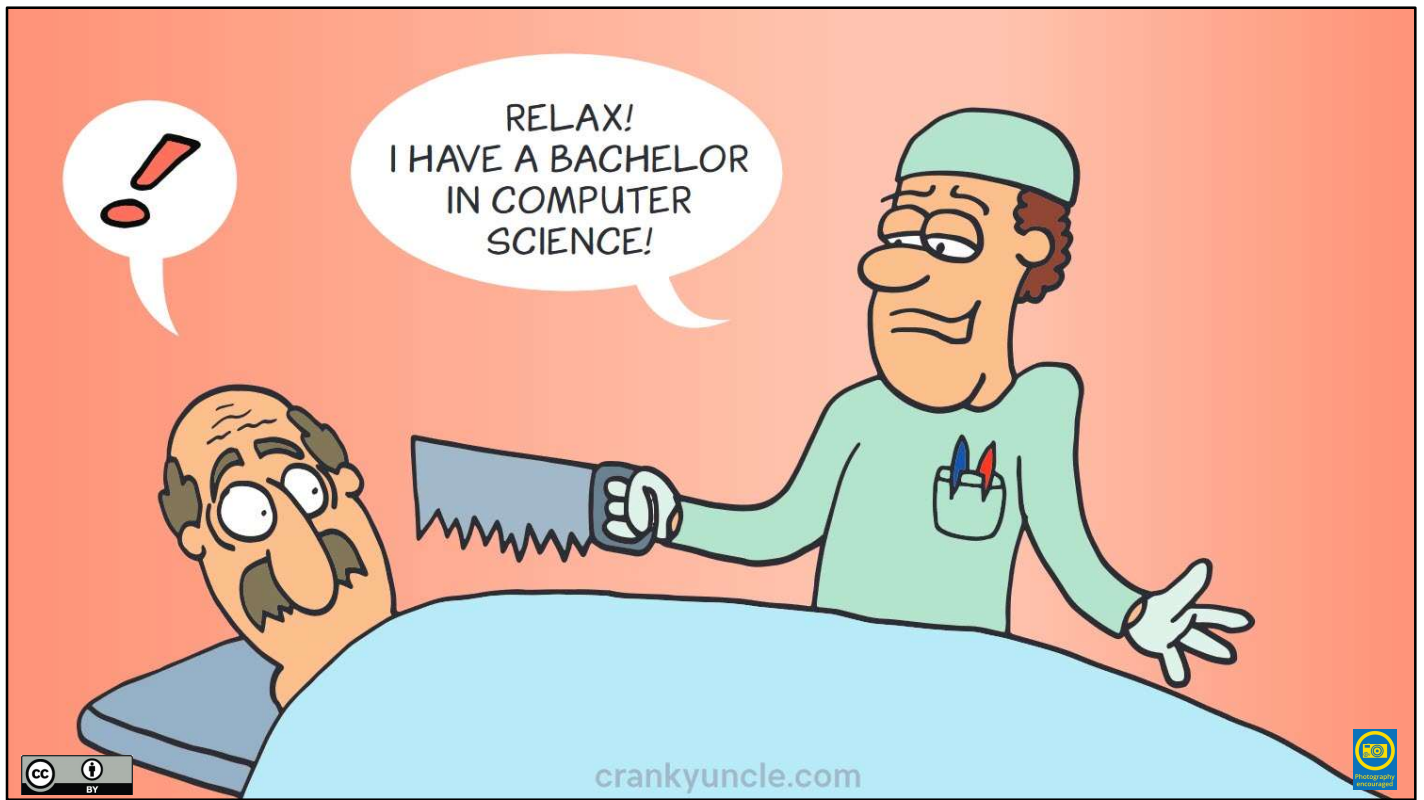


*Fake experts* are people who convey the appearance of expertise without possessing any actual relevant expertise.

kyuncle.com



***Fake experts*** are people who convey the appearance of expertise without possessing any actual relevant expertise.



They can make an appearance individually when mentioned in articles or as talk show guests with impressive sounding titles ...

# Global Warming Petition Project

*31,487 American scientists have signed this petition,  
including 9,029 with PhDs*

## Petition

We urge the United States government to reject the global warming agreement that was written in Kyoto, Japan in December, 1997, and any other similar proposals. The proposed limits on greenhouse gases would harm the environment, hinder the advance of science and technology, and damage the health and welfare of mankind.

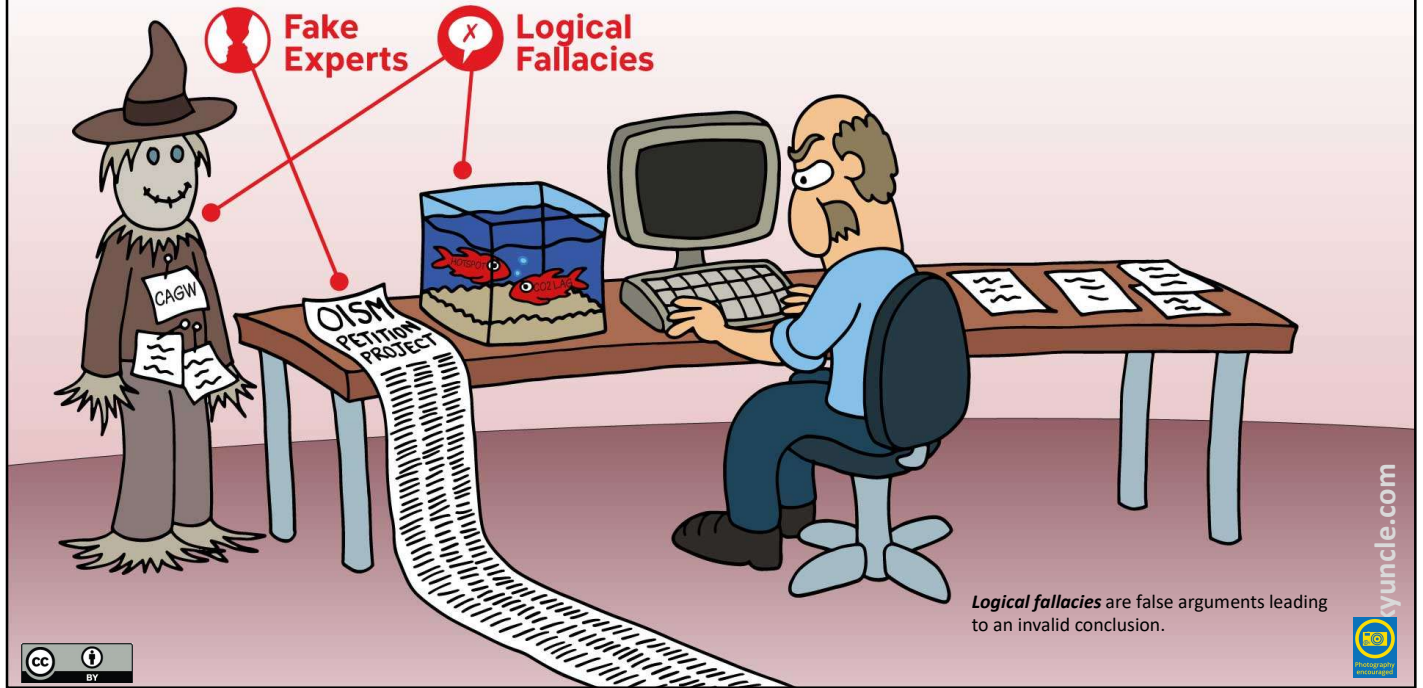
There is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth.



