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### Authors

Hanus, Nichole  
Wong-Parodi, Gabrielle  
Hoyos, Lisa  
[et al.](#)

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## LETTER

# Framing clean energy campaigns to promote civic engagement among parents

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Nichole Hanus<sup>1</sup>, Gabrielle Wong-Parodi<sup>1,4</sup>, Lisa Hoyos<sup>2</sup> and Molly Rauch<sup>3</sup>

<sup>1</sup> Department of Engineering and Public Policy, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, United States of America

<sup>2</sup> Climate Parents, c/o Sierra Club, 2101 Webster St. Suite 1300, Oakland, CA 94612, United States of America

<sup>3</sup> Moms Clean Air Force, c/o Environmental Defense Fund, 257 Park Avenue South, New York, NY 10010, United States of America

<sup>4</sup> Author to whom any correspondence should be addressed.

E-mail: [gwongpar@cmu.edu](mailto:gwongpar@cmu.edu)

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## Abstract

Civic engagement is one important way citizens can influence the rate of decarbonization in the electricity sector. However, motivating engagement can be challenging even if people are affected and interested in participating. Here we employed a randomized controlled trial to assess the effect of clean energy campaigns emphasizing cost savings, health, climate, or health and climate, or no additional information at all (control) on civic engagement behaviors (signing a petition or making a phone call). We targeted parents as they have been shown to be powerful agents of political and business practice change in other contexts, and hence, could play an important role in the decarbonization of the electricity sector. In Study 1, we recruited  $n = 292$  parents already engaged in climate advocacy; in Study 2, we recruited a representative sample of  $n = 1254$  parents drawn from the general public. Both studies were conducted in Michigan, Florida, and California, as these states have sizable advocacy group membership, divergent energy profiles, and strategic importance to the climate movement. In both studies, we find the odds of taking action are reduced by over 90% when participants are asked to make a phone call and leave a voicemail message, versus signing an online petition. Among the parents already engaged in advocacy, we observe a ceiling effect regarding attitudes towards clean energy and find the cost campaign produces unintended consequences. Among our public sample, we find that participants who believe the campaign to be credible and comprehensible are more likely to take action than those who discredit the campaign or do not understand its message. Additionally, we find parents who have children under the age of 18 negatively adjust their attitudes towards fossil fuels after being presented with health information. Ultimately, we find that campaign messages can influence energy attitudes and parents are willing to take action on the topic if the advocacy action seems like an effective approach.

## 1. Introduction

Approximately two-thirds of the electricity generated in the United States (US) comes from fossil fuels, with negative externalities occurring at every point of the supply chain. Water and air pollution emanate from extraction processes; air pollution and spills can arise from fuel transportation; and, finally, environment and public health impacts result from burning fossil fuels and hazardous waste [1–9]. At-risk populations such

as families with children, asthmatics, and those living in flood-prone regions are particularly vulnerable [10–14]. However, without clear signals, utilities have little incentive to use cleaner energy sources to mitigate these ill effects [15]. Civic engagement—voting, demonstrating, signing petitions, and fundraising—is one way that people can signal their dissatisfaction with fossil fuels [16–19], and is increasingly vital as negative externalities are more widely understood and as environmental regulatory bodies are weakened through

proposed budget cuts [20–22]. The challenge, however, is learning how to leverage this concern and transform it into action on clean energy issues.

Parents are a potential compelling target audience for clean energy campaigns. Parenthood has been described as either a hindrance to political activism, because parents are so busy, or a reason to participate [39]. However, there is a strong reason to believe that parents can be powerful agents of change. Examples of parent movements abound, including the immensely successful Mothers Against Drunk Driving founded by Candy Lightner [40], Shannon Watts' Moms Demand Action for Gun Sense in America [41], and more recently MomsRising, which campaigns for initiatives such as maternity/paternity leave as well as health care for all [42]. Other seminal examples of parent initiatives include Lois Gibbs' establishment of the Love Canal Homeowner's Association that lobbied successfully for the remediation of hazardous chemical waste in Niagara Falls, New York [43] and Mary Brune's *Making our Milk Safe* initiative, which demanded that retailers stop selling baby products made with polyvinyl chloride [44]. Finally, there also exists the EcoMom Alliance, a nonprofit empowering women through education to help create an 'environmentally, socially and economically sustainable future' [45] and numerous school cafeteria food initiatives such as Farm to School [46] or Parents for Healthy Schools [47]. Drawing on these examples, there is reason to believe that parents wishing to protect their children from environmental threats, such as buried toxic waste and water pollution, may be highly motivated activists [48, 49]. Additionally, we focus on parents since the majority (85%) of women in the US between the ages of 18 and 44 have had at least one child [50] and, hence, our findings could potentially generalize to a large segment of society. Therefore, our research objective is to investigate the extent to which health and environmental arguments influence parents' attitudes towards and motivation to take civic action on clean energy.

