

Influencing people

Climate communication

Assignments

~~Brightspace discussion question~~

(Optional) course feedback:

https://nyu.qualtrics.com/jfe/form/SV_73c1EEHPLaJV062

Written Project Plan

Due Thursday the 23rd by midnight.

Project Plan Presentation

Tuesday the 28th, in class.

Short project plan

~500 words. Provide team members and team name. Describe the problem you are tackling and how it will help mitigate or adapt to climate change and why you chose this problem. Explain the data you intend to use, the methods, and how you will evaluate your results. List anticipated challenges (e.g., data cleaning issues, learning to use new methods/coding packages, etc).

Due March 23. **I will provide feedback on your plan before your presentation.**

Climate change in the news

Climate change in the news

The New York Times

BREAKING NEWS

Earth is likely to cross a critical global warming threshold within the next decade unless drastic changes are made, a major U.N. report said.

Monday, March 20, 2023 9:04 AM ET

The report by the Intergovernmental Panel on Climate Change, a body of experts convened by the United Nations, says it is still possible to hold global warming to relatively safe levels, but doing so will require global cooperation, billions of dollars and big changes.

[Read more](#)

“Global average temperatures are estimated to rise 1.5 degrees Celsius (2.7 degrees Fahrenheit) above preindustrial levels sometime around “the first half of the 2030s,” as humans continue to burn coal, oil and natural gas.”

The report comes as the world’s two biggest polluters, China and the United States, continue to approve new fossil fuel projects. Last year, China issued [permits for 168 coal-fired power plants of various sizes](#), according to the Centre for Research on Energy and Clean Air in Finland. Last week, the Biden administration [approved an enormous oil drilling project known as Willow that will take place on pristine federal land in Alaska](#).

Biden Administration Approves Huge Alaska Oil Project

The administration also announced new limits on Arctic drilling in an apparent effort to temper criticism over the \$8 billion Willow oil project, which has faced sharp opposition.

Everything is done by people

Leadership & University Administration

Leadership & University Administration
Board of Trustees
Office of the President
President-Designate
Office of the Provost
Deans and Directors
Senior Leadership Team
University Senate
President Emeritus
Provost Emeritus
University Initiatives
News, Publications, and Facts
Careers at NYU
Visitor Information
Policies and Guidelines
Giving to NYU

Office of the President



Andrew Hamilton, President of NYU

President Designate



Linda G. Mills, President-Designate

EXECUTIVE COMMITTEE

The Shell plc Executive Committee operates under the direction of the Chief Executive Officer and is responsible for Shell's overall business and affairs.

The Chief Executive Officer has final authority in all matters of management that are not within the duties and authorities of the Board or of the shareholders' general meeting. The Executive Committee supports the Chief Executive Officer and implements all Board resolutions and supervises all management levels in Shell.



Wael Sawan

Chief Executive Officer.



Sinead Gorman

Chief Financial Officer.



Harry Brekelmans

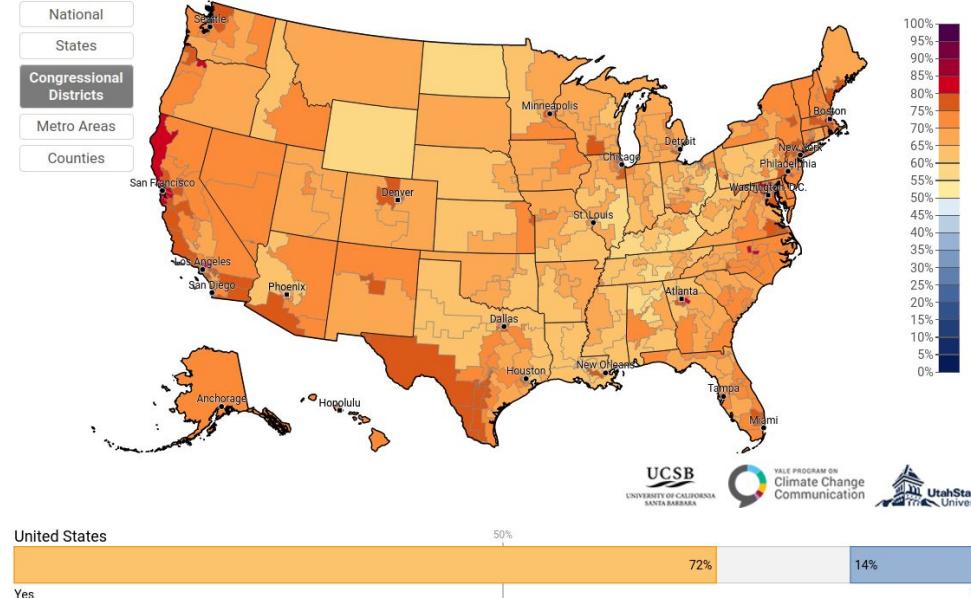
Projects & Technology Director.



What do people think about climate change?

Estimated % of adults who think global warming is happening (nat'l avg. 72%), 2021

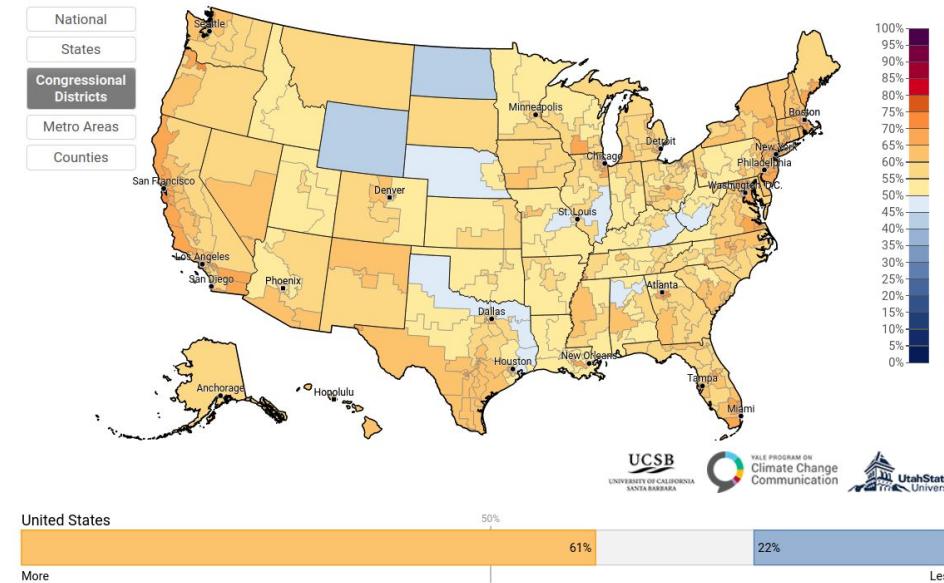
Select Question: Global warming is happening Absolute Value
Click on map to select geography, or: Select a State Select a Congressional District



What do people think about climate change?

Estimated % of adults who think Congress should do more to address global warming (nat'l avg. 61%), 2021

Select Question: Congress should do more to address global warming Absolute Value
Click on map to select geography, or: Select a State Select a Congressional District

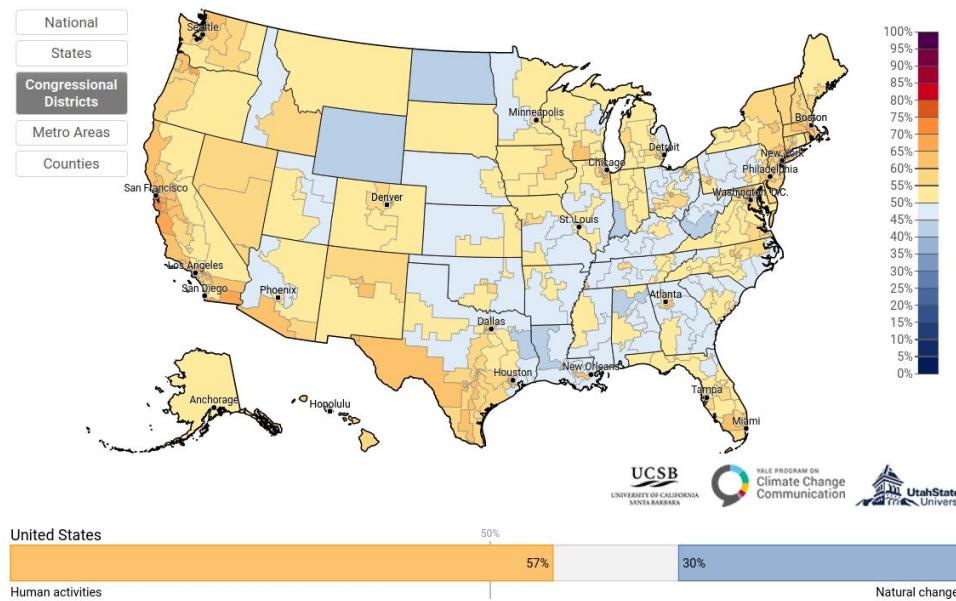


What do people think about climate change?

