Correcting Consumer Misperceptions about CO2 Emissions

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Motivation

To fight climate change, policy maker are keen to rely on information provision.

- EU Commission:
  - New consumer Agenda
  - Farm to Fork strategy
- US:
  - American Clean Energy and Security Act

Research question

Question

Can we actually change people behavior if we correct their beliefs about CO_2 emissions?

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Focus on:

- Misperceptions of carbon footprint
- Give the best chance to beliefs correction to work
- (Roughly) representative samples

What do we know

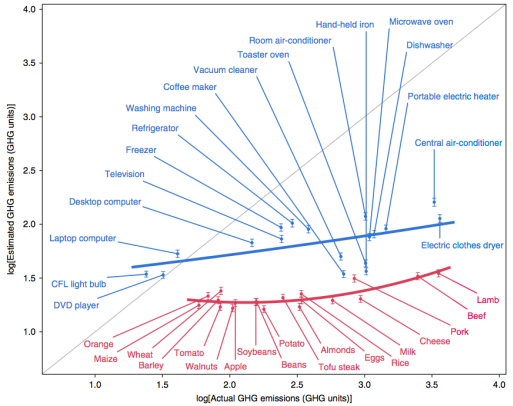

Figure 1: Source: Camilleri et al. (2019)

- We are not good at estimating GHG emissions
- However: missing connection with attitudes
- Both beliefs and attitudes determine the effect of information

Project Agenda

1. **Survey**:
    - Eliciting beliefs about CO_2 emissions of consumer products
    - Eliciting Willingness To Mitigate (WTM) CO_2 emissions
    - Combining the data to predict the effect of information policies

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    - Combining the data to predict the effect of information policies
2. **Experiment**
    - Test if indeed beliefs correction changes behavior.

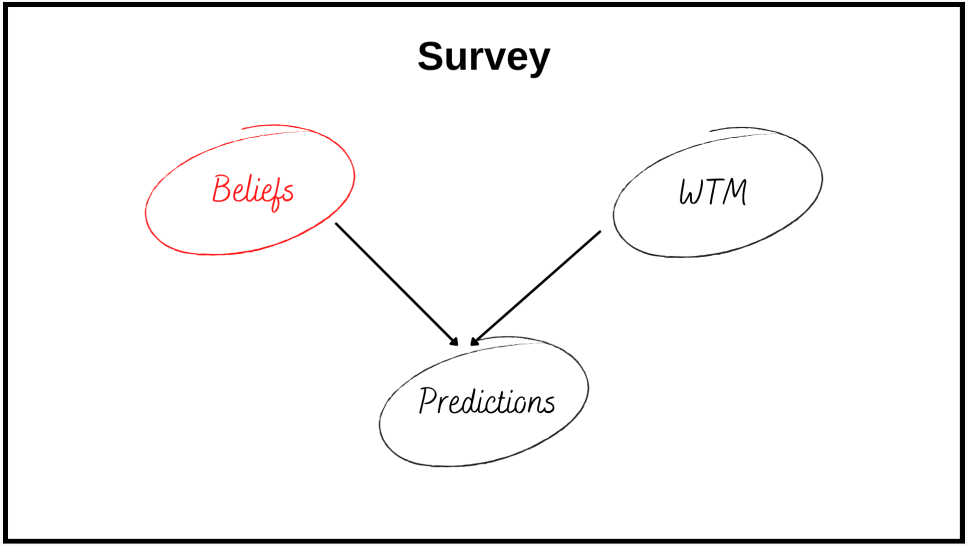
Any clarifying question at this point?

Survey

Sample and procedures

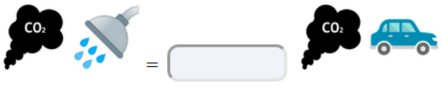
- Run on Prolific.co
- 3-6 Dec 2020
- Representative sample of 1024 US subjects

Beliefs



Point Estimate

Example question:



For example, you are asked to fill the blank space with the number of miles you need to drive to produce as much CO_2 as the average shower.