To achieve our research objective, parents in Florida, California and Michigan are exposed to a real clean energy campaign. They are then randomly assigned to learn more about cost savings, health, climate, health and climate impacts related to fossil fuel consumption, or to learn nothing more (control). Finally, they are randomly asked to either sign a petition or leave a voice message to urge their local utility to increase its share of clean energy and encourage energy efficiency, with the signed petitions and voice messages being batched and sent to utility company CEOs. Established audience segmentation analyses suggest that messaging which assumes a diverse population as homogenous will fall flat or potentially result in unintended 'boomerang effects'; therefore, it is important to identify sources of diverse perspectives [29, 36, 51]<sup>5</sup>. Hence, we perform two studies where we evaluate the effect of a clean energy campaign among (Study 1)

those parents who are already actively engaged on climate change and (Study 2) those who are not. We hypothesize:

1. **H1:** Compared to cost savings or no information, exposure to health, climate, or the combination of health and climate information will result in less favorable attitudes by parents towards fossil fuels and more favorable attitudes towards clean energy.
2. **H2:** Compared to cost savings or no information, exposure to health, climate, or the combination of health and climate information will result in higher intention and action rates by parents.
3. **H3:** Those parents who accept climate change, see the campaigns as more credible, and believe taking action is effective will express higher civic engagement intent and higher action rates.

## 2. Study 1—Advocacy parents sample

### 2.1. Method

#### 2.1.1. Sampling and participants

We recruited from the membership lists of two advocacy organizations, Climate Parents (climateparents.org) and Moms Clean Air Force (momscleanairforce.org), targeting parents and grandparents concerned about climate change. Participants completed a web-based study in exchange for being entered to win one of four solar gift bundles, valued at \$200 each. The target population consisted of adults (age 18 years or older) who were or had ever been parents, aunts or uncles. We targeted members who were customers of select utilities residing in Michigan (Consumers Energy and DTE Energy), Florida (Florida Power and Light and Duke Energy), and California (Southern California Edison). We selected these utility districts and states based on advocacy group membership, divergent energy profiles, and strategic importance to the climate movement [52–55]<sup>6</sup>. Between 13 September 2016 and 7 November 2016, the advocacy groups invited 51 774 of their members by email to participate in a survey. Email reminders were sent out five times between September and November 2016. A total of 364 responded, with 292 completing the study for a completion rate of 0.6%<sup>7,8</sup>. According to self-reports, the participants' average age was 58

<sup>5</sup> See supplementary material (SM) available at [stacks.iop.org/ERL/13/034021/mmedia](http://stacks.iop.org/ERL/13/034021/mmedia) section A for more details on background, framing, and theoretical models of decision-making.

<sup>6</sup> SM section B for justification of utility selection and associated electricity generation portfolios.

<sup>7</sup> An *a priori* power analysis using G\*Power [79] indicated a total sample of 196 for a medium effect size ( $\eta^2 = 0.25$ ) with 80% power, for ANOVA (fixed effects, main effects, and interactions) with alpha at 0.05.

<sup>8</sup> See SM section C for email templates and SM tables 3–5 for a summary of the Study 1 sample.