... or in bulk form as signatories to online petitions disputing the consensus on human-caused global warming.

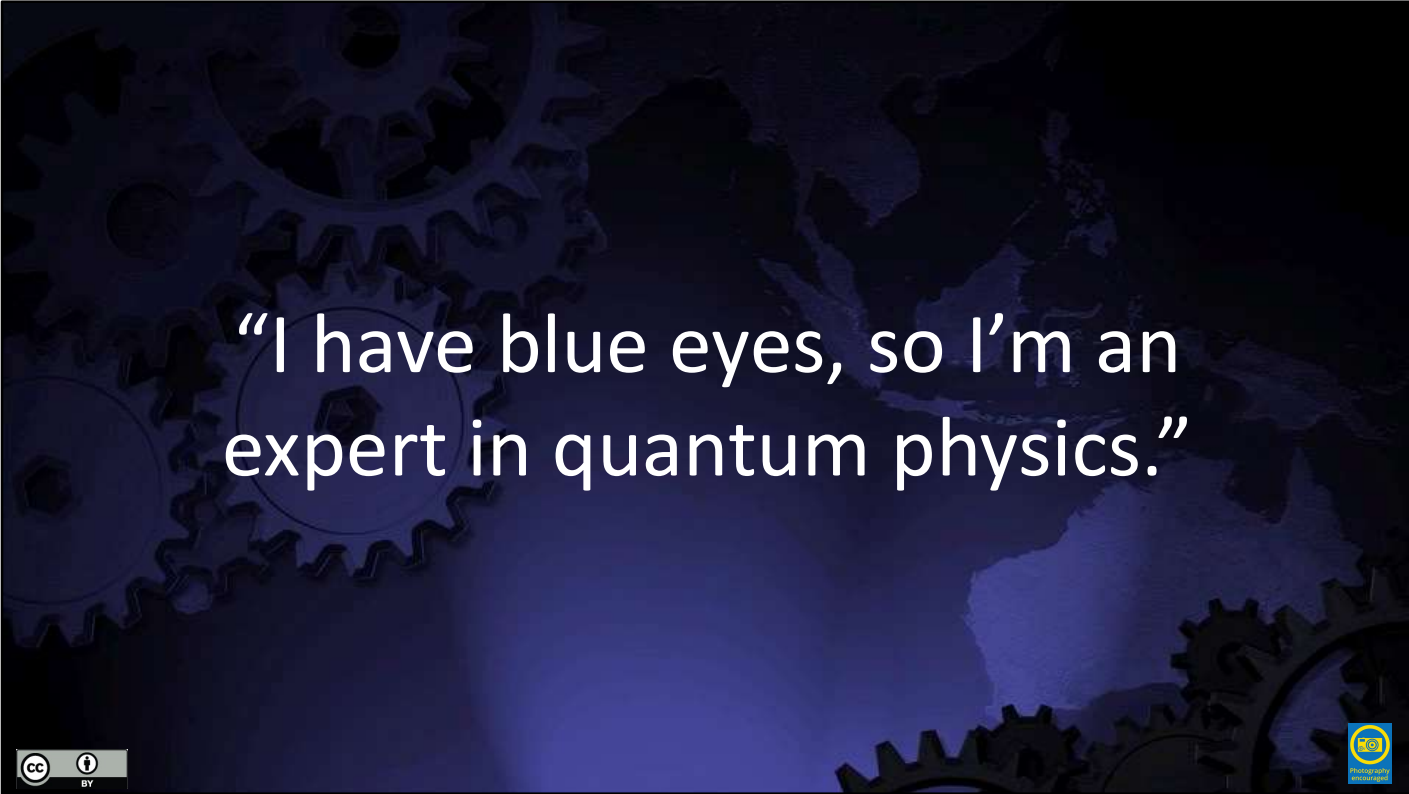


## The 5 techniques of science denial (FLICC)



**Logical fallacies** are false arguments leading to an invalid conclusion. There are a number of different fallacies— strawman and red herrings shown here are just two of commonly found denier arguments.





“I have blue eyes, so I’m an expert in quantum physics.”



Some are obvious and easy to spot ...

