ONLINE SUPPLEMENTARY INFORMATION FOR "QUOTA SAMPLING USING FACE-
BOOK ADVERTISEMENTS"

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Further Information on Data and Procedures

Information in this subsection supplements that provided in the Study Design section of the manuscript. The population under study for both the Facebook and GfK surveys are residents of the United States who are age 18 or older. For the Facebook survey, we automatically rejected participants with IP addresses outside the United States.

The general recruitment process for Facebook user respondents is described in the Study Design section of the manuscript. We provide additional details of the recruitment process here.

Table A1 describes the demographic characteristics we used to construct the strata for Facebook quota sampling. The combination of nine U.S. census regions, two genders, four racial groups, four education levels, and two age groups generated 576 possible strata. We were able to quota sample using only 544 of the 576 possible strata because some strata contained too few Facebook users for us to cost effectively recruit respondents.

TABLE A1   *Demographic Characteristics Used to Generate Strata*

Demographic Categories	Subgroups
Census Regions	New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, Pacific
Gender	male, female
Race	non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic other
Education	less than high school diploma, high school graduate or GED, some college or associate's degree, bachelor's degree or higher
Age Group	18-34, 35 and above

The budgets for the strata were allocated according to proportional allocation given a fixed total budget of $10000. The proportional allocation sought to reflect the real-world conditional frequencies of each stratum. The conditional frequencies are generated from the 2010-2015 American Community Survey Five-Year Public Use Microdata Sample. To comply with the regulations of Facebook's Marketing API, we allocated a daily budget of at least $5.00 to each stratum; however, users do not have to spend the full daily budget. Strata whose quota were left unfilled at the end of the day were given additional budgets

of \$5.00 per day until their quota was filled or until the end of the recruitment period. For each stratum, we launched two version of the ad: one designed for desktop computers only and one designed for mobile devices. Because our advertisements were optimized for link clicks, we were charged per click on the survey link. The distribution of cost per link click is displayed in Figure A1.

Figure A1.   Facebook Advertisements Cost Per Link Click
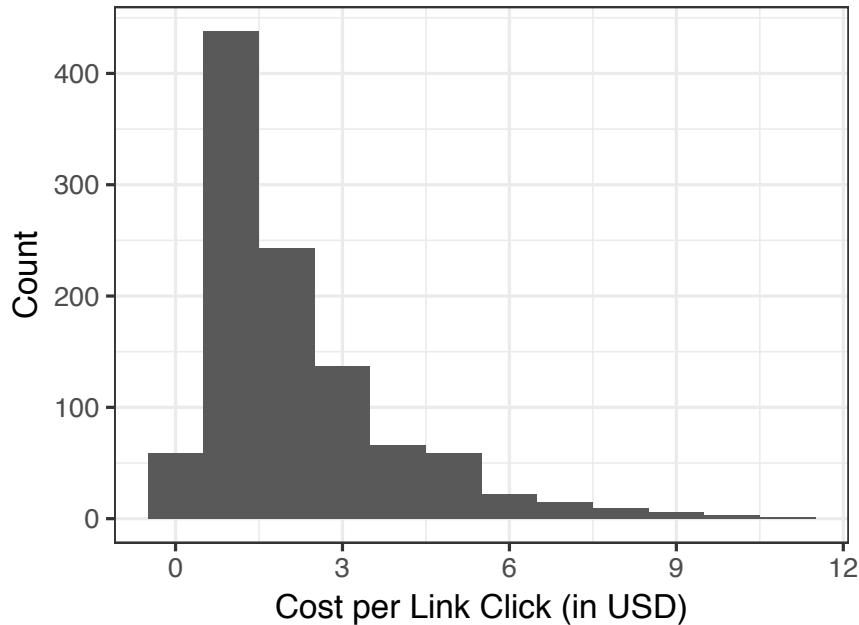
No monetary compensation was promised to respondents. Instead, we stated that by taking the survey, respondents would see how their views on climate change compared with the rest of America (see Figure A2). After completing the survey, respondents were taken to a landing page that showed how their views compared with the rest of Americans' views as promised in our advertisements. The information on the landing page is derived from survey research conducted by the Yale Program on Climate Change Communication.