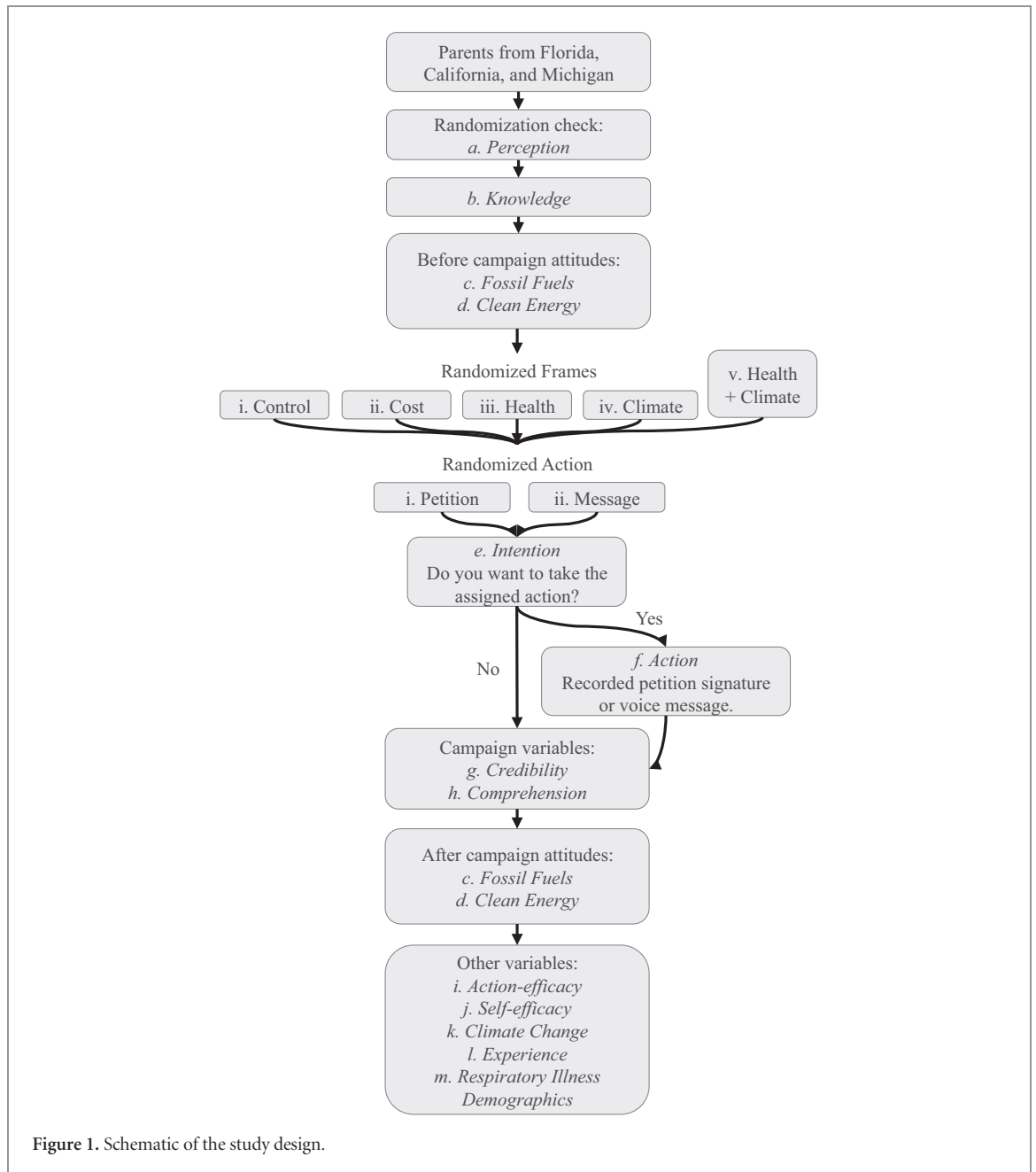


Figure 1. Schematic of the study design.

(SD = 15.4), 53% were female ( $n = 153$ ), 79% were White or Caucasian ( $n = 229$ ), 55% had at least a bachelor's degree ( $n = 162$ ), and 45% had a household annual income of \$40k or greater ( $n = 133$ ). In terms of party affiliation, 47% identified as Democrats ( $n = 136$ ), 29% identified as Independents or Undecided ( $n = 84$ ), 3% identified as Republicans ( $n = 10$ ), and 21% preferred not to answer ( $n = 62$ ). Most participants answered that they were parents (62%,  $n = 182$ ), and of these 45% were also grandparents ( $n = 82$ ) and 84% were also aunts or uncles ( $n = 153$ ). Of those who reported being aunts or uncles, 63 out of 182 participants reported not having children of their own. A number of participants reported having at least one child under the age of 18 living at home (43 out of 182; 24%), and of these 21% had at least one child age 5 or under ( $n = 9$ ). Only 5% ( $n = 15$ ) of

participants in Study 1 were not involved in other community service activities, 46% were involved in one to three other activities ( $n = 134$ ), and 49% were involved in more than three activities ( $n = 143$ ).

### 2.1.2. Experimental protocol

Figure 1 summarizes the study design; the full survey can be found in SM section G. In this study, participants were randomly assigned to one of ten conditions, with clean energy campaign and advocacy action as fully crossed factors. The five types of campaign<sup>9</sup> were:

1. **Control.** Participants read a neutral, informative message about the role of electricity utilities in generating and distributing electricity.

<sup>9</sup> See SM section F for campaign materials.