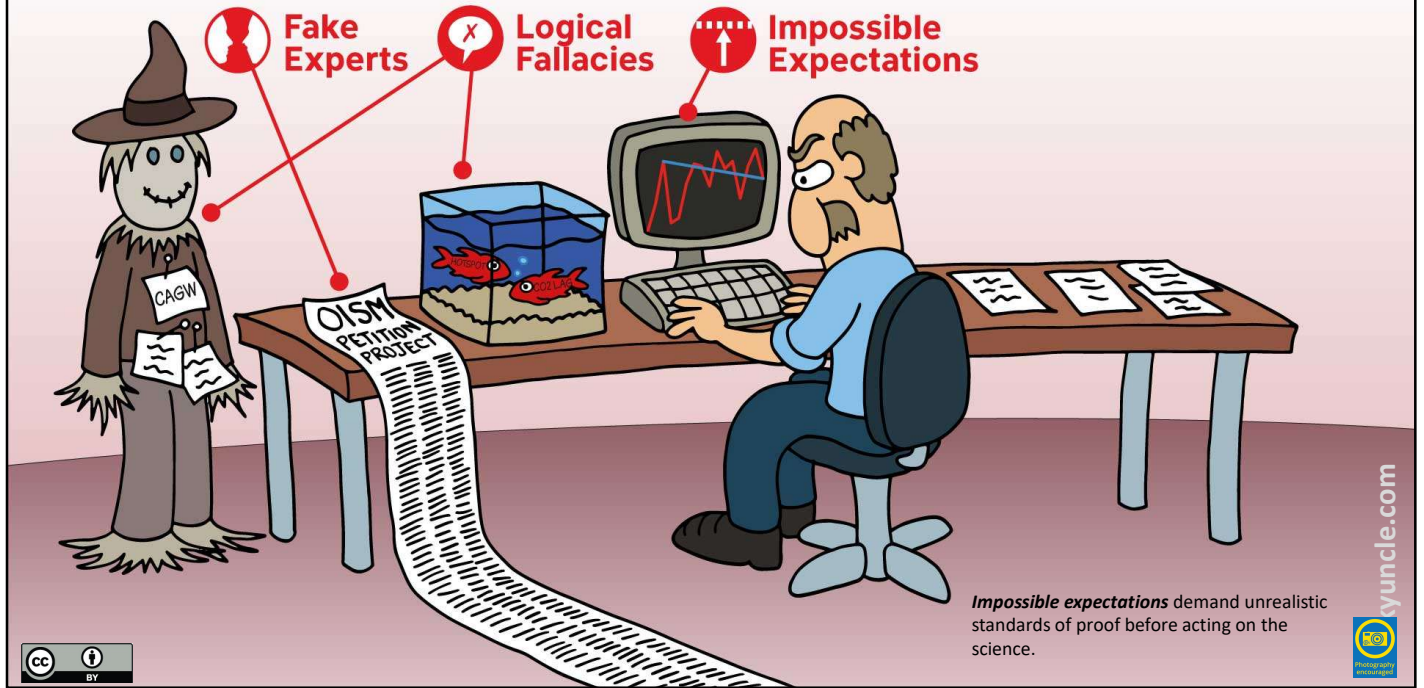


... while others need a bit more unpacking:

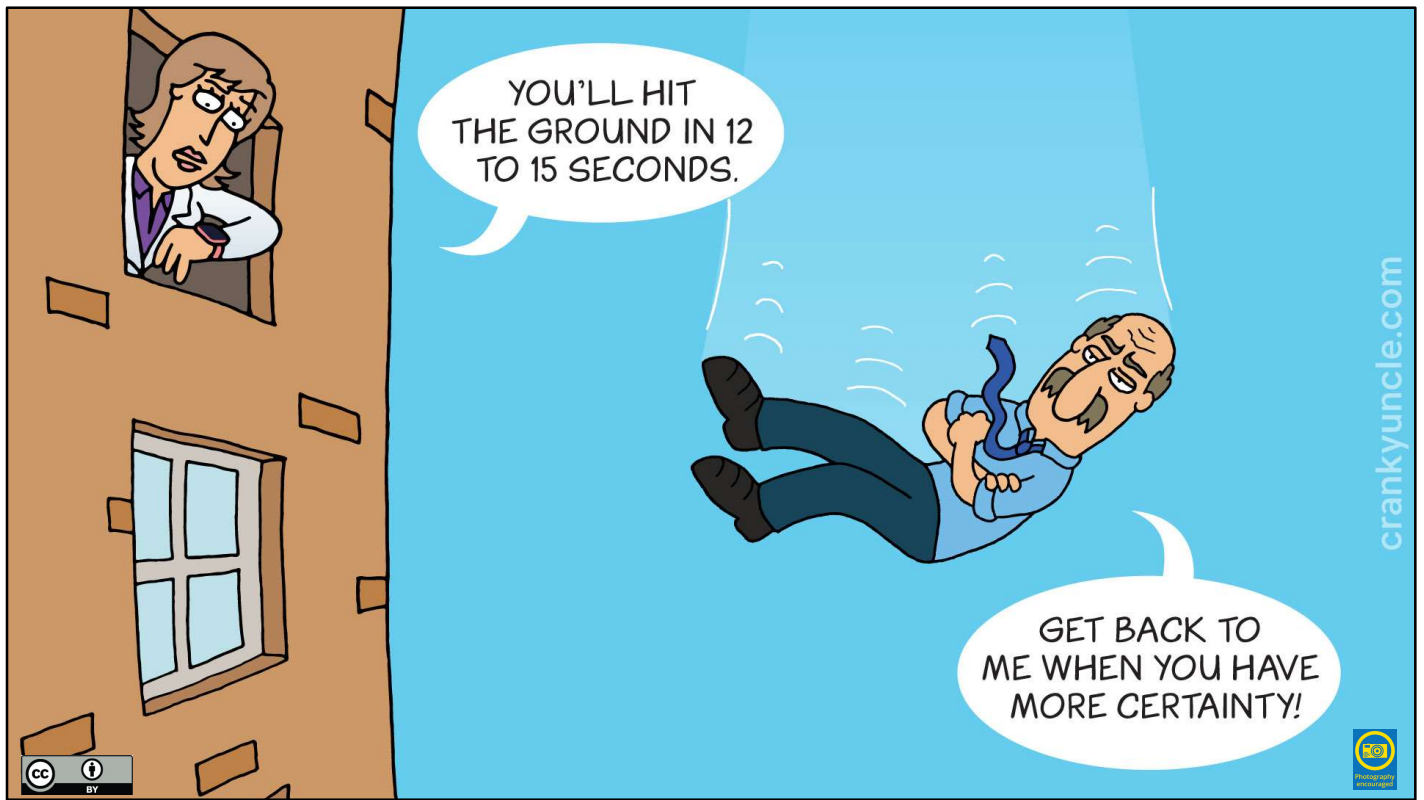
The argument that **the reason why climate is changing now, is because climate has always changed throughout the earth's past** commits the single cause fallacy. This is assuming that whatever caused something in the past, must also be the cause now.

It's exactly the same logic as arguing in front of a body that was obviously murdered, that people have died of natural causes in the past so this person must have died of natural causes as well.

# The 5 techniques of science denial (FLICC)



**Impossible expectations** demand unrealistic standards of proof before acting on the science.



The problem with this - or why this is so challenging - is because science by nature is not definitive. It doesn't give exact values. It gives estimated ranges of values. This confusion about science is exploited by climate science deniers.

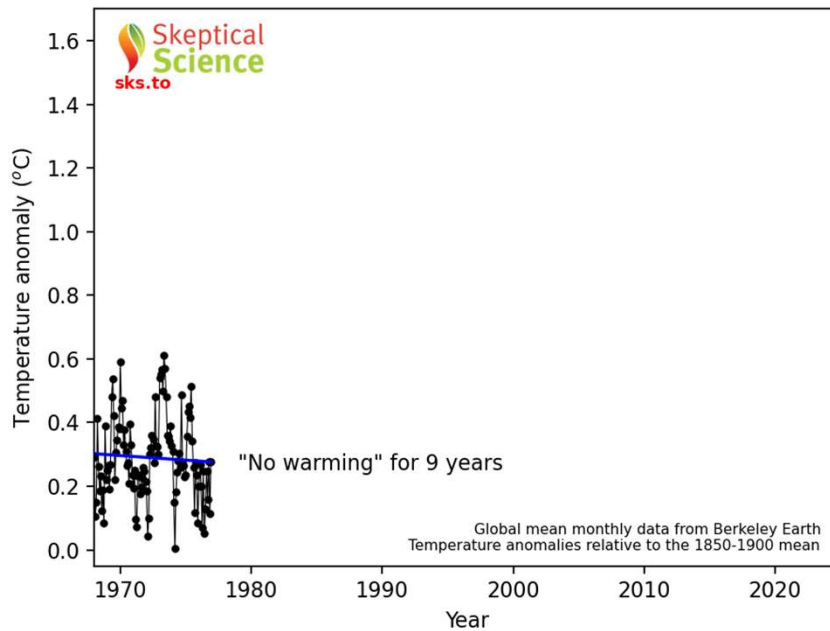






It's like being on the bow of a ship that's sinking and arguing "well I'm moving upwards so there's no problem!"