Estimated % of adults who think global warming is mostly caused by human activities (nat'l avg. 57%), 2021

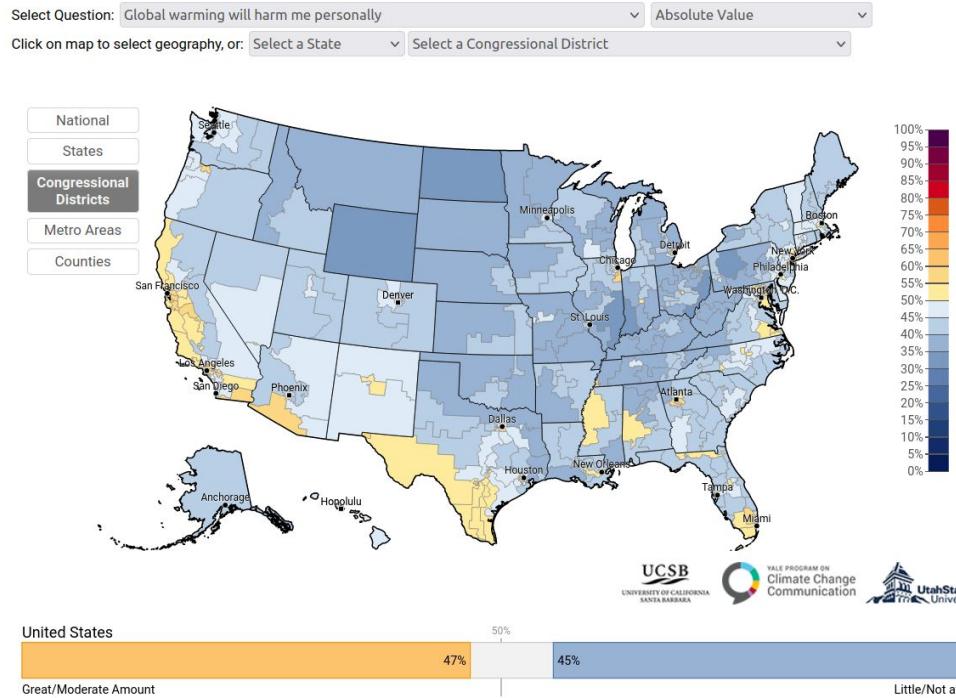
Select Question: Global warming is caused mostly by human activities ▾ Absolute Value ▾

Click on map to select geography, or: Select a State ▾ Select a Congressional District ▾



What do people think about climate change?

Estimated % of adults who think global warming will harm them personally
(nat'l avg. 47%), 2021

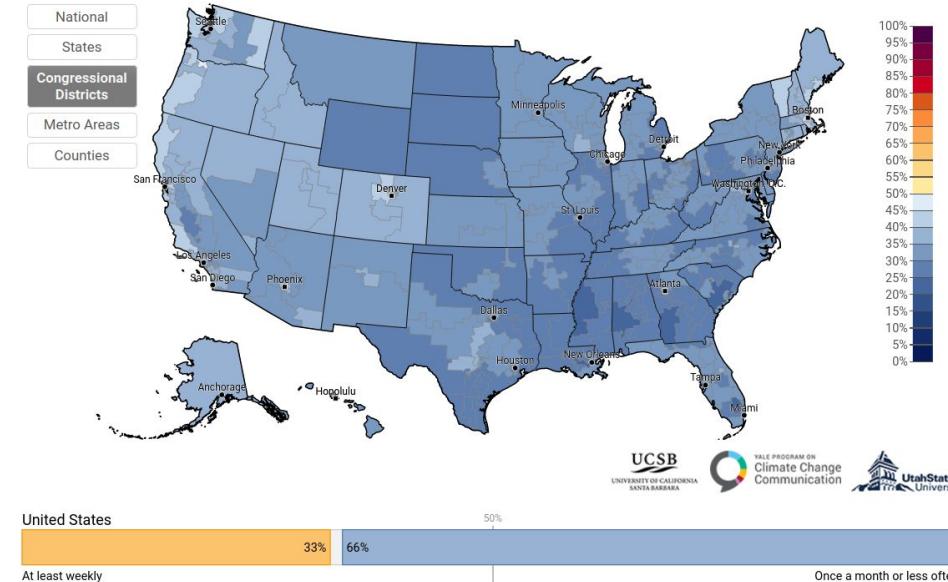


What do people think about climate change?

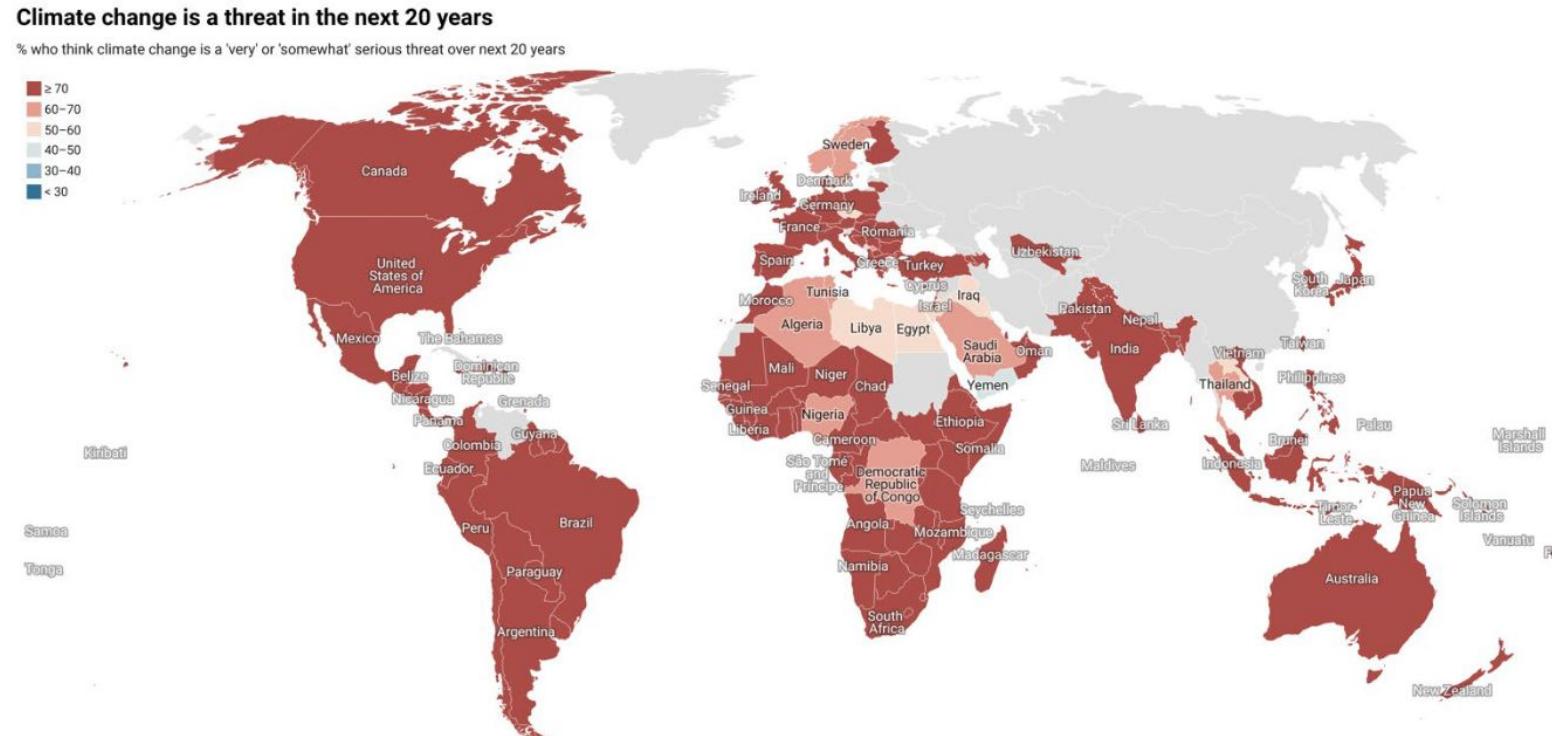
Estimated % of adults who hear about global warming in the media at least once a week (nat'l avg. 33%), 2021

Select Question: Hear about global warming in the media at least once a week ▾ Absolute Value

Click on map to select geography, or: Select a State ▾ Select a Congressional District ▾