2. **Cost.** Identical to the control but with additional information about potential reductions in future electricity bills if utilities switched to renewables or were more efficient.
3. **Health.** Identical to the control but with additional information about negative health impacts associated with burning fossil fuels.
4. **Climate.** Identical to the control but with additional information about negative climate impacts associated with burning fossil fuels.
5. **Health + Climate.** Identical to the control but with additional information about negative health and climate impacts associated with burning fossil fuels.

After reading the campaign, participants were informed that this was a real campaign albeit within a study. They then were asked to urge their utility to invest in clean energy and energy efficiency by either signing a petition or leaving a voice message:

1. **Petition.** If they chose to sign the petition, they were taken to a page to fill out their participant code, first name, last name, and zip code (See SM figures 8 and 10).
2. **Message.** If they chose to leave a voice message, they were taken to a page where they were given a phone number for the researchers' Google voice mail account, name of the utility CEO, and a sample script. They were asked to also include their participant code and name in their voice message (see SM figures 9 and 11).

Campaign materials, selected advocacy actions, and survey questions were developed in collaboration with Moms Clean Air Force and Climate Parents. Campaign materials and survey questions were pre-tested for affect, readability, and comprehension in a series of in-person interviews ( $n = 5$ ) and online pilot tests ( $n = 172$ ). Additional explanation of framing selection is provided in SM section A. In addition to exposing participants to various clean energy campaigns and measuring advocacy intentions and actions, data was collected on key variables that were relevant to the campaign materials (e.g. agreement with utilities using various energy sources) and individual differences were measured (e.g. climate change acceptance). These variables are explained in the next section. The Institutional Review Board of Carnegie Mellon University approved all procedures. All participants provided informed consent.

### 2.1.3. Variables

For a further description of the included variables and coding methodology, please see SM section H.

1. **Perception.** Participants indicated their perception of their utility's electricity portfolio by answering the following question: 'What percentage of the electricity that you use in your home do you think comes

from fossil fuels (i.e. natural gas, oil, and/or coal)?' the responses were recorded on a sliding scale from 0%–100%.

2. **Knowledge.** Given a participant's perception of the fossil fuel percentage of their utility's portfolio, we calculated knowledge as an absolute difference from their response and the actual percentage published on their respective utility's websites<sup>10</sup>.
3. **Fossil fuel attitudes.** Participants indicated their fossil fuel attitudes with their agreement to the following statement (1 = strongly disagree, 5 = strongly agree) before and after being exposed to their condition: 'My utility should use fossil fuels to make electricity.'
4. **Clean energy attitudes.** Participants' attitudes towards clean energy were measured by taking the mean of their agreement with the following two statements (1 = strongly disagree, 5 = strongly agree) before and after the conditions: 'My utility should use wind, sun, and other renewable energy sources to make electricity,' and 'My utility should use energy efficiency to reduce the amount of electricity needed.' (Before: Cronbach's  $\alpha = 0.33$ ; after: Cronbach's  $\alpha = 0.62$ ).
5. **Intention.** Participants indicated their intention to take action<sup>11</sup> by either selecting, 'Sign the petition'/'Leave a message' or 'No thanks'.
6. **Action.** Participants who took action were assigned a 1, and those who did not take action were assigned a 0.
7. **Credibility.** Participants indicated their perception of campaign credibility by answering the following question (1 = definitely no, 5 = definitely yes): 'Was the clean energy information just presented to you credible?'
8. **Comprehension.** Participants' comprehension was measured by their responses to two questions (1 = definitely false, 5 = definitely true): (1) 'My utility can only provide electricity generated from fossil fuels' [correct answer = definitely false] and (2) 'My utility can choose to invest in energy efficiency' [correct answer = definitely true].
9. **Action-efficacy.** Participants indicated action efficacy beliefs by indicating their agreement (1 = strongly disagree, 5 = strongly agree) with either 'Signing an online petition is an effective way to change my utility's practices' or 'Joining others who have already made a phone call to my utility is an effective way to change my utility's practices.'
10. **Self-efficacy.** Participants' self-efficacy was assessed by taking the mean of their agreement with two statements from Schwarzer and Jerusalem's General Self-Efficacy Scale [65] (1 = strongly disagree,

<sup>10</sup> See SM tables 1 and 2 for utility portfolios.

<sup>11</sup> See SM figures 8–11 for an example of the Intention and Action Screens.