12 products/ activities

	Product	Unit	CO_2 ($\approx$ mi by car)
1	Gas heating	1 month	606.68
2	Flight	SFO to LAX	304.60
3	Beef	7 oz.	68.39
4	Coffee beans	1lb. roasted	44.41
5	Dark chocolate	100g	16.03
6	Poultry meat	7 oz.	6.78
7	Egg	6 eggs	4.81
8	Shower	Average length	3.90
9	Milk	1 cup	2.60
10	Microwave	1000w, 2 hours	1.76
11	Phone call	1 hour	1.55
12	Beer	12 fl. oz.	1.46

Subjective probability distribution

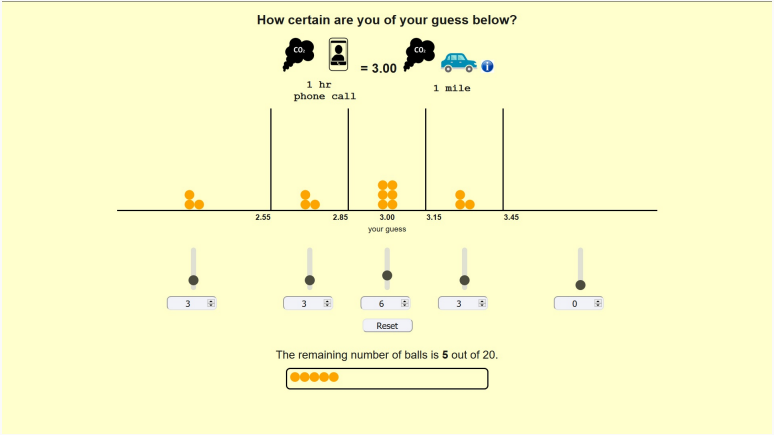


Figure 2: Interface for eliciting subjective probability distributions

Procedures Elicitations

- To avoid anchoring:
  - Free form questions
  - Step 1: All questions on one page
  - Step 2: Interface centered on step 1 beliefs
  - Order of products randomized at the individual level

- Incentives:
  - Step 1: Modal beliefs (£4 if within 5 percent of the true answer)
  - Step 2: Probability that the scientific estimate is each of the 5 bins (randomized qsr - £6 prize)