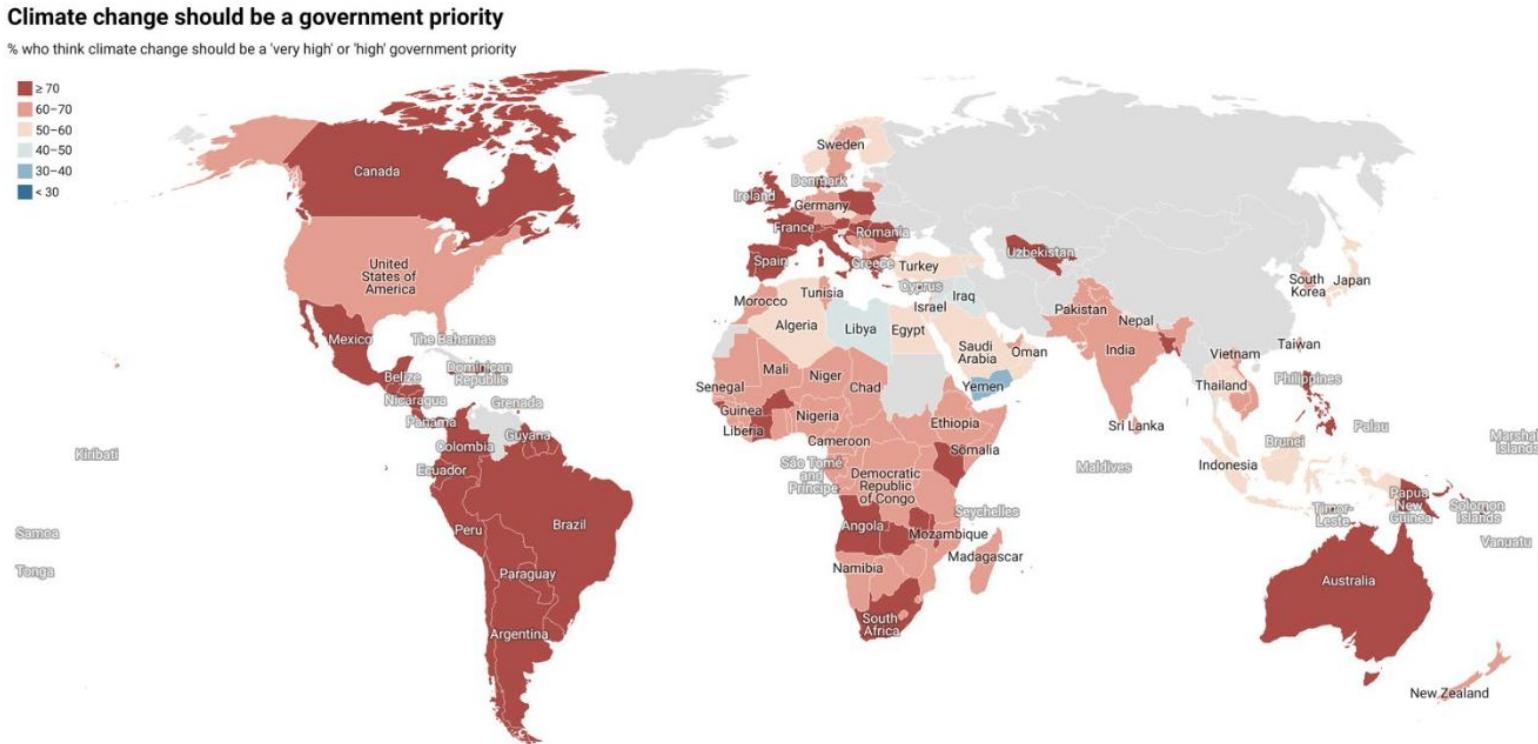


What do people think about climate change?



Source: Yale Program on Climate Change Communication / Data For Good at Meta - Created with Datawrapper

What do people think about climate change?

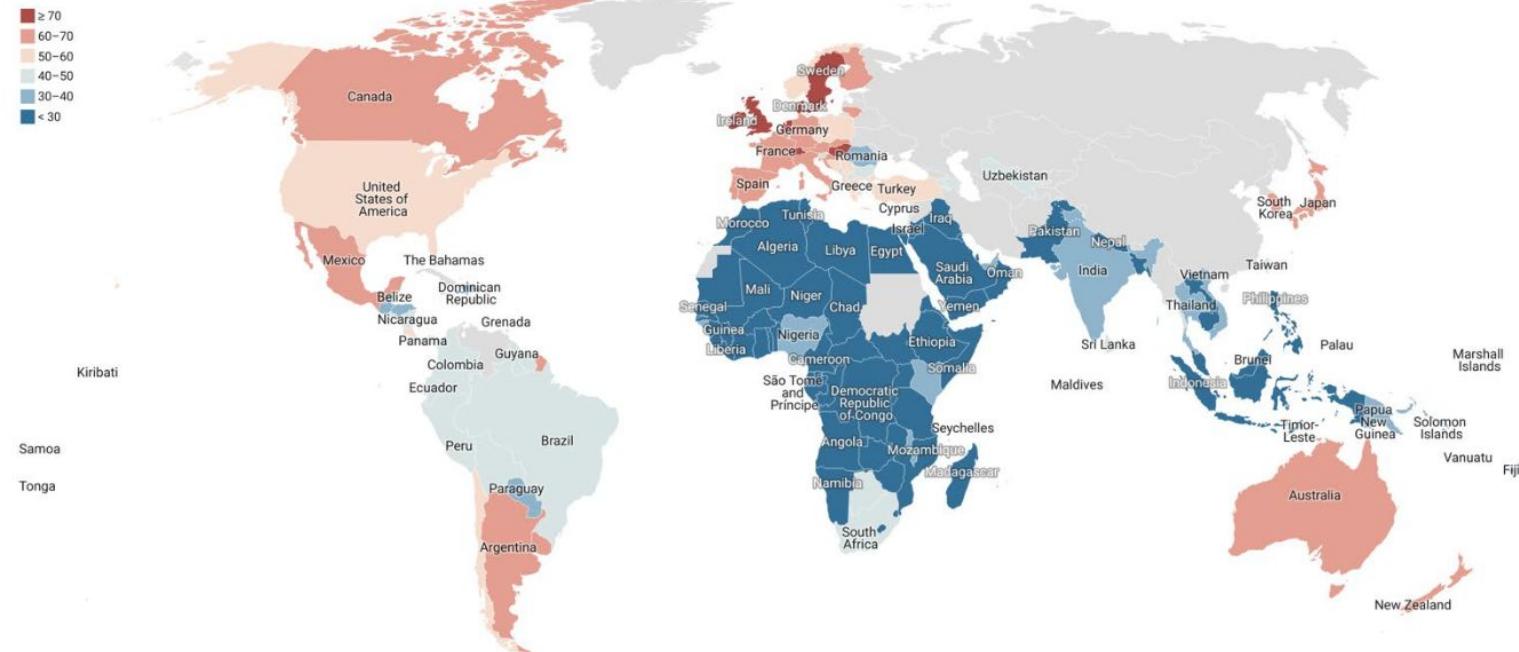


Source: Yale Program on Climate Change Communication / Data for Good at Meta - Created with Datawrapper

What do people think about climate change?

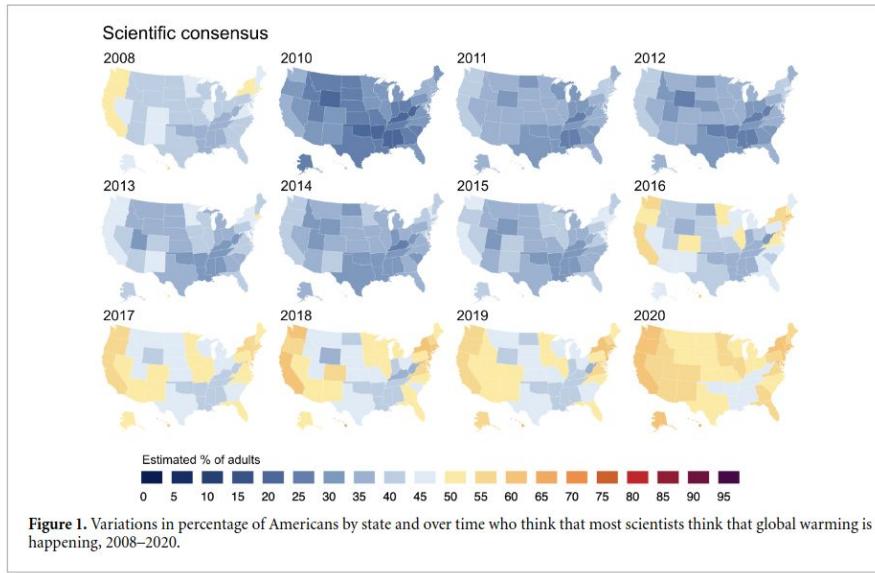
Support for reducing fossil fuels

% who support 'much less' or 'somewhat less' fossil fuels



Source: Yale Program on Climate Change Communication / Data for Good at Meta • Created with Datawrapper

Can we change people's minds?

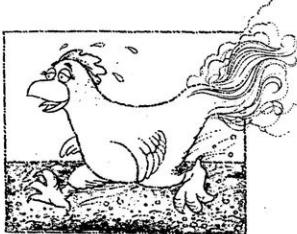


It's already been happening

Can we change people's minds?

Oil companies have done it (in the wrong way)

**Who told
you the earth was
warming...
Chicken Little?**

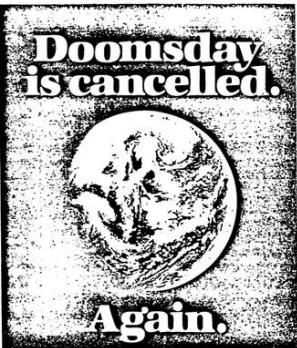


Chicken Little's cry went up to the sky. Falling was based on a fact that was true.

It's the same with global warming. There's hard evidence it's occurring. It's the same with ExxonMobil's climate science. Carbon dioxide has been the primary cause of non-existent Climate models cannot accurately predict future global warming. And the underlying physics of the climate change are still wide open to interpretation.

If you care about the environment, but don't want your imagination run away with you, then here's what you can do:

Write to the Citizens for the Environment, P.O. Box 1513, Grand Forks, North Dakota 58201, or call toll-free 1-800-467-9311 and tell the facts about global warming.



The twentieth century has seen many predictions of global destruction. In the 1930's, some scientists predicted that we were in the middle of a disastrous warming trend. By the 1950's, they were sure we were entering a new ice Age. And so on. It's the same with global warming. There's no hard evidence it's occurring. In fact, there's proof that Earth is warming is weak. Proof that carbon dioxide has been the primary cause of non-existent Climate models cannot accurately

predict future global change. And the underlying physics of the climate change are still wide open to interpretation.

If you care about the environment, but don't care to be overwhelmed by the many problems that don't exist, then here's what you can do:

Write to the Citizens for the Environment, P.O. Box 1513, Grand Forks, North Dakota 58201, or call toll-free 1-800-467-9311 and tell the facts about global warming.

Lies they tell our children

"I don't have a future."

With tears streaming down her face, a 13-year-old girl made the somber assessment to her mother. To snap up her pessimism, she had brought home from school a mimeographed sheet listing the horrors that awaited her generation over the next 25 years: World famine, overpopulation, pollution so bad that everyone would wear a gas mask, befouled rivers and streams that would mandate cleansing tablets in drinking water, a global ice age, the melting of the polar ice caps and devastate U.S. coastal cities... a cancer epidemic brought on by damage to the ozone layer.

Moving on to the girl's misery, her father, Howard London, a Hudson Institute and New York University, wrote a book, *Why Are They Lying to Our Children? The Book Documenting How Some of the Myths of the 1980s and 1990s are Even More Dumb Than Those That are Being Perpetuated and Taught as Gospel Truth in Some of Our Schools*. And the book raises a question in our minds: Will the next generation grow up with a solid understanding of science and technology—both their merits and their problems—than our own?