**Table 1.** Study 1 summary statistics of dependent variables across experimental conditions.

Campaign	Action	Average change in fossil fuel attitude			Average change in clean energy attitude			Count of intentions		Count of actions	
		<i>n</i> <sup>a</sup>	Mean	SD	<i>n</i>	Mean	SD	<i>n</i>	Made Intention <sup>b</sup>	<i>n</i>	Took Action <sup>c</sup>
Control	Petition	30	-0.10	0.96	30	0.08	0.42	33	33	33	32
Cost	Petition	38	0.31	1.16	38	0.01	0.25	40	40	40	37
Health	Petition	36	0.11	1.14	36	-0.10	0.49	37	34	37	33
Climate	Petition	32	-0.15	0.51	33	-0.05	0.20	34	34	34	32
Health + Climate	Petition	31	0.00	0.89	31	0.03	0.48	34	33	34	31
Control	Voice message	21	0.10	0.70	22	-0.02	0.11	31	10	31	5
Cost	Voice message	27	-0.07	0.92	27	0.04	0.19	29	9	29	6
Health	Voice message	31	-0.06	0.36	33	-0.03	0.21	35	9	35	7
Climate	Voice message	25	-0.12	0.60	25	-0.02	0.27	29	5	29	4
Health + Climate	Voice message	29	-0.31	0.85	29	-0.09	0.30	34	11	34	3

<sup>a</sup> Participants were not required to answer every question in the online survey. Therefore, we observe some small differences in the *n* values for different dependent variables within each condition.

<sup>b</sup> 'Made Intention' means participants indicated their intention to take action.

<sup>c</sup> 'Took Action' means participants took their assigned advocacy actions.

5 = strongly agree): (1) 'I am often able to overcome barriers' and (2) 'I generally accomplish what I set out to do' (Cronbach's  $\alpha = 0.76$ ) [66].

11. **Climate change.** Participants' climate change acceptance was assessed by taking the mean of their agreement with four statements from Leiserowitz *et al*'s Global Warming's Six Americas survey [67] (1 = definitely no, 5 = definitely yes): (1) 'Do you think that climate change is happening?' (2) 'Do you think that climate change is mostly caused by humans?' (3) 'Do you think that climate change will harm future generations?' and (4) 'Are you worried about climate change?' (Cronbach's  $\alpha = 0.75$ ) [66].
12. **Experience.** Participants indicated their experience of extreme events by checking any of the following: coastal/inland flooding, drought, severe weather, wildfires, other, and prefer not to answer.
13. **Respiratory Illness.** Participants answered, 'Have YOU been diagnosed by a doctor or other qualified medical professional with asthma, chronic bronchitis, COPD, or other lung disease?'

#### 2.1.4. Analytic strategy

Statistical analyses were conducted using Stata 14.2. We performed a Pearson's chi-squared test to confirm balanced experimental conditions. To ensure successful randomization, we performed a two-way Analysis of Variance (ANOVA) with Campaign x Action on Perception. We conducted separate linear regressions, considering Campaign and Action on change of attitude (after campaign—before campaign) for Fossil Fuels (Model 1) and Clean Energy (Model 2). In these regressions, we controlled for Knowledge, Credibility, Comprehension, Experience, Respiratory Illness and demographics. We conducted separate logistic regressions using a hierarchical variable-entry strategy to analyze correlates of our dependent variables, Intention and Action, in theoretically relevant blocks<sup>12</sup>.

## 2.2. Results

Table 1 provides summary statistics for our dependent variables across the experimental conditions in Study 1.

### 2.2.1. Balance and randomization check

A chi-square test of independence found no significant difference in the number of participants assigned to each condition,  $\chi^2(4, N=292) = 1.11, p = 0.893$ , indicating a balanced experimental design. A two-way ANOVA also found no significant interaction between Campaign and Action on Perception,  $F(4,292) = 1.65, p = 0.161$ , suggesting successful randomization<sup>13</sup>.

### 2.2.2. Attitudes

Figure 2 depicts the effects of Campaign on overall attitudes towards fossil fuels. As shown in table 2 (Model 1) and figure 2, cost information resulted in fossil fuels being viewed more favorably than neutral information (control) or climate information [approached significance]. Figure 3 depicts the effects of Campaign on overall attitudes towards renewable energy. While we observed no significant main effects from campaign on clean energy attitudes, it is important to note that views across all conditions were high before ( $M = 4.92, SD = 0.27$ ) and after ( $M = 4.91, SD = 0.31$ ), indicating the strong environmental orientation of our sample (figure 3). Unplanned post hoc analyses found those shown health information saw fossil fuels more negatively than those shown cost information (Contrast =  $-0.71, SE = 0.22, p = 0.002$ )<sup>14</sup>.