The GfK survey was conducted March 18-31, 2016. All questionnaires were self-administered by respondents in a web-based environment. The sample was drawn from GfK's KnowledgePanel, an online panel of members drawn using probability sampling methods. Prospective members are recruited using a combination of random digit dial and address-based sampling techniques that cover virtually all (non-institutional) resident phone numbers and addresses in the United States. Those contacted who would choose to join the panel but do not have access to the Internet are loaned computers and given Internet access so they may participate. The sample, therefore, includes a representative

Figure A2.   Example Advertisement for Survey Recruitment
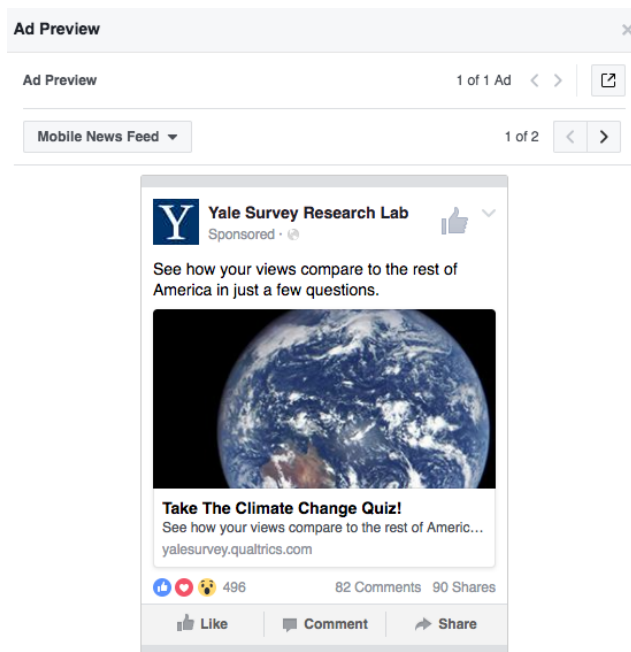
cross-section of American adults – irrespective of whether they have Internet access or use only a cell phone.

ACS Validation Test

As a further validation test, we compare three results from the Facebook survey with those from the 2016 ACS One-Year Estimates.[14] Specifically, we estimated the proportions of adult Americans who are veterans, who own their residences, or who were born in the U.S. using the Facebook responses. The questions respondents received were identical to the ones asked by the ACS. As Figure A3 demonstrates, the Facebook survey overestimated the proportion who are veterans and were born in the U.S., while it underestimated the proportion who own their residences.

　　Although it remains unclear why the Facebook survey would overestimate the proportion who are veterans, there is likely a simple reason why our recruitment method overestimated those who were born in the U.S. The ACS was available in many languages

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[14]The ACS results are generated using the 2016 ACS One-Year Public Use Microdata Sample.

while our Facebook survey was only available in English; as a result, Facebook users who did not understand English – who are also more likely to be born outside the U.S. – could not participate in the survey. In contrast, the underestimation of the proportion who are homeowners could be attributed to the fact that the Facebook sample contained disproportionately more young adults, a group who are less likely to be homeowners. However, despite these differences at the margins, the results of the Facebook survey resembled the results of the online panel survey and the ACS. Differences in responses could be explained by the younger and more pro-climate action subjects who constituted the Facebook sample.

Figure A3.   Comparing Facebook Survey with the ACS
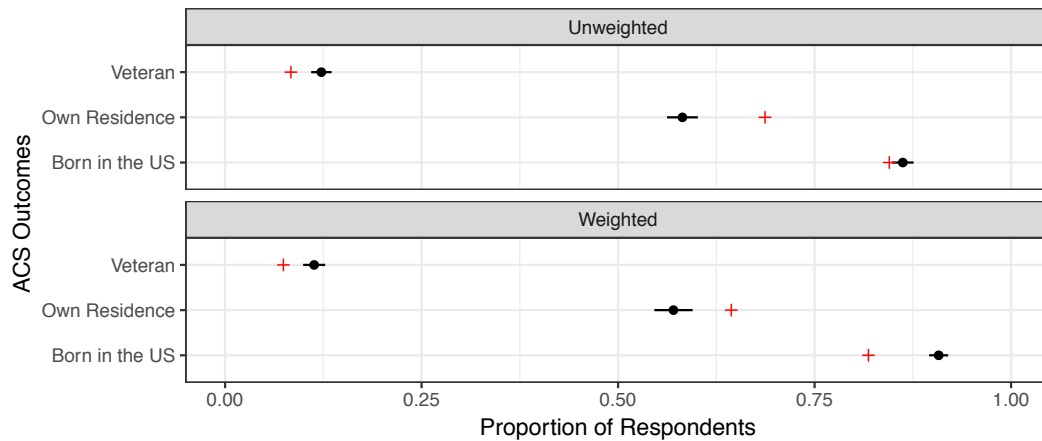
In the plot above, the red crosses represent the ACS estimates, and the black dots represent the Facebook Survey estimates. For the Facebook Survey estimates, the plots also report the 95 percent confidence interval for each outcome measure. The confidence intervals are calculated from heteroscedasticity-consistent standard errors.