Professor London's book is not a plea for unbridled technology. But it is a plea for balance. And school textbooks, he believes, are notoriously unbalanced. In dealing with environmental questions, for example, no textbook the author could find made any mention of the following facts:

■ Total automobile emissions of hydrocarbons, carbon monoxide, and nitrogen oxide

in the U.S. are less than half what they were from 1957 to 1966.

■ The level of unhealthy sulfur dioxide in the air has been steadily declining since 1970.

■ The bacteria level in the Hudson River decreased more than 30 percent between 1966 and 1981.

Textbooks, Professor London finds, mythologize nature as eternally benign until disturbed by humans. A schoolbook might talk about volcanoes belching smoke into the air, floods that overwhelm river towns, and tornadoes that lift people into oblivion. Moreover, textbooks hardly mention the promise of a bright future ahead of the horizon—when, on average, expectancy may approach 90 years, when products derived from recombinant DNA research will eliminate most viral diseases, when we can employ nanotech, seizure and materials—especially plastics—will be better, stronger, and safer.

Professor London's conclusion: with what good intentions that we should help our children think for themselves and reach balanced conclusions. Let's look at these textbooks, not to censor them but to raise questions, to encourage them to think points of view, and help dispel myths. That way we can educate a new generation of citizens who aren't scared by science, and who can be wary of old mythologies.

Our younger citizens have to learn, like us, the schools, should help them look forward to it with hope, even as they prepare to deal with its problems.

Unsettled Science

Knowing that weather forecasts are reliable for a few days at best, we should recognize the enormous challenge facing scientists seeking to predict climate change and its impact over the next century. In spite of everyone's desire for clear answers, it is not surprising that fundamental gaps in knowledge leave scientists unable to make reliable predictions about future changes.

A recent report from the National Research Council (NRC) raises important issues, including these still-unanswered questions:

- (1) Has human activity already begun to change temperature and the climate?
- (2) How significant will future change be?

The NRC report confirms that Earth's surface temperature has risen by about 1 degree Fahrenheit over the past 150 years. Some use this result to claim that humans are causing global warming, and they point to storms or floods to say that dangerous impacts are already under way. Yet scientists remain unable to confirm either contention.

Geological evidence indicates that climate and greenhouse gas levels experience significant natural variability for reasons having nothing to do with human activity. Historical records and current scientific evidence show that Europe and North America experienced a medieval warm period one thousand years ago, followed centuries later by a little ice age. The geological record shows even larger changes throughout Earth's history. Against this backdrop of large, poorly understood natural variability, it is impossible for scientists to attribute the recent small surface temperature increase to human causes.

Moreover, computer models relied upon by climate scientists predict that lower atmospheric temperatures will rise as fast or faster than temperatures at the surface. However, only within the last 20 years have reliable global measurements of temperatures in the lower atmosphere been available through the use of satellite technology. These measurements show little if any warming.

Even less is known about the potential positive or negative impacts of climate change.

In fact, many academic studies and field experiments have demonstrated that increased levels of carbon dioxide can promote crop and forest growth.

So, while some argue that the science debate is settled and governments should focus only on near-term policies—that is empty rhetoric. Inevitably, future scientific research will help us understand how human actions and natural climate change may affect the world and will help determine what actions may be desirable to address the long-term.

Science has given us enough information to know that climate changes may pose long-term risks. Natural variability and human activity may lead to climate change that could be significant and perhaps both positive and negative. Consequently, people, companies and governments should take responsible actions now to address the issue.

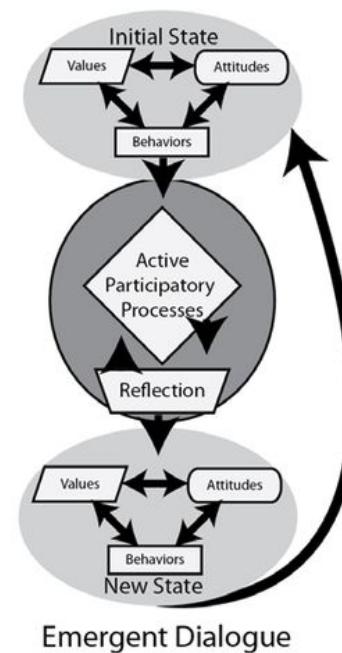
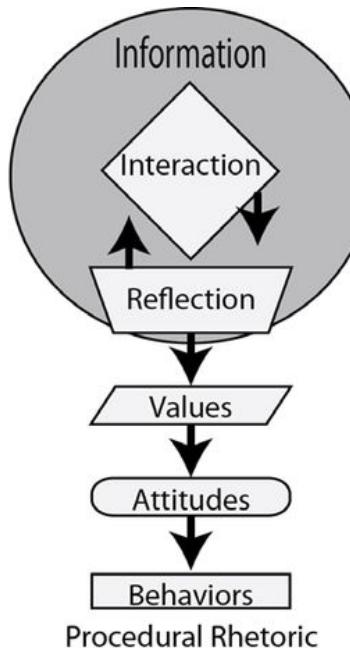
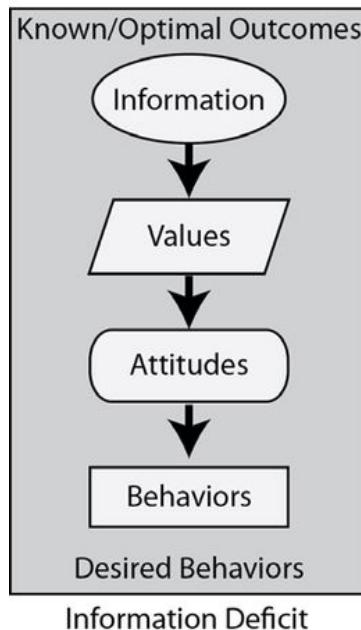
One essential step is to encourage development of lower-emission technologies to meet our future needs for energy. We'll next look at the promise of technology and what is being done today.

ExxonMobil

Mobil

'ExxonMobil's climate "advertisorials" – advertisements disguised as editorials – appeared in the op-ed page of the New York Times and other newspapers and were part of what scholars have called "the longest, regular (weekly) use of media to influence public and elite opinion in contemporary America".'

What is effective at changing minds?

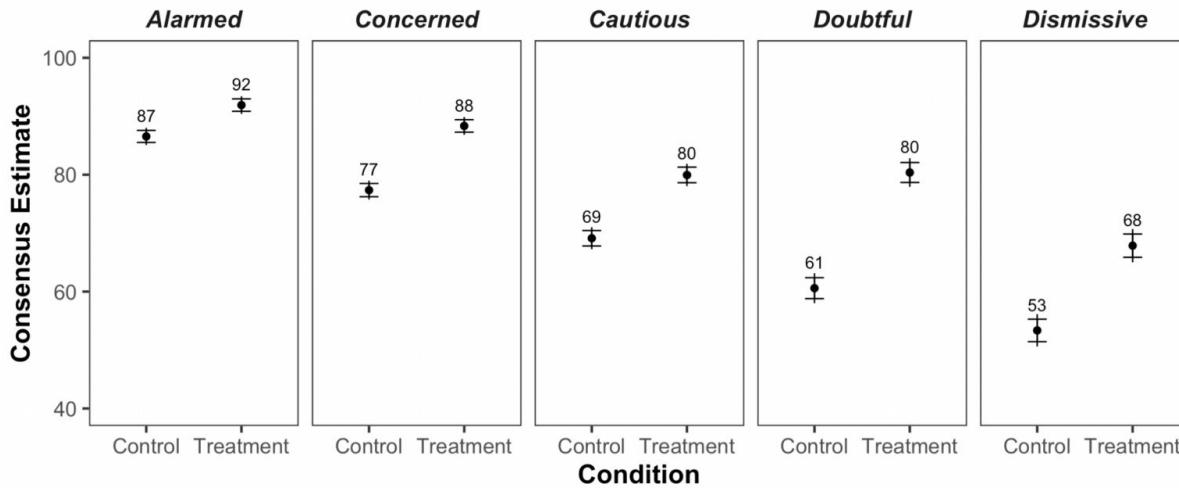


The ability to change minds and behaviors can depend simply on providing information or may require more involved processes of interaction and activations of a sense of identity

What is effective at changing minds?

Enforcing that there is scientific consensus

Estimates of the scientific consensus across conditions and audience segments

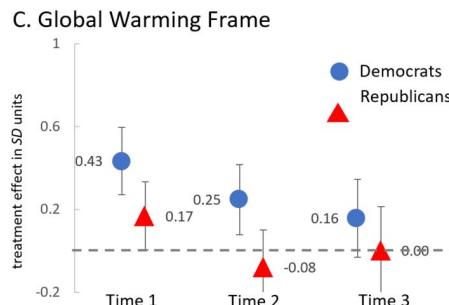
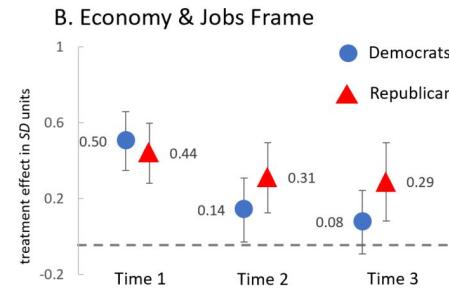
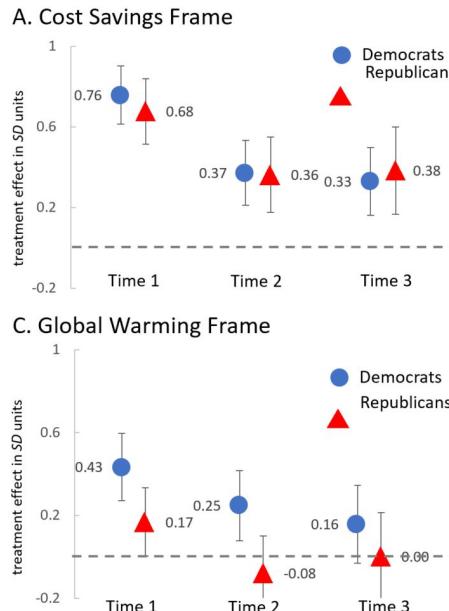


"We delivered a consensus message (i.e., "97% of climate scientists have concluded that human-caused global warming is happening") to members of five of the six U.S. climate audiences. We found that all audiences – from *Alarmed* to *Dismissive* – updated their beliefs about the scientific consensus."