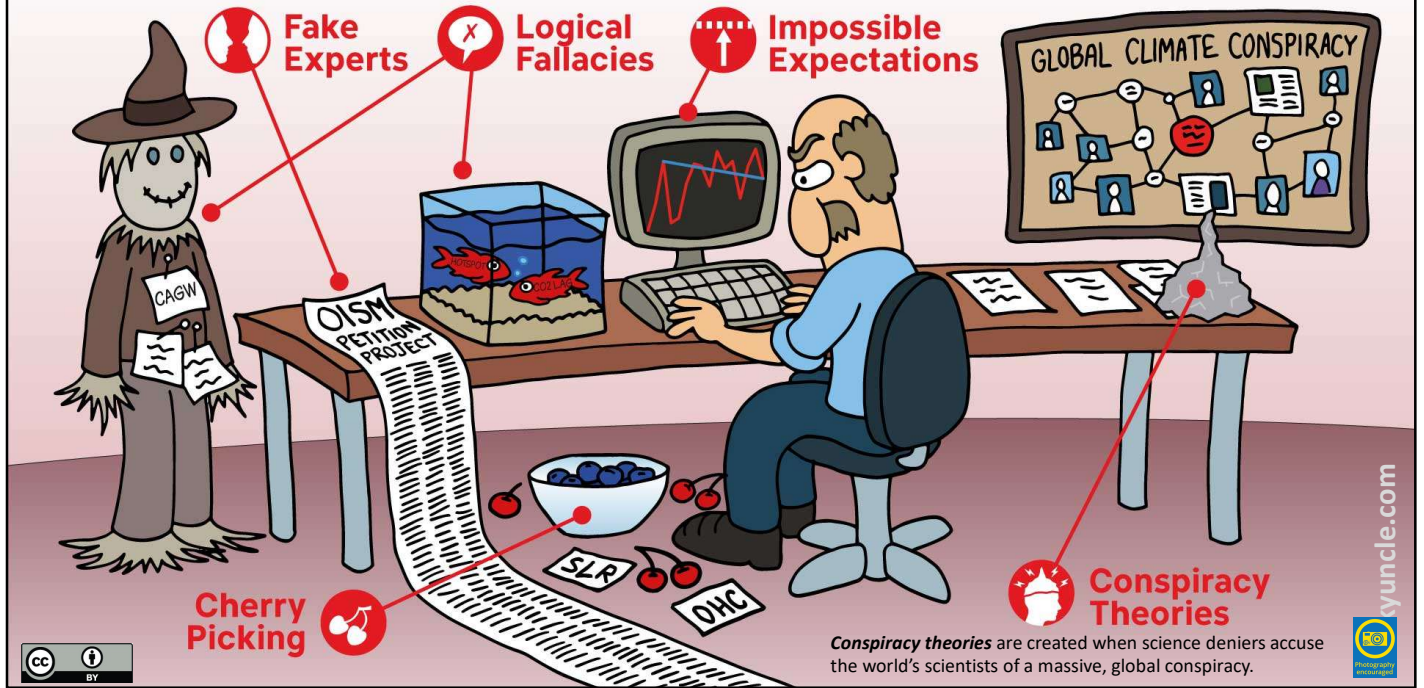
What this is doing, is ignoring what the bigger picture is and the way you can tell if someone is cherry picking, is if the conclusion that they come to from just a small part of the data, is different to the conclusion that you come to when you look at all the data, then that's cherry-picking.



You might have seen mentions of “The Escalator” recently which is an illustration for the cherry picking going into the claim that it hasn’t warmed for “x” number of years. We see that temperature goes up and down from year to year, mostly due to ocean cycles. That means that even during a period of long-term warming, you can cherry pick short periods when it looks like global temperature is not rising.



# The 5 techniques of science denial (FLICC)



**Conspiracy theories** are created when science deniers accuse the world's scientists of a massive, global conspiracy.



**Donald J. Trump** ✓  
@realDonaldTrump



The concept of global warming was created by and for the Chinese in order to make U.S. manufacturing non-competitive.

2:15 PM · Nov 6, 2012 · [Twitter Web Client](#)