### 2.2.3. Intention

Cost information resulted in lower intent to take action than neutral information (control) (table 3, Model 5a

<sup>12</sup> See SM section H for regression block details.

<sup>13</sup> See SM tables 6 and 7 for additional balance and randomization check results for Study 1.

<sup>14</sup> See SM tables 8 and 9 for additional post-hoc analysis results for Study 1.

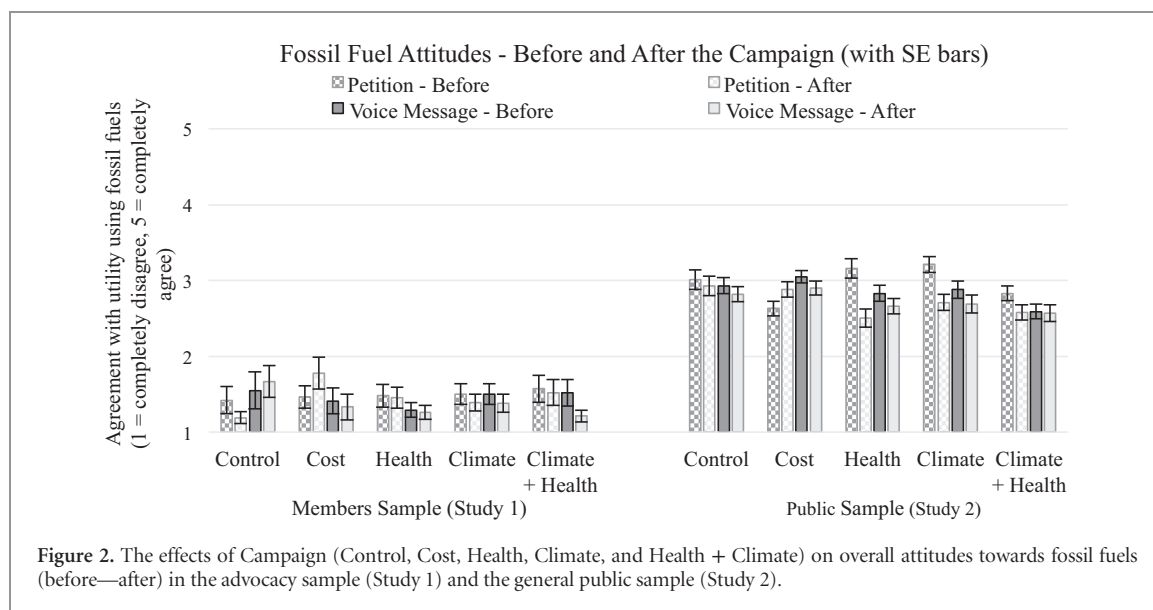


Figure 2. The effects of Campaign (Control, Cost, Health, Climate, and Health + Climate) on overall attitudes towards fossil fuels (before—after) in the advocacy sample (Study 1) and the general public sample (Study 2).