Note. Vertical error bars represent 95% confidence intervals. Horizontal error bars represent 83% confidence intervals to facilitate visual comparisons of significant differences at $p = .05$. Values are means adjusted for pre-treatment estimates of the scientific consensus.

What is effective at changing minds?

Emphasizing co-benefits



The three panels show the effect of each of the three frames (Panel A = Cost Savings Frame; Panel B = Economy & Jobs Frame; Panel C = Global Warming Frame). The values in each panel represent the size of the effect (y-axis) of that frame on beliefs about that benefit of renewable energy, for Democrats and Republicans separately.

The x-axis shows how the size of these persuasive effects decayed over time. Time 1 measurement was immediately after viewing the message. Time 2 was an average of 11 days after Time 1. Time 3 was an average of 23 days after Time 1. Error bars indicate 95% confidence intervals around the mean.

What is effective at changing minds?

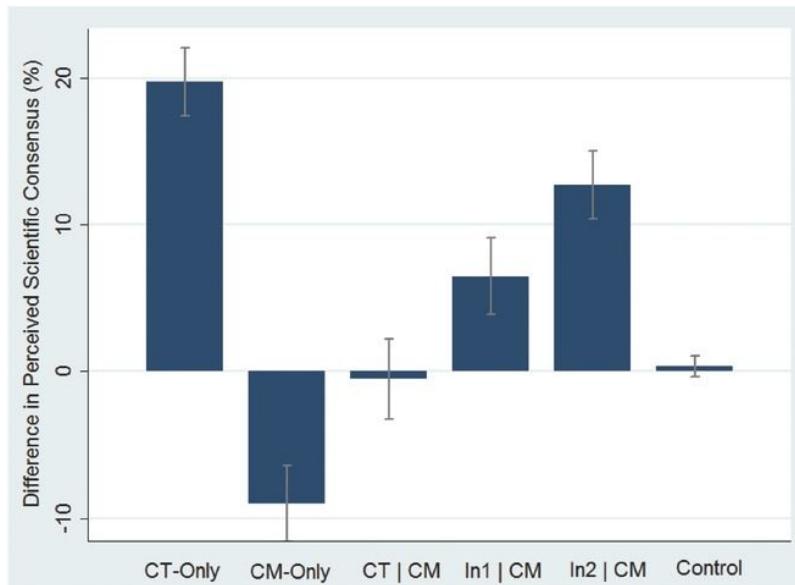
Changing actions can change beliefs

In fact, taking action with concrete solutions can actually help change minds. "Belief and action are connected," said anthropologist Ben Orlove, co-director of the Earth Institute's [Center for Research on Environmental Decisions](#). "Belief is often a basis for action. But once you're committed to a course of action, you tend to find lots of reasons for why you did it."

Hayhoe told a story that illustrates just this point. For years, her colleague argued the science of climate change with his father who was a long-time doubter, but he was never able to change his father's mind. Finally the local community offered a big rebate to get solar panels, so the father installed them on his house. One year later, after telling everyone what a good deal it was and how much money he had saved, the father came to Hayhoe's colleague and said, "You know, that climate thing might be real after all."

What is effective at changing minds?

‘Inoculation’ against known misinformation



Note: CT = Consensus Treatment, CM = Counter-Message, In1 = General Inoculation, In2 = Detailed Inoculation.
Error bars represent 95% confidence intervals.

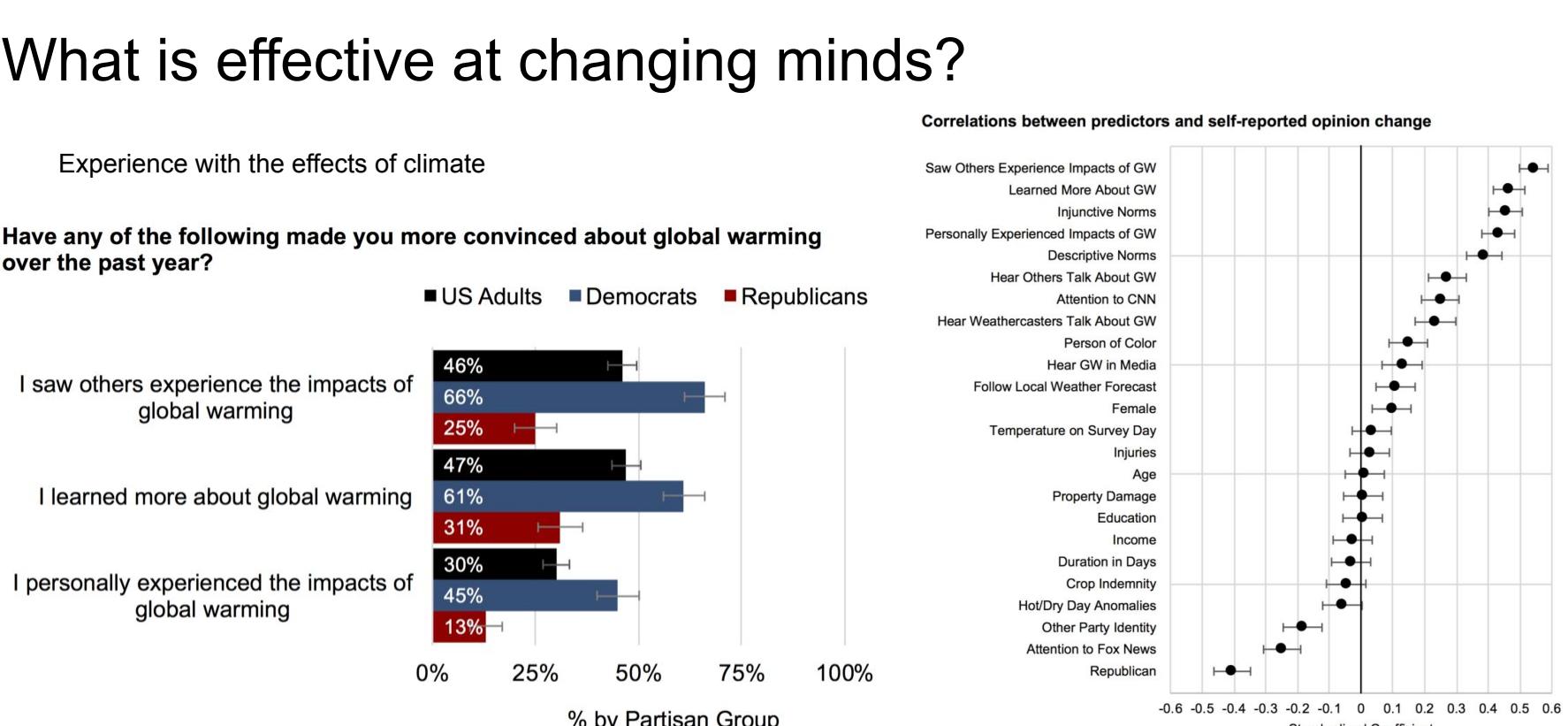
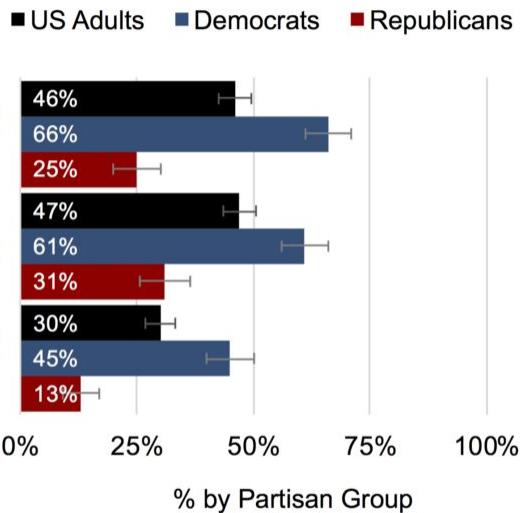
Letting people know that politically-motivated actors are spreading misinformation about climate change (In1 and In2) can reduce the impact of that misinformation.

<https://onlinelibrary.wiley.com/doi/full/10.1002/qch2.20160008>

What is effective at changing minds?

Experience with the effects of climate

Have any of the following made you more convinced about global warming over the past year?