**96.7K** Retweets   **64.7K** Likes

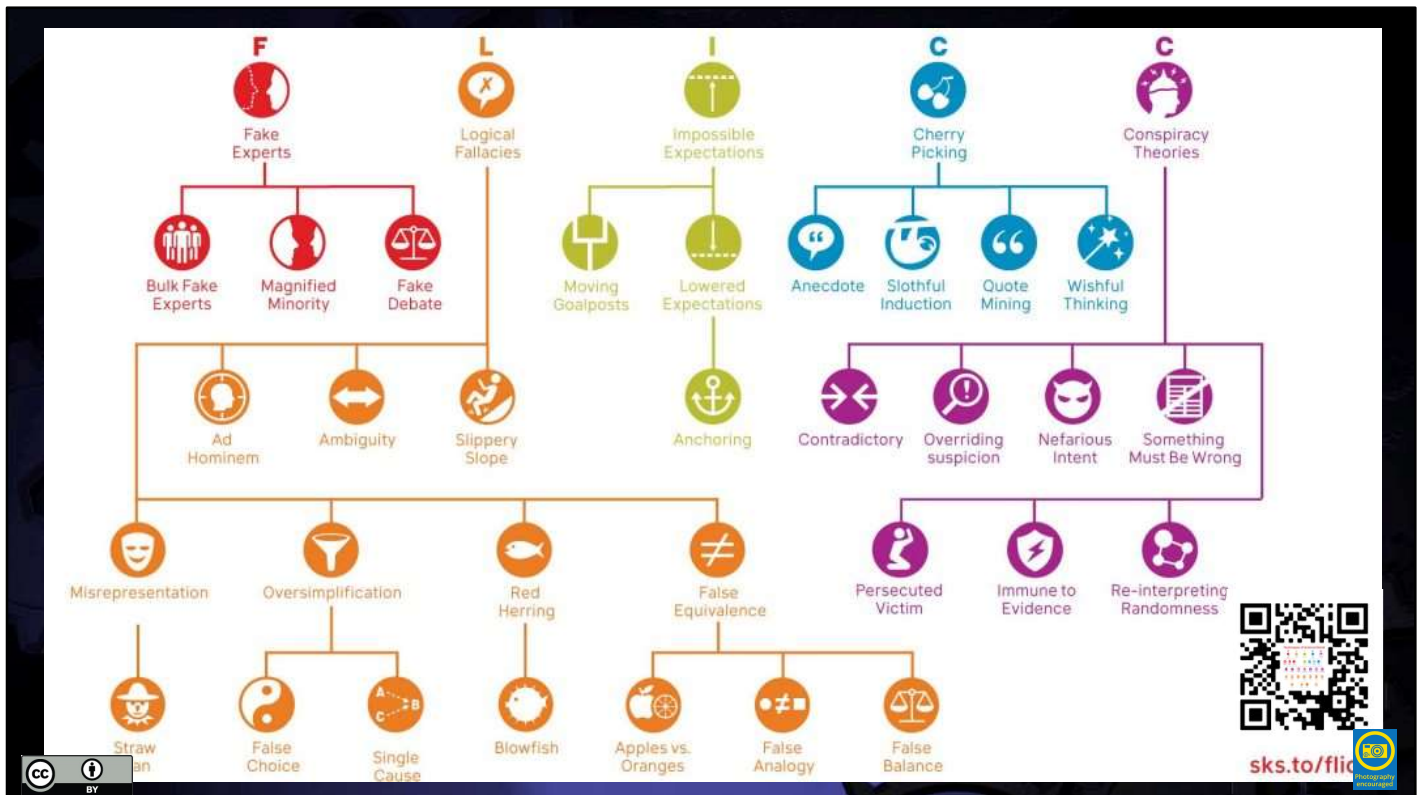


We tend to think of conspiracy theories as kind of amusing and a little bit ridiculous.



But there are actually really damaging conspiracy theories. And January 6 2021 has really underscored just how extreme, marginal, conspiracy theories can burst into the mainstream and then have devastating impacts on society. And even when you forget the violent aspects, just at a much more subtle level, conspiracy theories erode public trust in scientific and governmental institutions. And that is dangerous when it comes to climate change as well as when it comes to COVID.





These 5 main techniques are however just the tip of the proverbial iceberg!

Many fallacies can be broken down further and the current taxonomy includes 36 of them all told!

Which obviously is quite a lot to take in and memorize!.

# A big Challenge for Inoculation

Critical Thinking is hard and requires a lot of effort to not just memorize the techniques of science denial but to also be able to quickly recognize them “in the wild”.



It's also a big challenge for inoculation.

Especially if you want people to recognize them quickly when confronted with them „in the wild“!

# Cranky Uncle to the rescue!



This is where the Cranky Uncle game can help.

John Cook has been developing a smartphone game, that builds public resilience against misinformation by explaining these techniques of science denial.

The way the game works, is that a cranky uncle basically mentors you into how to become a science denying cranky uncle by explaining all the different techniques that he uses to reject science.

You'll first learn the five main techniques of science denial which – as we've already seen - are: fake experts, logical fallacies, impossible expectations, cherry picking and conspiracy theories.



**Cranky Uncle - a multi-lingual critical thinking game  
to build resilience against climate misinformation**  
Game is available for iPhone, Android and Browser



[sks.to/crankyiphone](https://sks.to/crankyiphone)



[sks.to/crankyandroid](https://sks.to/crankyandroid)



[sks.to/crankybrowser](https://sks.to/crankybrowser)

The game is available for iOS, Android and browsers and can currently be played in 12 languages with more in the works.

Thanks to John Cook  
for his slides as well as the Cranky Uncle  
cartoons used in this presentation!

More information is available at  
<https://crankyuncle.com>



Credit where credit is due!

Thank you!

Bärbel Winkler

Email - [baerbelw@skepticalscience.com](mailto:baerbelw@skepticalscience.com)

Web - <https://skepticalscience.com>

More about me - <https://sks.to/BaerbelW>



# Resources & References

Van der Linden, S., Leiserowitz, A., Rosenthal, S., & Maibach, E. (2017). Inoculating the public against misinformation about climate change. *Global Challenges*, 1(2), 1600008.

Cook, J., Lewandowsky, S., & Ecker, U. (2017). Neutralizing misinformation through inoculation: Exposing misleading argumentation techniques reduces their influence. *PLoS ONE*, 12(5): e0175799. <https://doi.org/10.1371/journal.pone.0175799>

Cook, J., Oreskes, N., Doran, P. T., Anderegg, W. R., Verheggen, B., Maibach, E. W., Carlton, J. S., Lewandowsky, S., Skuce, A. G., Green, S. A., & Nuccitelli, D. (2016). Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters*, 11(4), 048002.

Cook, J., Schuennemann, K., Nuccitelli, D., Jacobs, P., Cowtan, K., Green, S., Way, R., Richardson, M., Cawley, G., Mandia, S., Skuce, A., & Bedford, D. (April 2015). *Denial101x: Making Sense of Climate Science Denial*. edX. <http://edx.org/understanding-climate-denial>

References for many of the rebuttals mentioned in the presentation can be found via the reference list for our MOOC Denial101x: <http://sks.to/denial101xrefs>



# Additional Materials



Is there a way to tell genuine scepticism – which is the cornerstone of scientific inquiry – from denial?

Skeptical Science  
<https://skepticalscience.com>

For detailed information about Skeptical Science please check the display presented at EGU2020  
<https://sks.to/egu2020-display>

Skeptical Science (SkS) is a website and registered non-profit science education organization with international reach founded by John Cook in 2007. Our main purpose is to debunk misconceptions and misinformation about human-caused climate change and we have a database that currently has more than 200 rebuttals based on peer-reviewed literature.

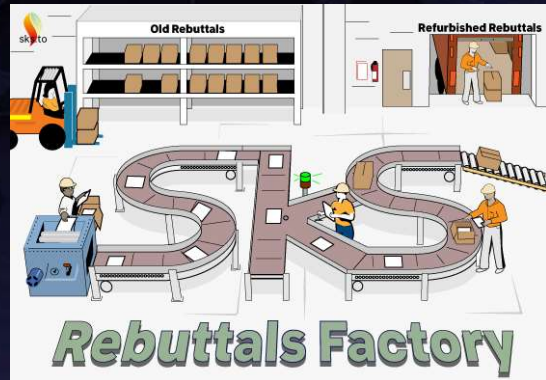
We employ what science tells us about how people listen and think to deliver more effective communications, which is better than guessing. We encourage all science communicators to do this. What follows are a few examples of how we apply this.