Results: Beliefs

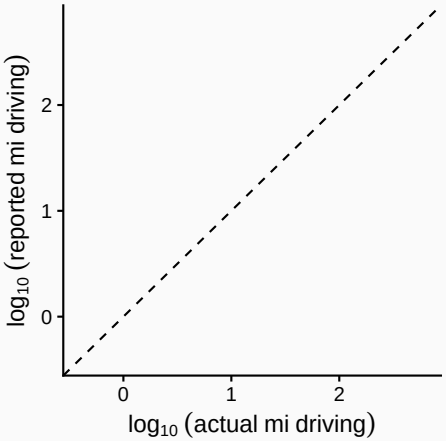


Figure 3: Points: Median. Bars: IQR

Results: Beliefs

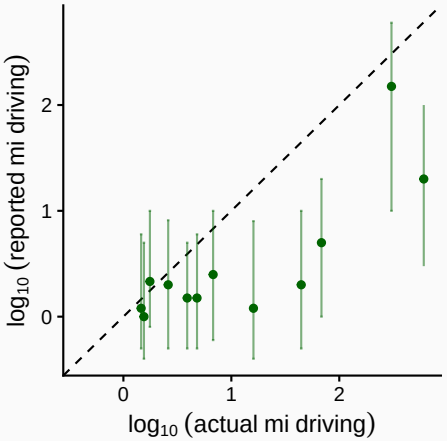


Figure 4: Points: Median. Bars: IQR

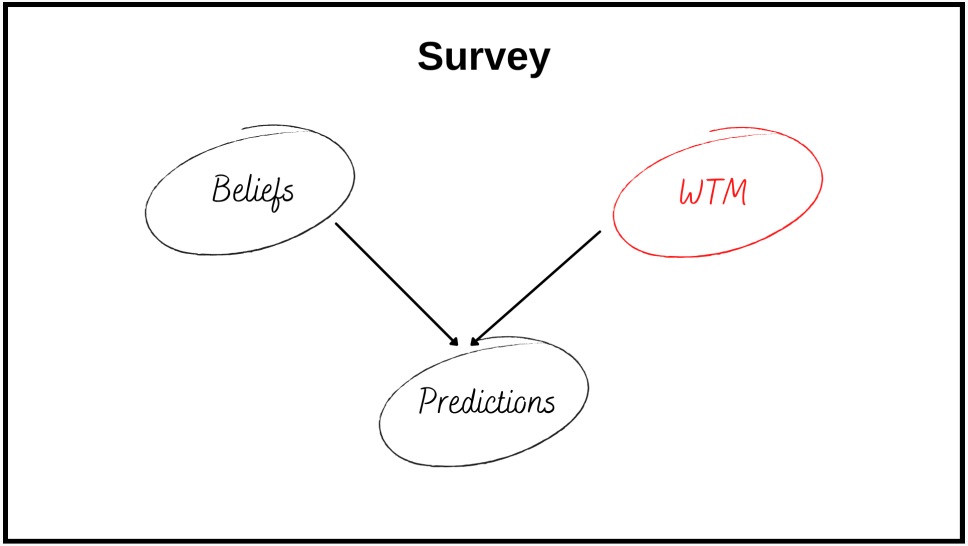
Contribution

Replicate findings on **people misperceptions about CO_2 emissions**:

- Underestimation of the magnitudes of the emissions
- Ranking of products/actions is roughly correct

Original findings in Camilleri et al. (2019)

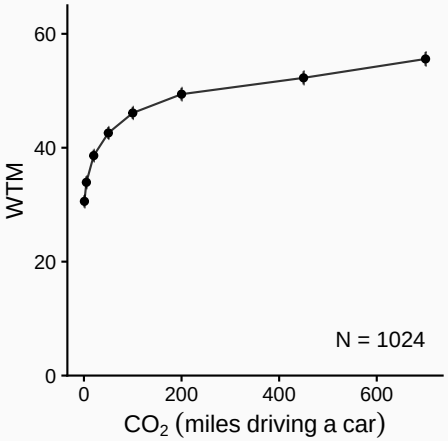
Willingness To Mitigate



WTM

- WTM = Willingness to pay to mitigate CO_2 emissions
- Incentives: BDM
- 8 levels of emission:
  - {1,5,20,50, 100, 250, 450, 700} miles by car
- within subjects

Results: WTM



- Concave

Figure 5: Points: Mean. Bars: SEM

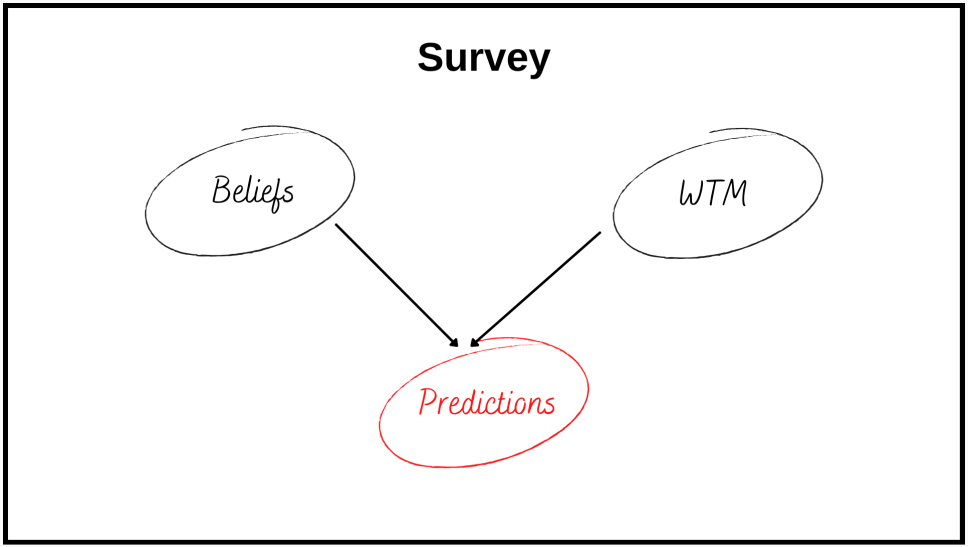
Contribution

Replicate findings on **people WTM**:

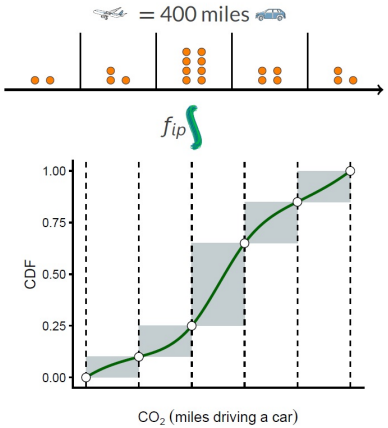
- WTM increasing but highly concave in emissions size

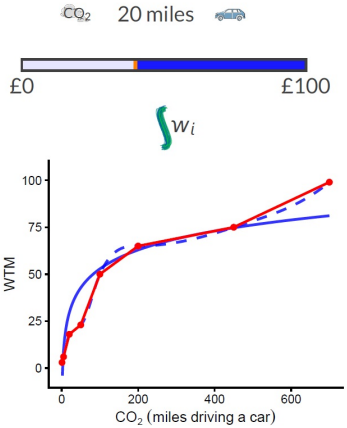
Original findings in Pace et al. (2025)

Model



Model Input


= 400 miles
f_{ip}
1.00
0.75
0.50
0.25
0.00
CDF
CO_2 (miles driving a car)


CO_2
20 miles
£0
£100
w_i
100
75
50
25
0
WTM
0
200
400
600
CO_2 (miles driving a car)

Model

- Expected disutility: for each subject i and product p

$$\bar{W}(w, f) = \mathrm{E}_f[w] = \int_{c \geq 0} w(c) f(c) dc$$

w : WTM function
f : belief distribution
c : CO_2 emission (in miles driving a car)

Model

Effect of information provision

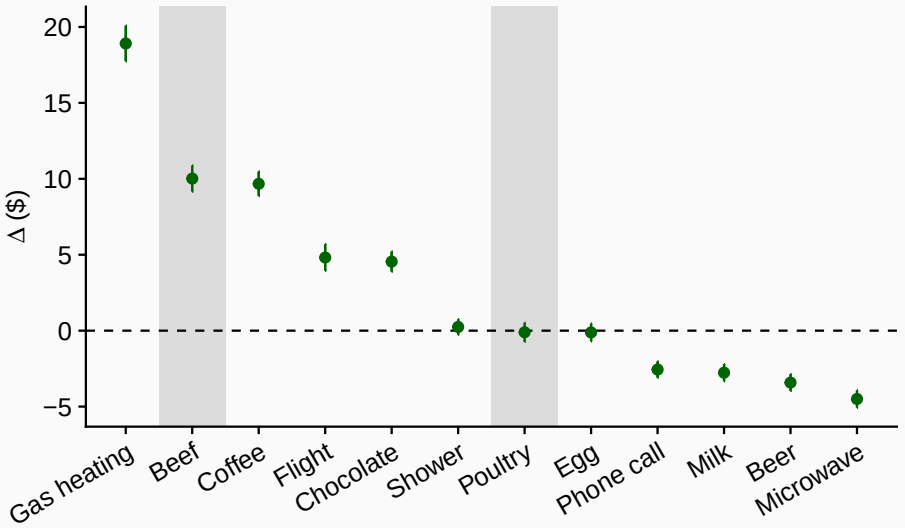
$$\bar{W}_{ip}(w_i, \delta_p) - \bar{W}_{ip}(w_i, f_{ip}) = \mathrm{E}_{\delta_p}[w_i] - \mathrm{E}_{f_{ip}}[w_i]$$

w_i : subject i's WTM function

δ_p : point mass at the "true" CO_2 emissions from product p

f_{ip} : subject i's belief about CO_2 emissions from product p

Predicted effect of information



Any Question?

Experiment

Experiment: Design

2 by 2 design:

- Beef VS Poultry
- Info VS No Info
- Between subjects
- Main variable: WTP for a meat shipment

The experiment gives the best shot at information interventions

Experiment: Procedures

Sample

- Study run via Luc.id
- 2049 US participants (representative along gender and age)
- Data collection: early April 2022.
- Implemented meat/money decisions for one in every twenty participants.