December 2018
N = 1,114 (505 Democrats;
389 Republicans)



December 2018, N = 1,114
GW = Global warming
Error bars indicate the 95% confidence interval of the standardized coefficient

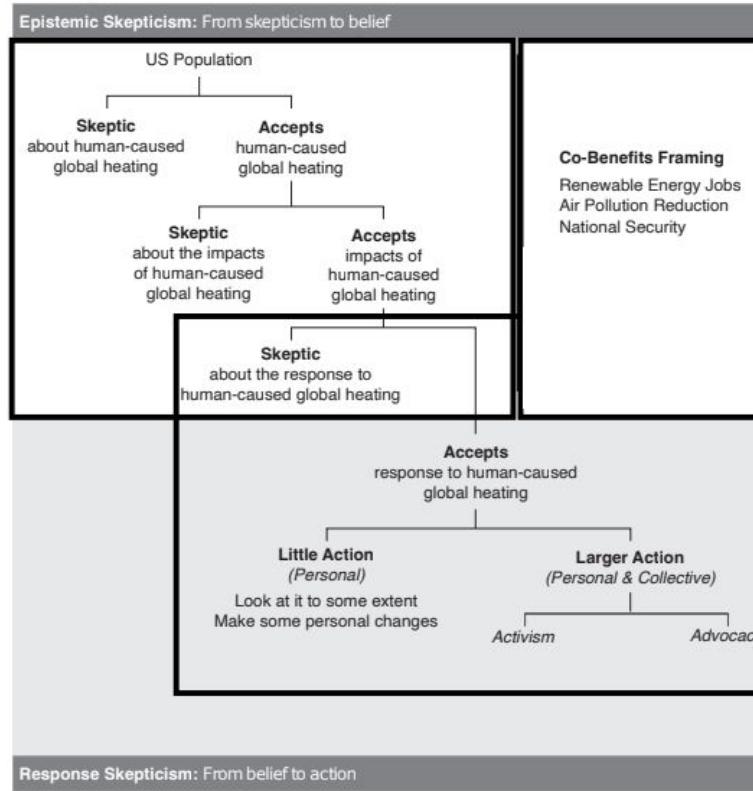


Three ways to get a broader social mobilization:

Shift the skeptics to belief

Shift the believers to action

Leverage co-benefits to get policy support



Paper Deep Dive

VISUALIZING THE CONSEQUENCES OF CLIMATE CHANGE USING CYCLE-CONSISTENT ADVERSARIAL NETWORKS

Victor Schmidt*, **Alexandra Luccioni***, **S. Karthik Mukkavilli**,
Kris Sankaran, & **Yoshua Bengio**
Montreal Institute for Learning Algorithms
Montreal, Canada
`{schmidtv, luccionis, mukkavis}@mila.quebec`

Narmada Balasooriya
ConscientAI Labs,
Colombo, Sri Lanka

Jennifer Chayes
Microsoft Research New England
Cambridge, Massachusetts

<https://arxiv.org/pdf/1905.03709.pdf>

The goal

“Recent studies have shown that **political will is currently the main obstacle** to keeping temperature rise within the limits proposed by the IPCC”

“It is difficult for people to mentally simulate the complex and probabilistic effects of climate change. **People often discount the impact that their actions will have** on the future, especially if the consequences are long-term, abstract, and at odds with current behavior and identity”

“Aim to generate images that depict **accurate, vivid, and personalized outcomes of climate change**” (particularly flooding)

Brainstorm

What kind of data would you want to have to be able to approach this problem?

What kind of methods would you apply?

How would you measure success?

What difficulties might we face?

Data

Collected by “manually searching open source photo-sharing websites for images of houses from various neighborhoods and settings”

Collected 500+ images of flooded homes, and 500 of non-flooded homes (not matched)

300x300 pixels



Data problem!

1000 images is not a lot of images for such a complex problem.

What can be done?

Data augmentation

“In order to increase the quantity of images that we could use for training, we performed several **data augmentation techniques** such as: random crops of a subset of each image, horizontal flipping, small rotations, etc., which enabled us to increase our data set five-fold to over 5000 images total.”

Original



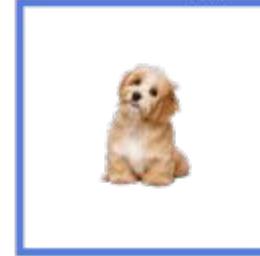
Rotation



Flip



Scaling



Brightness



Method

Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks

Jun-Yan Zhu* Taesung Park* Phillip Isola Alexei A. Efros
Berkeley AI Research (BAIR) laboratory, UC Berkeley

<https://arxiv.org/pdf/1703.10593.pdf>

“CycleGAN”, developed in 2017

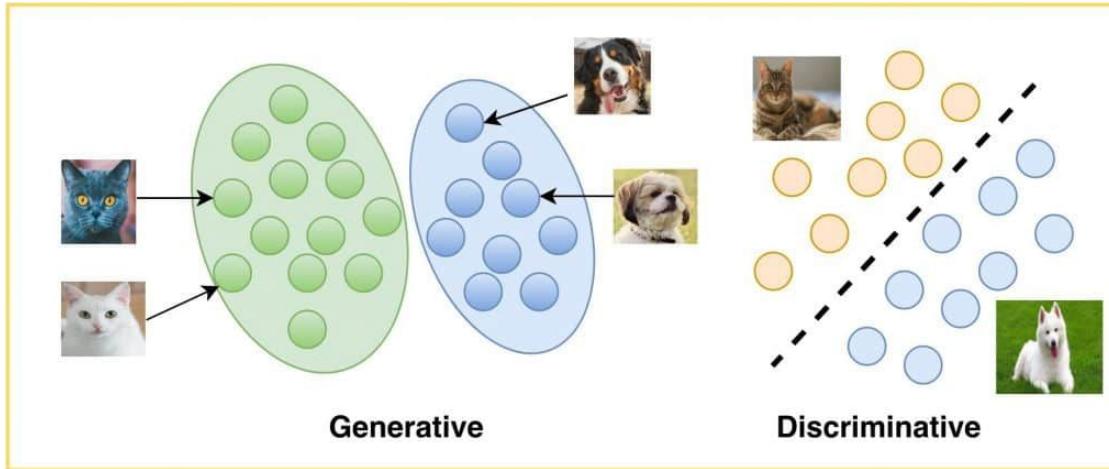
Cycle-consistent generative adversarial network

What is a generative model?

What is an adversarial network?

What does cycle-consistency mean?

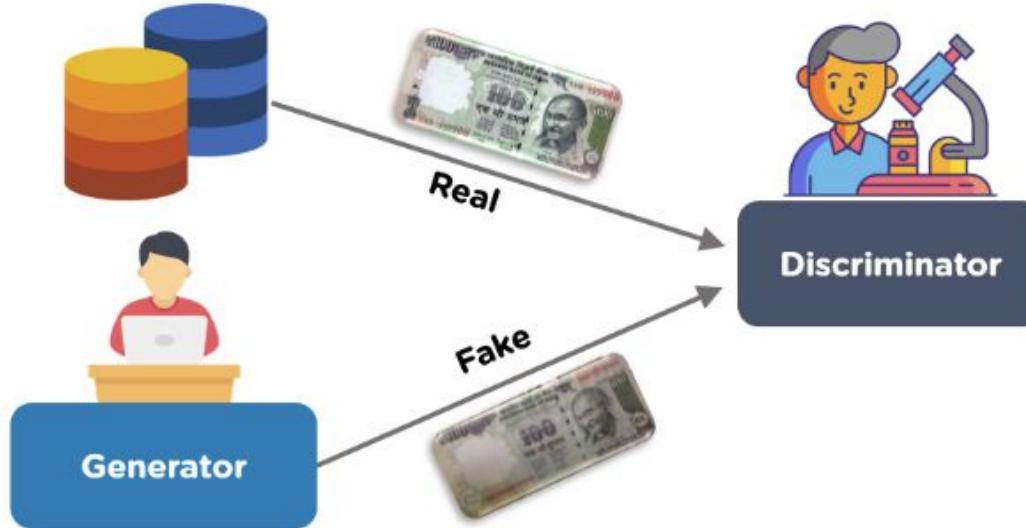
Discriminative vs Generative models



Discriminative models find a way to separate input data

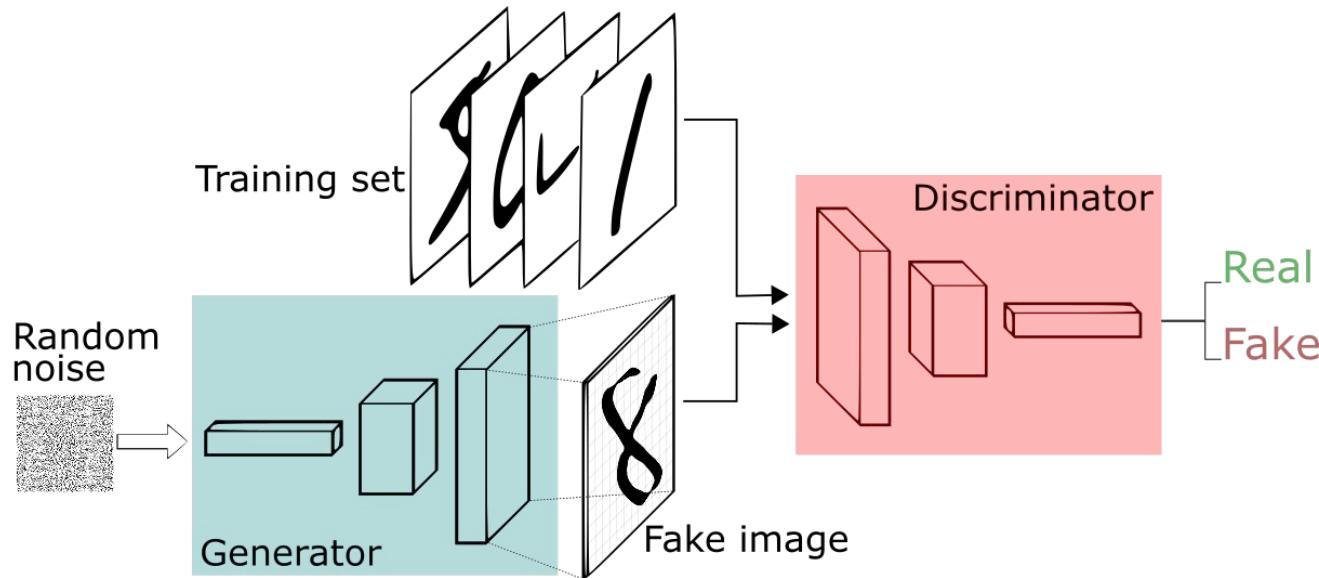
Generative models aim to identify the populations that underlie the data and sample examples from them. ***In this way, they can *generate* data***

What are generative adversarial networks (GANs)?