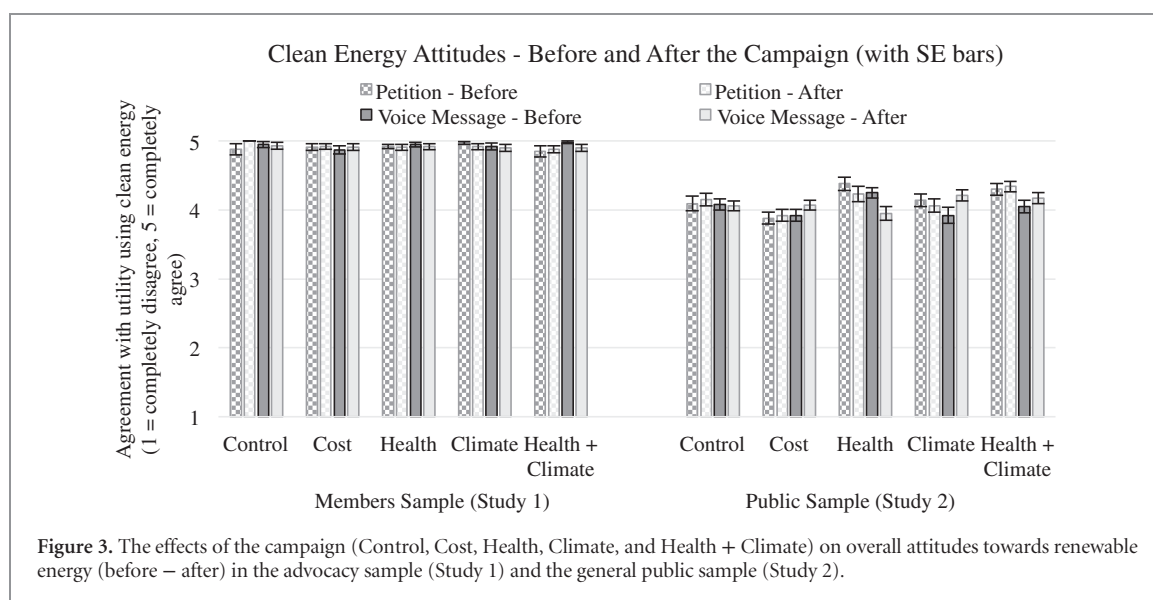


Figure 3. The effects of the campaign (Control, Cost, Health, Climate, and Health + Climate) on overall attitudes towards renewable energy (before – after) in the advocacy sample (Study 1) and the general public sample (Study 2).

Table 2. Study 1 (advocacy) linear regression predicting changes<sup>a</sup> in attitudes towards fossil fuels and clean energy<sup>b</sup>.

Variables	Model 1 (Fossil Fuels)( <i>n</i> = 284)			Model 2 (Clean Energy)( <i>n</i> = 286)		
	<i>B</i> (95% CI)	SE	<i>t</i>	<i>B</i> (95% CI)	SE	<i>t</i>
Campaign (Ref. = Control)						
Cost	0.50 (0.02, 0.98)*	0.24	2.05	-0.03 (-0.22, 0.17)	0.10	-0.27
Health	-0.21 (-0.69, 0.28)	0.24	-0.85	-0.01 (-0.20, 0.19)	0.10	-0.08
Climate	0.07 (-0.48, 0.62)	0.28	0.24	-0.03 (-0.25, 0.20)	0.11	-0.23
Health + Climate	0.06 (-0.46, 0.58)	0.26	0.24	0.05 (-0.16, 0.26)	0.11	0.46
Action (Ref. = Petition)						
Voice message	-0.10 (-0.40, 0.21)	0.15	-0.64	-0.16 (-0.28, -0.04)*	0.06	-2.48
Knowledge	0.00 (-0.01, 0.00)	0.00	-1.06	0.00 (-0.01, 0.00)	0.00	-1.06
Credibility	-0.25 (-0.50, 0.01)	0.13	-1.91	0.06 (-0.04, 0.17)	0.05	1.19
Comprehension	-0.04 (-0.43, 0.35)	0.20	-0.20	-0.06 (-0.21, 0.10)	0.08	-0.71
Constant	2.01 (0.35, 3.68)*	0.84	2.40	-0.20 (-0.87, 0.47)	0.34	-0.59
<i>R</i> <sup>2</sup>	0.16			0.12		

\*\*\* *p* < .001, \*\* *p* < .01, \* *p* < .05.

<sup>a</sup> Here changes in attitudes were calculated by subtracting attitudinal responses after participants viewed the campaigns and were asked to take an action from their original responses.

<sup>b</sup> Demographics controlled for in Model 1 and Model 2 include age, income, number of children, experience with climate change-related weather, and whether or not the participant suffers from respiratory illness.