Product

Meat produced and shipped by Porter Road, premium online butcher:

In Part 1 of the study, you will be able to buy 10 high-quality **beef sirloin steaks**. The sirloin steaks are from **Porter Road**, a premium online butcher, and, at the start of this study, were sold for **$100**.

Products

10 sirloin steaks

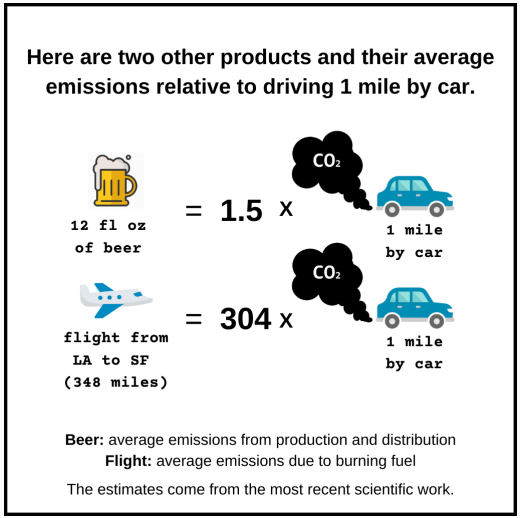
- No Hormones
- No Antibiotics
- Pasture raised
- US raised
- Around 5 lb in total

10 chicken breasts (skinless)

- No Hormones
- No Antibiotics
- Pasture raised
- US raised
- Around 5 lb in total

Both packages valued at approximately $100

Baseline Info



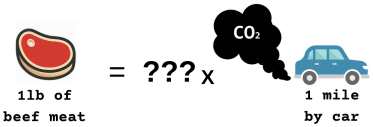
- Keep salience of emissions constant across treatments
- Enable comparison of emissions
- Use products that are equally (un)informative about beef and poultry

Eliciting Beliefs

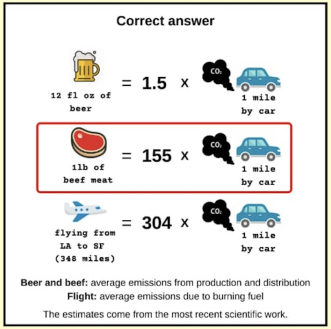
Your estimate:

What do you think, relative to driving 1 mile by car, how much CO_2 is generated by 1lb of beef meat?

(You receive 50 cents if your answer is within 5 percent of the correct answer.)



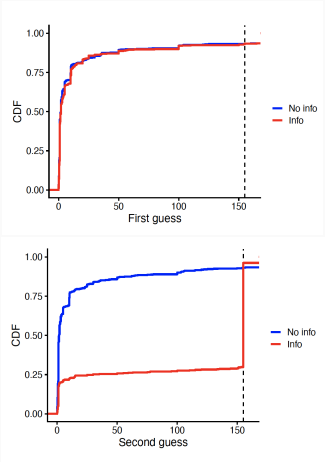
Information



According to the picture above, how much CO_2 emissions does 1lb of beef meat produces?

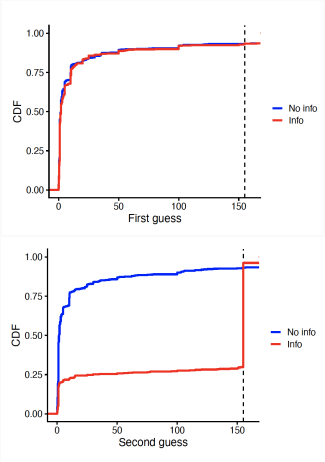
- The equivalent of driving **95 miles** by car
- The equivalent of driving **155 miles** by car
- The equivalent of driving **233 miles** by car