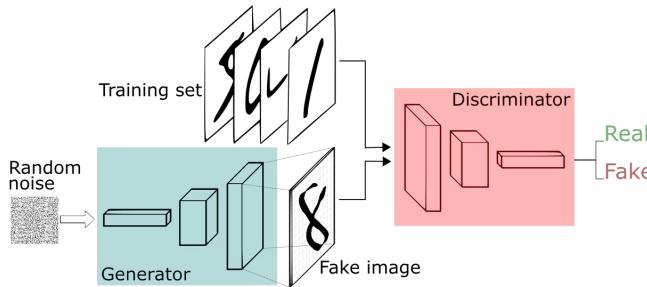
GANs are based on the idea that a generative model will get better if it needs to fool a discriminator that is trying to spot real vs. fake (generated) data.

What are generative adversarial networks (GANs)?



In a GAN, both the generator and the discriminator are artificial neural networks. They are trained together.

What are generative adversarial networks (GANs)?



Algorithm 1 Minibatch stochastic gradient descent training of generative adversarial nets. The number of steps to apply to the discriminator, k , is a hyperparameter. We used $k = 1$, the least expensive option, in our experiments.

```
for number of training iterations do
  for  $k$  steps do
    • Sample minibatch of  $m$  noise samples  $\{z^{(1)}, \dots, z^{(m)}\}$  from noise prior  $p_g(z)$ .
    • Sample minibatch of  $m$  examples  $\{x^{(1)}, \dots, x^{(m)}\}$  from data generating distribution  $p_{\text{data}}(x)$ .
    • Update the discriminator by ascending its stochastic gradient:
```

$$\nabla_{\theta_d} \frac{1}{m} \sum_{i=1}^m \left[\log D(x^{(i)}) + \log (1 - D(G(z^{(i)}))) \right].$$

```
end for
• Sample minibatch of  $m$  noise samples  $\{z^{(1)}, \dots, z^{(m)}\}$  from noise prior  $p_g(z)$ .
• Update the generator by descending its stochastic gradient:
```

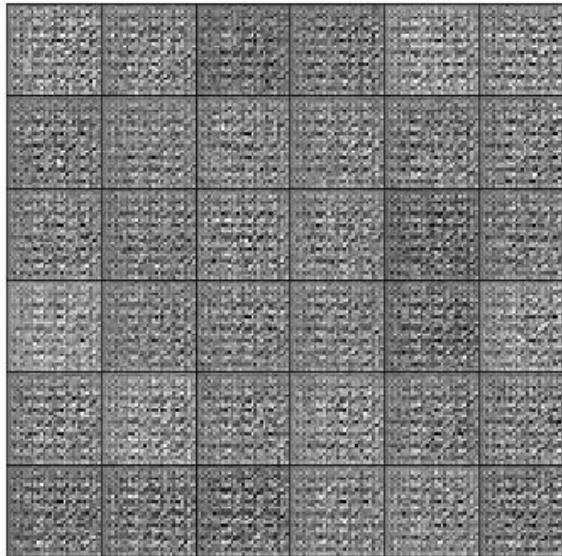
$$\nabla_{\theta_g} \frac{1}{m} \sum_{i=1}^m \log (1 - D(G(z^{(i)}))).$$

```
end for
```

The gradient-based updates can use any standard gradient-based learning rule. We used momentum in our experiments.

The two networks are trained together, with opposite goals.

What are generative adversarial networks (GANs)?



Here, the generator learned the statistics of hand-written digits.

Image-to-image

In a standard GAN, a meaningless input is put into the network and it generates an image that looks like it could have come from the training set. In this version, there is no way to control the specific properties of the generated image.

Here, we want to be able to edit a specific image.

Image-to-image

Previous work has built GANs based on *pairs* of images instead. For example, if you want to generate a photo-realistic image from a sketch/edges.

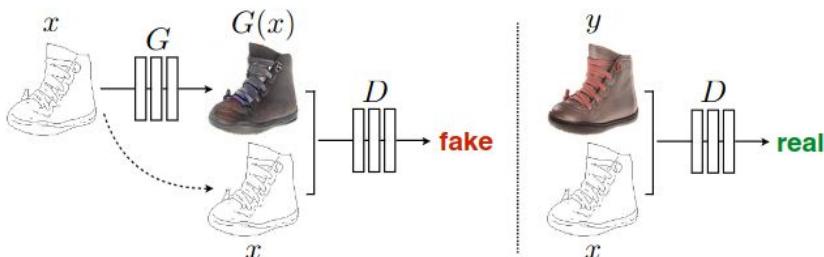


Image-to-Image Translation with Conditional Adversarial Networks

Philip Isola Jun-Yan Zhu Tinghui Zhou Alexei A. Efros

Berkeley AI Research (BAIR) Laboratory, UC Berkeley
`{isola,junyanz,tinghuiz,efros}@eecs.berkeley.edu`

Figure 2: Training a conditional GAN to map edges→photo. The discriminator, D , learns to classify between fake (synthesized by the generator) and real {edge, photo} tuples. The generator, G , learns to fool the discriminator. Unlike an unconditional GAN, both the generator and discriminator observe the input edge map.

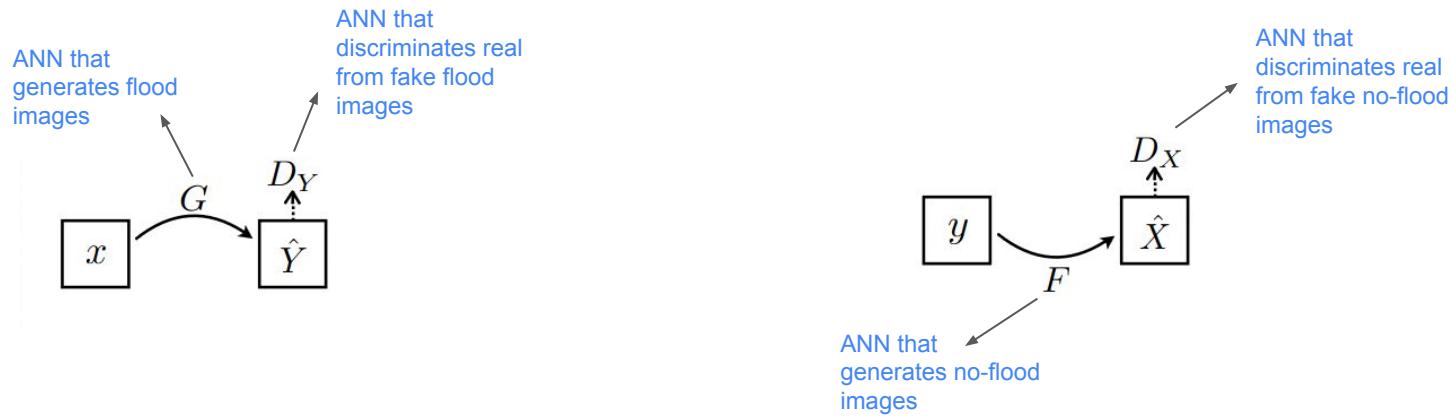
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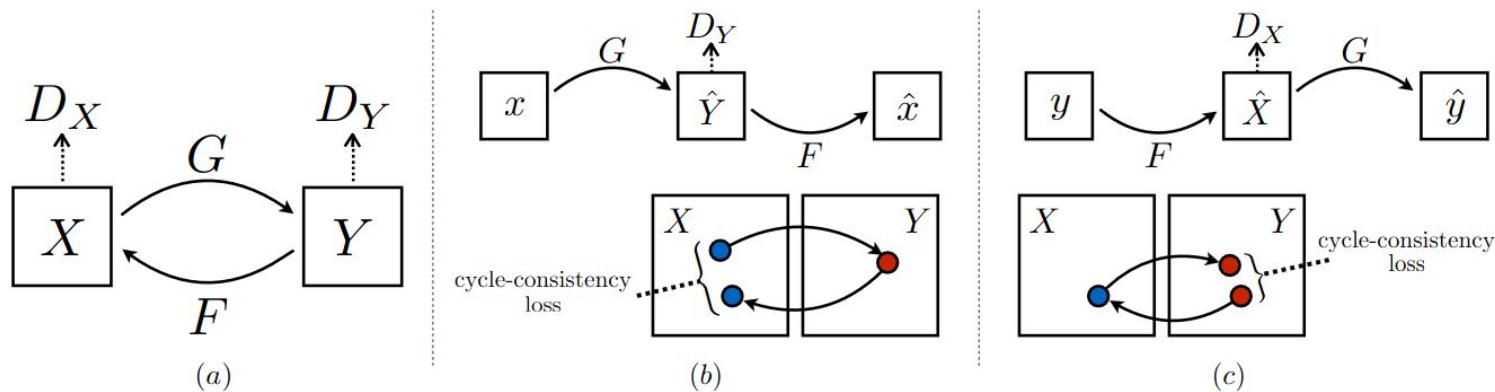
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Cycle-consistent generative adversarial network