For detailed information about Skeptical Science please check the display presented at EGU2020 <https://sks.to/egu2020-display>



# Skeptical Science – Rebuttal Updates

<https://sks.to/at-a-glance>



For detailed information about our rebuttal updates please check the display presented at EGU2023  
<https://sks.to/egu23-abstract-1>



Since February 2023 we have been updating our rebuttals to common climate myths. They now feature an easy to understand “At a Glance” section in the basic level explanation followed by more details. Thus far, more than 60 of our more than 200 rebuttals have been updated and more are in the pipeline in our “rebuttals update factory”.

For detailed information about our rebuttal updates please check the display presented at EGU2023 <https://sks.to/egu23-abstract-1>



# Skeptical Science – Debunking

<https://sks.to/hotmess>

„Climate – the Movie: a hot mess with (c)old myths!“ – 25 of them to be exact!



*Climate - the Movie:* Skeptical Science Myth Rebuttals Online *a hot mess of (c)old myths!*

Use "http://sks.to/" plus the keyword listed in the table to access the complete rebuttal on SkepticalScience.com

#1 sun	#2 past	#3 consensus	#4 cooling	#5 model	#6 temp	#7 1998	#8 1970s	#9 keage	#10 antarctica
#11 lag	#12 impacts	#13 gore	#14 council	#15 cold	#16 hurricane	#17 1934	#18 hockey	#19 mars	#20 uah
#21 1500cycle	#22 arcticcycle	#23 sealvel	#24 vapor	#25 planets	#26 green	#27 oceanheat	#28 climatgate	#29 co2	#30 sensitivity
#31 greenhouse	#32 ia	#33 midcentury	#34 glacier	#35 pre1940	#36 evidence	#37 bear	#38 troposphere	#39 kilimanaro	#40 understat
#41 extreme	#42 pollutant	#43 coralbleach	#44 greentide	#45 weather	#46 hotspot	#47 methane	#48 jaguar	#49 job	#50 arctic
#51 saturate	#52 plate	#53 iceoutbase	#54 volcano	#55 species	#56 wing	#57 co2data	#58 ocean	#59 shmo	#60 arctic
#61 schelte	#62 dropped	#63 sic	#64 aerosols	#65 microbe	#66 residence	#67 jobs	#68 thermo	#69 significant	#70 warming
#71 lately	#72 tandem	#73 settled	#74 winter	#75 methane	#76 so2	#77 decline	#78 himalaya	#79 acid	#80 seapredict
#81 orestes	#82 1995	#83 comet	#84 oceanco2	#85 age	#86 albedo	#87 amazon	#88 stratopere	#89 hansen1988	#90 linderoth
#91 actin	#92 solarcycle	#93 spring	#94 olum	#95 waterum	#96 co2up	#97 chos	#98 stonefall	#99 searetract	#100 mauna
#101 driver	#102 treberth	#103 ordovician	#104 southice	#105 amplify	#106 stopped	#107 diverge	#108 hulna	#109 sic	#110 volcanodrop
#111 coz2inc	#112 light	#113 warmco2	#114 ozone	#115 microwave	#116 industrial	#117 icefraction	#118 tooold	#119 waste	#120 plant
#121 pratfak	#122 runaway	#123 track	#124 overestimate	#125 brush	#126 kelvin	#127 arctic	#128 den	#129 freudgrees	#130 humidity
#131 tyke	#132 freudgrees	#133 tothead	#134 economy	#135 bushad	#136 cleof	#137 tarnger	#138 perreview	#139 ipcc4ipcc3	#140 fo
#141 blabch	#142 futurfood	#143 stonata	#144 name	#145 icecap	#146 linear	#147 sonocover	#148 ipcc	#149 smerta	#150 smerta
#151 arctic1940	#152 expressive	#153 sealvelrise	#154 venus	#155 variable	#156 uk2010	#157 underground	#158 galileo	#159 job	#160 megpencer
#161 booble	#162 trend	#163 10000	#164 ipccwpp	#165 tungusit	#166 smth	#167 removco2	#168 suggest	#169 2004	#170 stepfunction
#171 tusulu	#172 best	#173 planetary	#174 schmittner	#175 nuclear	#176 seaice1940	#177 pastarctic	#178 arcticstorm	#179 cadabrate	#180 ipccnatral
#181 survived	#182 himalayagrow	#183 pal	#184 nuclear	#185 seaice1940	#186 pastarctic	#187 arcticstorm	#188 sandy	#189 15years	#190 langtal
#191 solermimimus	#192 robot97	#193 aksouti	#194 confidence	#195 projections	#196 locapaus	#197 trearwave	#198 fringe	#199 damgports	#200 adaptstrap
#201 meet	#202 satellite	#203 money	#204 helioli	#205 volc2up					

(Available at: <http://skepticalscience.com/feednum.php>)

We sometimes manage to produce some “rapid debunking” like was the case in March 2024 when Martin Durkin’s sorry excuse of a movie was launched on Youtube and elsewhere. John Mason from our team sat down to watch it and took notes while doing so. He identified 25 old myths catalogued and debunked in our database, so within a day we cobbled together a blog post and published it on Saturday, March 23. It also contained the Myth Rebuttal Chart – a bingo card if you like – highlighting the myths identified. Thanks to being shared far and wide – including by Katharine Hayhoe – the blog post has been viewed more than 30K times, an order of magnitude more than our articles usually do. We just wish that we had the resources to do this more often than is possible right now!

You can read the blog post at <https://sks.to/hotmess>

# The Debunking Handbook 2020

<https://sks.to/debunk2020>

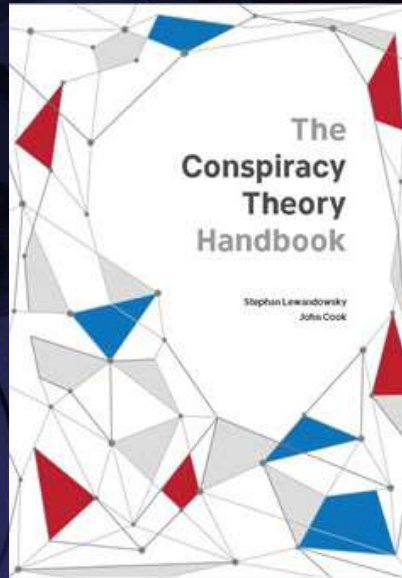


We also provide downloadable materials like various handbooks. The Debunking Handbook is a consensus document written by 19 co-authors invited by the three lead authors Stephan Lewandowsky, John Cook and Ullrich Ecker based on their scientific status in the field. The Handbook explains what mis- and disinformation is, why it can cause substantial harm for individuals and societies, why it is often sticky and therefore hard to dislodge, why pre-bunking can be more effective than debunking and how to go about the latter best. Most importantly, it point outs to not refrain from attempting to debunk or correct misinformation out of fear that doing so will backfire or increase beliefs in false information.