We also note here that the ACS validation test is a strong test of our Facebook sample's quality. Many online probability-based samples may equally fail this type of validation test, and so it is difficult to use these results to compare the relative quality of Facebook samples relative to other available survey products. To investigate this possibility, three ACS validation questions were included in a similar GfK survey that the authors conducted in October 2017. The proportion of the U.S. adult population who own their residence was estimated to be 0.74 unweighted (0.69 weighted). The proportion estimated to be veterans was 0.11 unweighted (0.09 weighted). The proportion estimated to be U.S.-born was 0.91 unweighted (0.88 weighted). These estimates also approximate the ACS benchmarks, but also with error.

Additional Data Tables

The following tables report the numerical results illustrated by the manuscript's figures. Heteroscedasticity-consistent standard errors are reported in parentheses following the estimated population proportions.

TABLE A2   *Comparing Facebook Survey with GfK Survey: Climate Change Public Opinion Unweighted Results*

Survey Items	Facebook	GfK
Global warming is happening	0.744 (0.009)	0.712 (0.012)
Global warming is mostly human-caused	0.577 (0.010)	0.538 (0.014)
Most scientists think global warming is happening	0.587 (0.010)	0.491 (0.014)
Worried about global warming	0.642 (0.010)	0.562 (0.014)
Global warming will harm me personally	0.495 (0.010)	0.382 (0.013)
Global warming will harm future generations	0.706 (0.009)	0.705 (0.013)
Global warming will harm plants and animals	0.710 (0.009)	0.707 (0.013)
Support funding research into renewable energy sources	0.876 (0.007)	0.836 (0.010)

Best Practices and Potential Areas for Improvement

In this subsection, we discuss best practices based on our own study and suggest ways to improve upon our method.

Below are best practices we have learned from our own study:

1. Advertise to a diversity of strata while also ensuring that each stratum has enough respondents to complete the survey.

2. Advertise using neutral language and images that do not reveal the content of the survey.

3. Experiment with advertisement content to determine the optimal content for recruitment.

4. Advertise in both English and other languages and create non-English versions of the survey if one wants to acquire accurate estimates about immigrants' public opinion.

5. Do not overfill strata. One method is to check the advertisements fairly regularly throughout the day. A better method is to set a program to automatically shut down advertisements once the quota for a stratum has been filled (see below).

Below are potential areas for improvement:

TABLE A3   *Comparing Facebook Survey with GfK Survey: Climate Change Public Opinion Weighted Results*

Survey Items	FB IPW	GfK IPW	GfK-supplied Weights
Global warming is happening	0.727	0.711	0.707
	(0.011)	(0.013)	(0.015)
Global warming is mostly human-caused	0.569	0.534	0.534
	(0.012)	(0.015)	(0.016)
Most scientists think global warming is happening	0.557	0.475	0.476
	(0.012)	(0.015)	(0.016)
Worried about global warming	0.643	0.574	0.576
	(0.012)	(0.014)	(0.016)
Global warming will harm me personally	0.486	0.400	0.402
	(0.012)	(0.015)	(0.016)
Global warming will harm future generations	0.704	0.704	0.698
	(0.011)	(0.013)	(0.015)
Global warming will harm plants and animals	0.711	0.707	0.703
	(0.011)	(0.013)	(0.015)
Support funding research into renewable energy sources	0.876	0.825	0.820
	(0.008)	(0.012)	(0.013)

Columns 2 and 3 show the weighted survey results using the inverse probability weights generated by the researchers. Column 4 shows the weighted survey results using the weights supplied by GfK.

TABLE A4   *Comparing the Facebook Survey with the 2016 ACS One-Year Estimates*

Survey Items	Facebook (Unweighted)	Facebook (Weighted)	ACS (Unweighted)	ACS (Weighted)
Veteran	0.123 (0.007)	0.113 (0.007)	0.084	0.074
Own Residence	0.582 (0.010)	0.570 (0.012)	0.687	0.644
Born in the US	0.862 (0.007)	0.908 (0.006)	0.845	0.818

1. Set up a program to automatically shut down advertisements once the quota for a stratum has been filled. One possible method is to optimize the advertisements for a set number of "conversions," or users' actions off Facebook, rather than for link clicks. In the case of quota sampling for a survey, the "conversion" event would be completing the survey. One can use Facebook to track survey completion by embedding a Facebook Pixel at the end of the survey; once a respondent completes a survey, Facebook would be alerted to the "conversion."