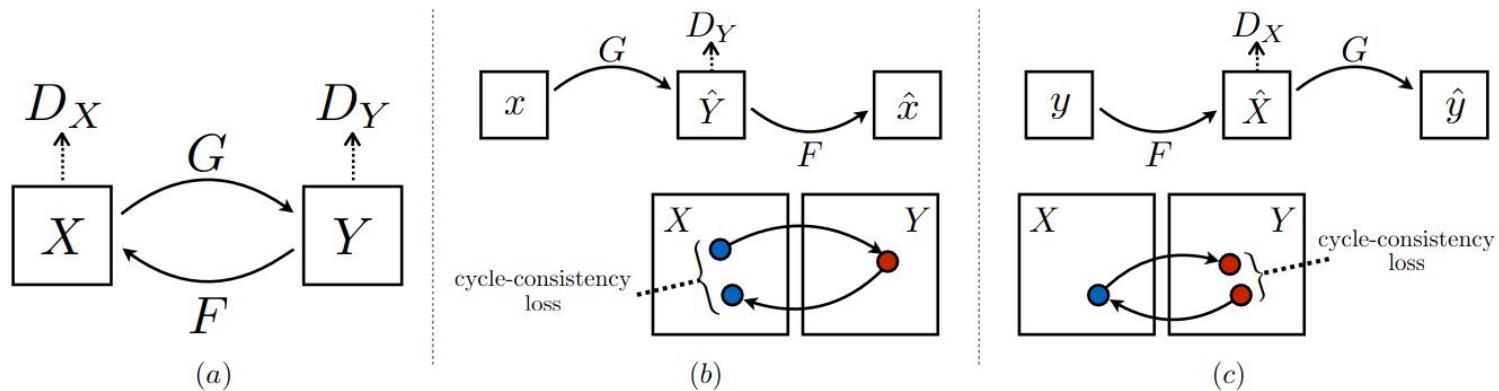
CycleGANs start with two separate GANs, each trained to produce images from the two separate image categories

Cycle-consistent generative adversarial network



“Cycle-consistent” networks constrain the type of image produced by forcing the two image-generating networks to be consistent with each other. Specifically, if an image from one class is transferred to the other, applying the transformation in the opposite direction should return the original image.

Cycle-consistent generative adversarial network

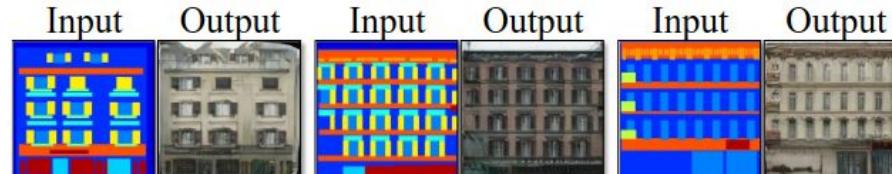


We incentivize this behavior using a *cycle consistency loss*:

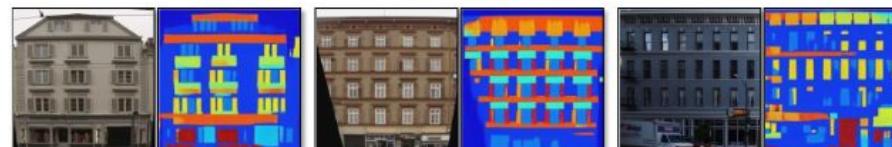
$$\begin{aligned}\mathcal{L}_{\text{cyc}}(G, F) = & \mathbb{E}_{x \sim p_{\text{data}}(x)} [\|F(G(x)) - x\|_1] \\ & + \mathbb{E}_{y \sim p_{\text{data}}(y)} [\|G(F(y)) - y\|_1].\end{aligned}\quad (2)$$

“Cycle-consistent” networks constrain the type of image produced by forcing the two image-generating networks to be consistent with each other. Specifically, if an image from one class is transferred to the other, applying the transformation in the opposite direction should return the original image.

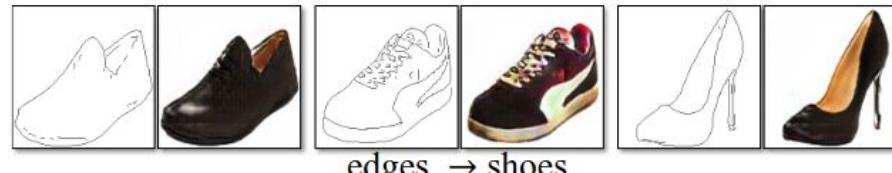
Cycle-consistent generative adversarial network



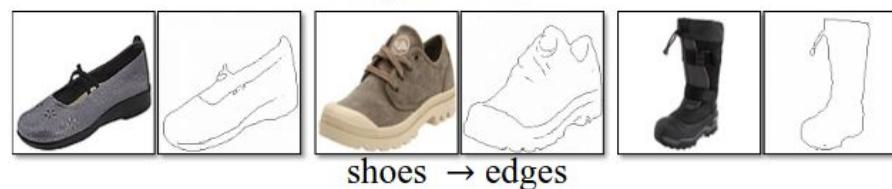
label → facade



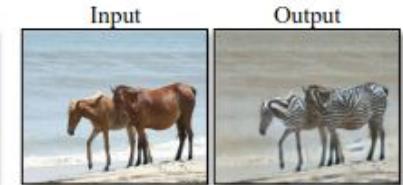
facade → label



edges → shoes



shoes → edges



horse → zebra



zebra → horse

Model/data problem

“A challenge that we encountered was the fact that flooding is not truly a one-to-one mapping such as the one assumed by the CycleGAN approach, but in fact a many-to-one mapping, i.e. roads, grass, dirt, fences are all mapped to water. For this reason, our data collection was constrained to houses surrounded by lawns, which were then mapped to water by the model.”

Results

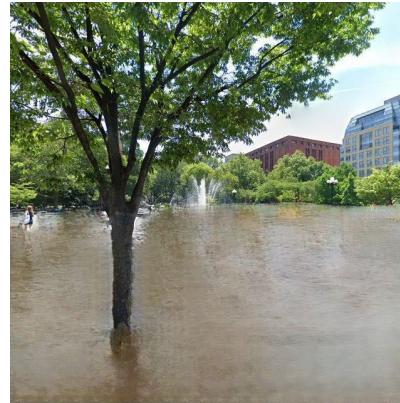
“From the 80 images in the test set, we found that about 70% were successfully mapped to realistically flooded houses”



5 DISCUSSION AND FUTURE DIRECTIONS

The initial version of the CycleGAN model that we have developed in the present paper is a prototype to illustrate the feasibility of applying generative models to create personalized images of an extreme climate event, flooding, that is expected to increase in frequency based on climate change projections. Subsequent versions of our model will integrate more varied types of houses and surroundings, as well as different types of climate-change related extreme event phenomena (i.e. droughts, hurricanes, wildfires, air pollution etc), depending on the expected impacts at a given location, as well as forecast time horizons.

<https://thisclimatedoesnotexist.com>



Further ideas/issues

Connect the image generation to the output of a climate model (and let users enter actions/pathways). However, most climate model predictions are too spatially coarse to be applied to individual homes.

Will this influence minds/behavior?

Further Resources

Psychology studies from Part II of this course:

<https://aronclimatecrisis.net/resources/>

Informal survey of ex-climate deniers:

<https://news.climate.columbia.edu/2017/08/09/what-changes-minds-about-climate-change/>

<https://www.tensorflow.org/tutorials/generative/cyclegan>

[Using Artificial Intelligence to Visualize the Impacts of Climate Change](#)

[Using Simulated Data To Generate Images Of Climate Change](#)

[Establishing an evaluation metric to quantify climate change image realism](#)

Summary

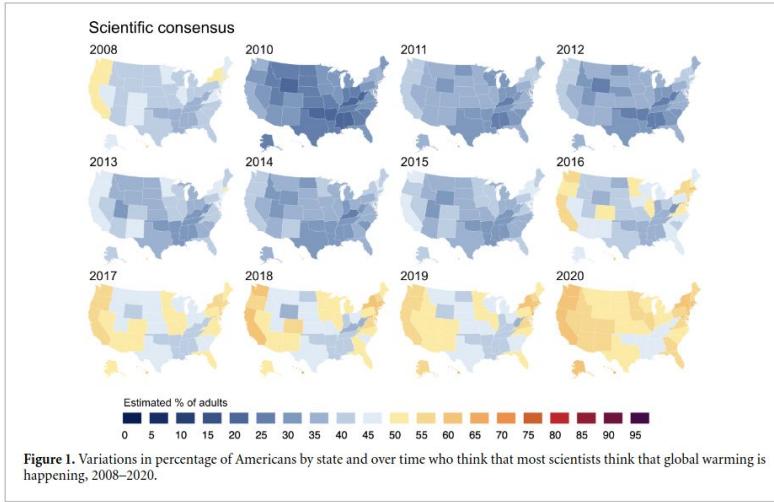
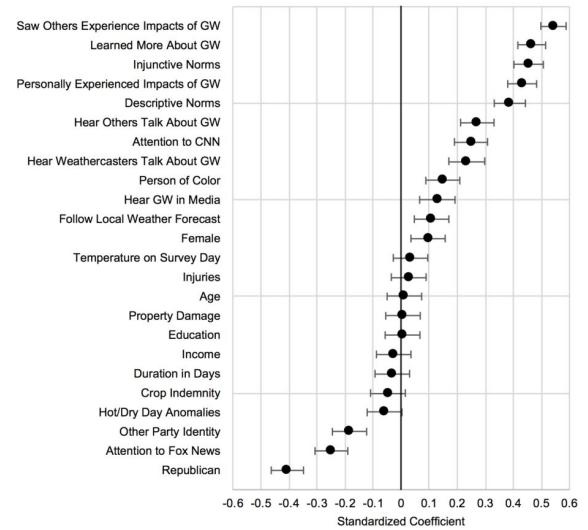


Figure 1. Variations in percentage of Americans by state and over time who think that most scientists think that global warming is happening, 2008–2020.

Correlations between predictors and self-reported opinion change



December 2018, $N = 1,114$
GW = Global warming
Error bars indicate the 95% confidence interval of the standardized coefficient