Download the handbook at <https://sks.to/debunk2020>

# The Conspiracy Theory Handbook

<https://sks.to/conspiracy>

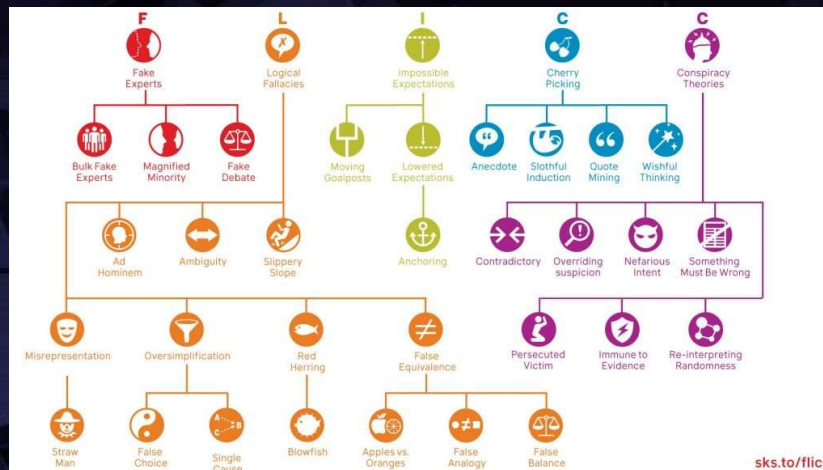


Conspiracy theories attempt to explain events as the secretive plots of powerful people. While conspiracy theories are not typically supported by evidence, this doesn't stop them from blossoming. Conspiracy theories damage society in a number of ways. To help minimise these harmful effects, The Conspiracy Theory Handbook written by Stephan Lewandowsky and John Cook explains why conspiracy theories are so popular, how to identify the traits of conspiratorial thinking, and what are effective response strategies.

Download the handbook from <https://sks.to/conspiracy>

# FLICC – the techniques of science denial

<https://sks.to/flicc-sks>



FLICC is a framework originally proposed by Mark Hoofnagle in 2007 who listed the five techniques of science denial: fake experts, logical fallacies, impossible expectations, cherry picking and conspiracy theories. These five main techniques are however just the tip of the iceberg and John Cook has gradually been building up a landscape of different techniques used to mislead.

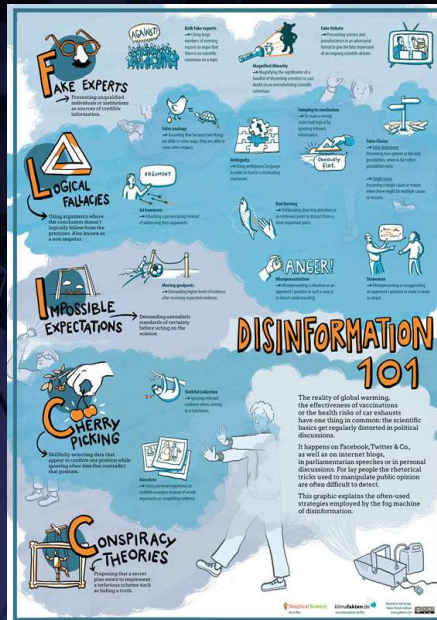
More information: <https://sks.to/flicc-sks>





# The FLICC Poster

<https://sks.to/flicc-poster>

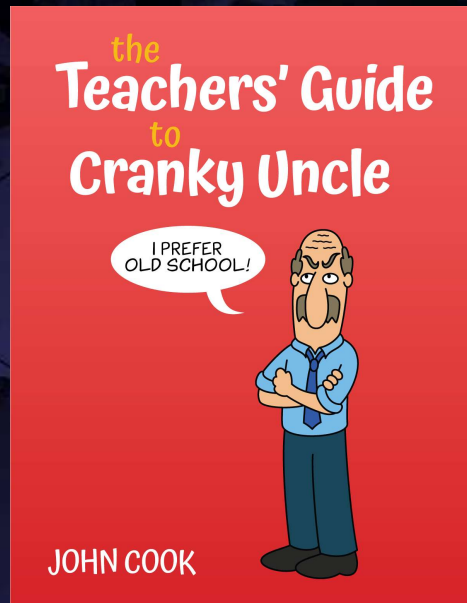


Many of these techniques are depicted in the FLICC Poster, which is the result of a successful collaboration between Skeptical Science and our German language partner website klimfakten.de. The poster's first version was in German but the idea to also create an English version soon came up. Several other language versions have been created since then.

Download the poster from <https://sks.to/FLICC-poster>  
Collaboration <https://sks.to/FLICC-poster-collab>.

# The Teachers' Guide to Cranky Uncle

<https://sks.to/crankyguide/>



The Teachers' Guide to Cranky Uncle explains the science behind the game and contains resources for various class activities. It has been translated in several languages already.

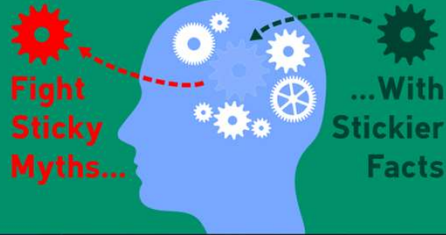
Download available at <https://sks.to/crankyguide>



## 3 ELEMENTS TO AN EFFECTIVE DEBUNKING

### FACT

Replace the myth with a factual alternative that meets all the causal requirements left by the myth. Ideally, the fact is more compelling and memorable than the myth.



THE  
GOLDEN  
RULE OF  
DEBUNKING

An effective debunking comes with three elements:

Start with the FACT and follow the golden rule of debunking by fighting sticky myths with stickier facts.

## 3 ELEMENTS TO AN EFFECTIVE DEBUNKING

### FACT

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THE  
GOLDEN  
RULE OF  
DEBUNKING

### MYTH/MISCONCEPTION

Mentioning the myth risks a familiarity backfire effect. Here are three techniques to reduce the risk of a backfire effect:

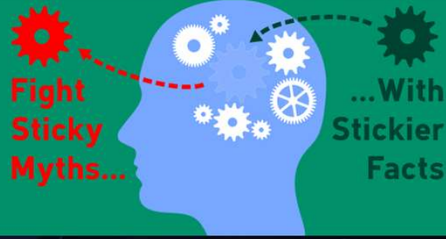
- Emphasise the fact rather than the myth
- Warn people before mentioning the myth
- Explain the myth's fallacy

Before mentioning the misconception, precede it with a warning to put people on guard.