Information shifts beliefs

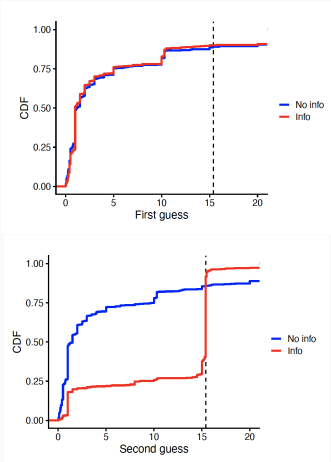


Beef

Information shifts beliefs



Beef



Poultry

Results: WTP

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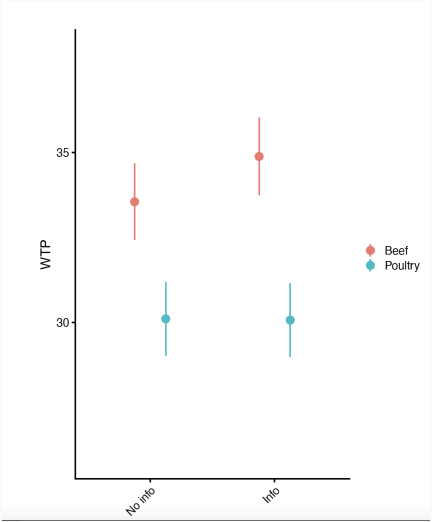

Implications

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  - Lohmann et al (2022)
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Implications

- Correcting consumers misperception about CO_2 emissions doesn't change their behavior.
- The results are consistent with the limited effects of information provision in other studies.
  - Lohmann et al (2022)
  - Fosgaard et. al (2021)
- Emissions salience might matter more than precise information. (Shulze-Tilling, 2023)

Possible reasons behind the null result

- Are people inattentive to the information? ✗
- Is there an attention-action gap? ✗
- Is correcting misperceptions effective in the mid-term? ✗
- Do participants demand less but better meat? ✗
- Do people become pessimistic about other products? ✗
- Are (near) vegetarians driving the null result? ✗
- Is the data extremely noisy? ✗
- Is meat special? ✗

Any Question?

Thank you!

Extra Slides

Results: WTP

Results robust to

- Different controls (gender, politics, education) regressions
- Excluding participants that don't correctly process the information (2.5%)
- Excluding participants who don't trust we will send the meat (about 20%)
- Did not provide their address (about 16%)
- Excluding participants that don't believe in climate change (8%)
- Combining all the exclusions above

Possible reasons behind the null result

- People don't pay attention to the information ✗

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- People don't pay attention to the information ✗
- WTP doesn't change, but quantities consumed go down ✗

Point Estimate

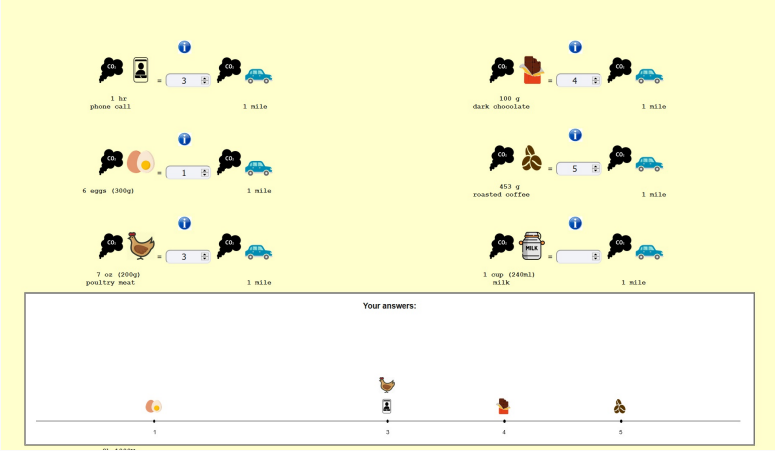

Figure 6: Interface for modal beliefs for other products

References

Camilleri, Adrian R., Richard P. Larrick, Shajuti Hossain, and Dalia Patino-Echeverri, "Consumers underestimate the emissions associated with food but are aided by labels," *Nature Climate Change*, 2019, *9* (1), 53–58.

Pace, Davide D., Taisuke Imai, Peter Schwardmann, and Joël J. van der Weele, "Uncertainty about carbon impact and the willingness to avoid CO2 emissions," *Ecological Economics*, January 2025, *227*, 108401.