2. Reduce the number of strata necessary for quota sampling. For instance, if two subgroups have similar outcome variables, one can combine them into a single stratum. Choosing which strata to combine requires some prior knowledge about subgroups' responses.

Text of Survey

The text of the survey is included below.

x65. Recently, you may have noticed that global warming has been getting some attention in the news. Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world's climate may change as a result.
   What do you think: Do you think that global warming is happening?

 • Yes

 • No

 • Don't know

x67. Assuming global warming is happening, do you think it is...

 • Caused mostly by human activities

 • Caused mostly by natural changes in the environment

 • Other (Please specify) [textbox]

x73

Which comes closest to your own view?

 • Most scientists think global warming is not happening

 • There is a lot of disagreement among scientists about whether or not global warming is happening

- Most scientists think global warming is happening

- Don't know enough to say

x78

How worried are you about global warming?

- Very worried

- Somewhat worried

- Not very worried

- Not at all worried

x79

How much do you think global warming will harm you personally?

- A great deal

- A moderate amount

- Only a little

- Not at all

- Don't know

x85

How much do you think global warming will harm future generations of people?

- A great deal

- A moderate amount

- Only a little

- Not at all

- Don't know

x86

How much do you think global warming will harm plant and animal species?

- A great deal

- A moderate amount

- Only a little

- Not at all

- Don't know

x137. How much do you support or oppose the following policy?
Fund more research into renewable energy sources, such as solar and wind power.

- Strongly support

- Somewhat support

- Somewhat oppose

- Strongly oppose

Gender. Are you...?

- Male

- Female

Age. What is your age?

- 18-24

- 25-34

- 35-44

- 45-64

- 65 or older

State. What U.S. State do you live in? Or do you live in a U.S. Territory or other country?
Please scroll down to select.

Hispanic. Do you have a Hispanic, Latino, or Spanish family heritage?

- Yes

- No

Race. What best describes your race?

- White or Caucasian

- Black or African-American

- Asian or Asian-American

- A Different Race

- 2 or More Races

Zip Code. Climate and weather are different in different parts of the country. Please enter your five-digit zip code to help us understand what the weather is like in your area.
[Textbox]

Education. What is the highest level of education you have completed?

- Did not graduate high school

- High school graduate, GED, or alternative

- Some college, or associates degree

- Bachelor's (college) degree or equivalent

- Graduate or professional degree (e.g., Master's Degree, M.D., Ph.D., J.D., MBA)

Veteran. Have you ever served on active duty in the U.S. Armed Forces, Reserves, or National Guard?

- I never served in the military

- I served only on active duty for training in the Reserves or National Guard

- I am now on active duty

- I was on active duty in the past, but not now

Born in the U.S.. Were you born in the United States, or not?

- Yes, I was born in the U.S.

- No, I was not born in the U.S.

Own Residence. Do you own or rent your current residence?

- I or someone in my household own my current residence with a mortgage or a loan

- I or someone in my household own my current residence free and clear

- I rent my current residence

- I live in my current residence without payment of rent

Registered to Vote. Are you currently registered to vote, or not?

- Registered

- Not registered

- Don't know

- Prefer not to answer

Party ID. Generally speaking, do you think of yourself as a...

- Republican

- Democrat

- Independent

- Other

- No party / not interested in politics

  If respondents selected "Independent" or "Other", they are asked the following. Do you think of yourself closer to the...

- Republican Party

- Democratic Party

- Neither

PID5. In general, do you think of yourself as...

- Very liberal

- Somewhat liberal

- Moderate, middle of the road

- Somewhat conservative

- Very conservative

Coding for Survey Items

The following tables describe how we coded the outcome variables analyzed in the manuscript.

TABLE A5 *Climate Change Public Opinion Questions*

Survey Items	Coded "Agree" for the Following Responses to Survey Questions
Global warming is happening	x65: Yes
Global warming is mostly human-caused	x67: Caused mostly by human activities
Most scientists think global warming is happening	x73: Most scientists think global warming is happening
Worried about global warming	x78: Somewhat worried; Very worried
Global warming will harm me personally	x79: A great deal; A moderate amount
Global warming will harm future generations	x85: A great deal; A moderate amount
Global warming will harm plants and animals	x86: A great deal; A moderate amount
Support funding research into renewable energy sources	x137: Somewhat support; Strongly support

TABLE A6 *ACS Demographics Questions*

Survey Item	Coded "Yes" for the Following Responses to Survey Questions
Veteran	Veteran: I was on active duty in the past, but not now
Own Residence	Own Residence: I or someone in my household own my current residence with a mortgage or a loan; I or someone in my household own my current residence free and clear
Born in the U.S.	Born in U.S.: Yes, I was born in the U.S.