# 3 ELEMENTS TO AN EFFECTIVE DEBUNKING

## FACT

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**THE  
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## MYTH/MISCONCEPTION

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- Emphasise the fact rather than the myth
- Warn people before mentioning the myth
- Explain the myth's fallacy

## FALLACY

Explain the technique used by the myth to distort the fact. This enables people to reconcile the fact with the myth.



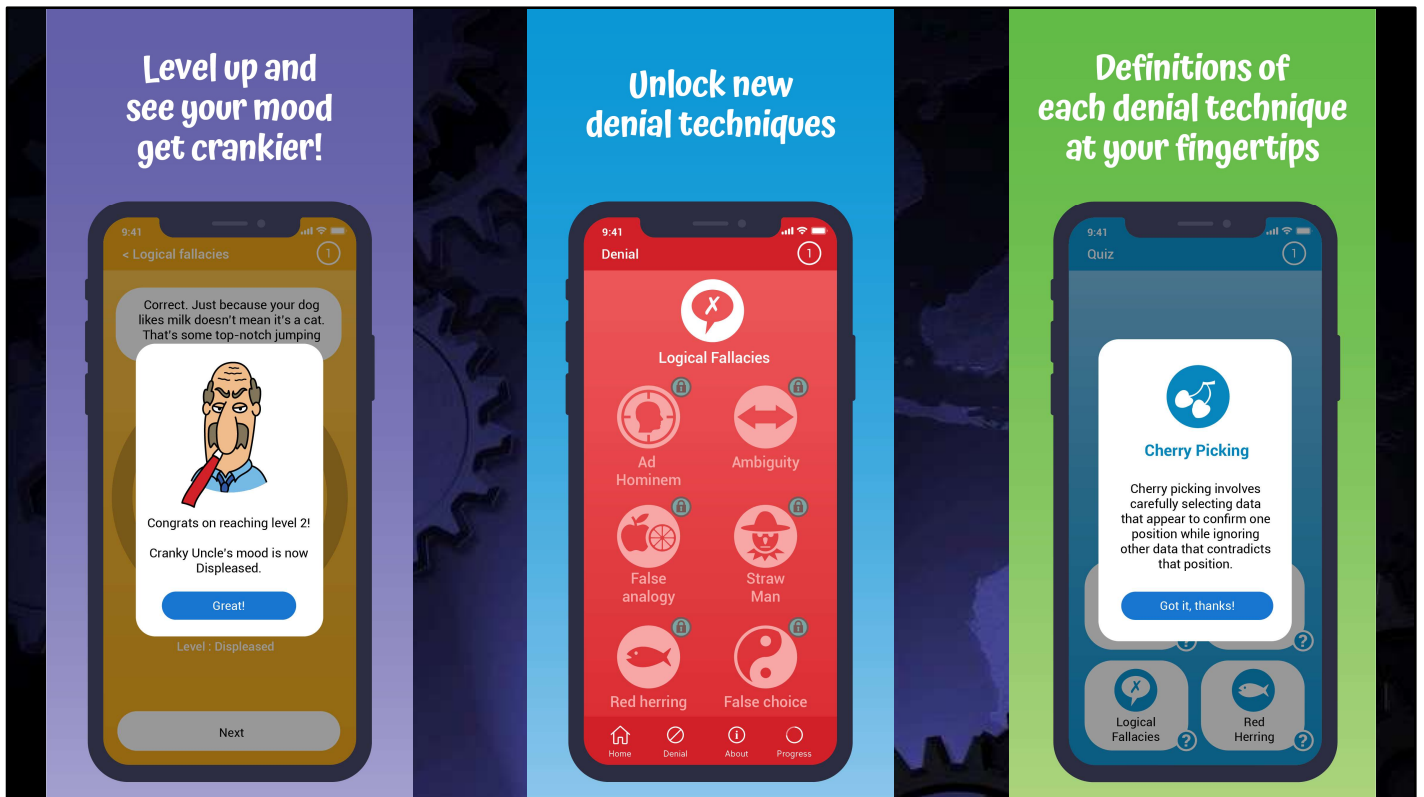
Finally, explain the fallacy employed by the myth



Cranky Uncle mentors you on how to deny science by using these FLICC techniques.

You then practice spotting these techniques with the help of cartoon quizzes and other forms of quiz questions.

As you move along you build up Cranky points.

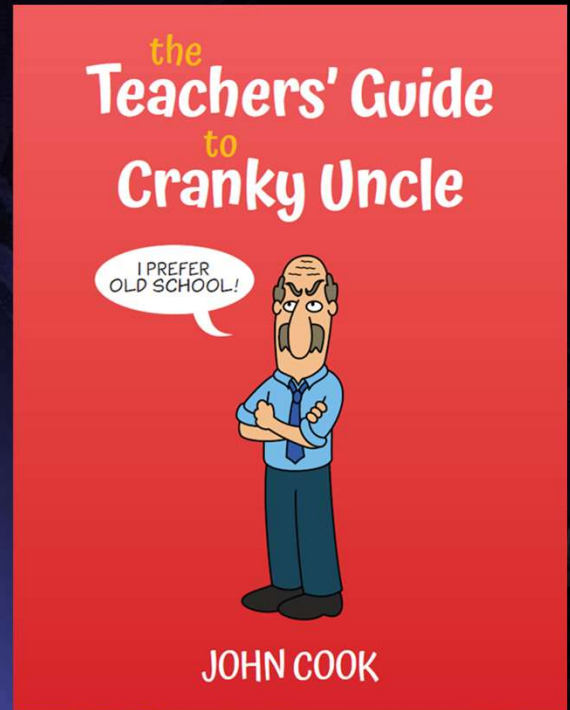


And the more cranky points you get, the more you are able to level up and see your mood get ever crankier.

Once you've mastered the initial five FLICC techniques more denial techniques will get unlocked.

And for each of the techniques, definitions are available right at your fingertips.

The Teacher's Guide explains the game's scientific background and includes suggestions for how to include the game in class.



A Teachers' Guide explains the game's scientific background and contains suggestions of how the game can be included in class.

Teachers from across the globe have already shown interest in using the game in almost any subject as well as different age groups.



## List of and links to Resources



Skeptical Science  
<https://sks.to>



MOOC Denial101x  
<https://sks.to/Denial101x>



History of FLICC  
<https://sks.to/FLICC>



FLICC Poster  
<https://sks.to/FLICC-poster>



The Conspiracy Theory  
Handbook  
<https://sks.to/conspiracy>



The Debunking Handbook 2020  
<https://sks.to/debunk2020>



Cranky Uncle  
Game and Book  
<https://crankyuncle.com>

There is a lot more supporting material for FLICC as I can get into within 7 minutes, so here is a slide with QR-codes and links to several of them.