**Table 3.** Study 1 (advocacy) logistic regression predicting intention and action<sup>a</sup>.

Variable	Intentions						Actions											
	Model 3a (n = 287)			Model 4a (n = 284)			Model 5a (n = 123)			Model 3b (n = 287)			Model 4b (n = 284)			Model 5b (n = 123)		
	B	SE	OR <sup>b</sup> (e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )
Campaign (Ref. = Control)																		
Cost	0.06	0.61	1.06	-0.34	0.66	0.71	-3.05*	1.49	0.05	-0.11	0.67	0.90	-0.69	0.70	0.50	-3.12*	1.49	0.04
Health	-0.17	0.61	0.84	0.05	0.65	1.05	-2.18	1.32	0.11	0.22	0.66	1.25	0.42	0.69	1.52	-1.37	1.20	0.25
Climate	-0.32	0.64	0.73	-0.45	0.68	0.64	-2.22	1.48	0.11	-0.07	0.68	0.93	-0.29	0.72	0.75	-0.30	1.28	0.74
Health + Climate	0.09	0.60	1.09	0.06	0.64	1.06	-0.53	1.33	0.59	-0.42	0.69	0.66	-0.59	0.71	0.55	-1.51	1.38	0.22
Action (Ref. = Petition)																		
Voice message	-5.03***	0.65	0.01	-5.24***	0.72	0.01	-7.43***	1.59	0.00	-4.88***	0.51	0.01	-5.25***	0.59	0.01	-6.44***	1.20	0.00
Knowledge	0.00	0.01	1.00	0.00	0.01	1.00	0.02	0.02	1.02	0.01	0.01	1.01	0.01	0.01	1.01	0.01	0.02	1.01
Credibility	0.61	0.34	1.84	0.41	0.35	1.51	1.14	0.63	3.13	0.83*	0.34	2.29	0.64	0.35	1.90	0.78	0.58	2.18
Comprehension	0.31	0.42	1.36	0.46	0.43	1.58	-1.82	1.03	0.16	-0.04	0.40	0.96	0.10	0.42	1.11	-1.27	0.83	0.28
Action-Efficacy				0.69**	0.21	1.99	0.53	0.43	1.70				0.82***	0.23	2.27	1.09*	0.47	2.97
Self-Efficacy				0.14	0.29	1.15	1.49*	0.74	4.44				-0.26	0.33	0.77	-0.05	0.62	0.95
Climate change				1.46*	0.72	4.31	2.85**	1.09	17.29				1.78*	0.69	5.93	2.45*	1.11	11.59
Demographics <sup>c</sup>	No			No			Yes			No			No			Yes		
Constant	0.59	1.92	1.80	-8.54*	3.68	0.00	-16.79*	6.51	0.00	-1.18	1.91	0.31	-10.73**	3.65	0.00	-14.92*	6.65	0.00
R <sup>2d</sup>	0.50			0.55			0.66			0.56			0.60			0.65		

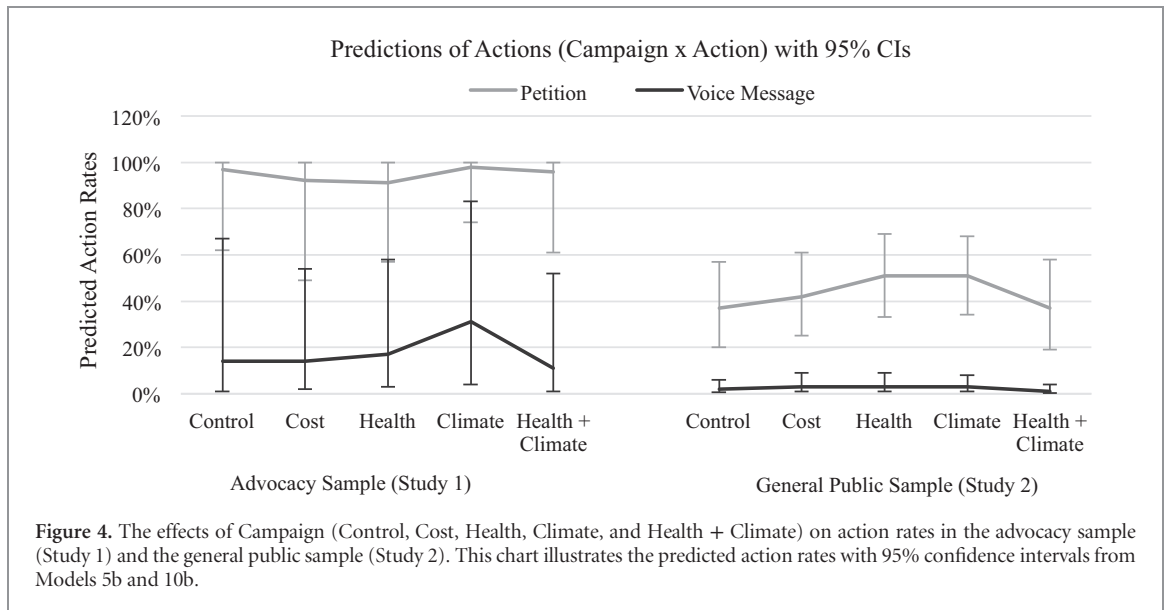
\*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ .

<sup>a</sup> We chose not to include Climate  $\times$  Action interaction term in these regression models.

<sup>b</sup> A significant odds ratio with a value below 1 indicates that the specified independent variable reduces the odds of a participant stating an intention to act (i.e. Intention = 1). An odds ratio greater than 1 indicates an increase in these odds. Therefore, we can subtract 1 from the ratio and multiply by 100 to determine the percent change in the odds of intending to take an action. The same can be done for the observed action regressions.

<sup>c</sup> Demographics controlled for in this regression include age, income, number of children, experience with climate change-related weather, and whether or not the participant suffers from respiratory illness.

<sup>d</sup> These represent pseudo R<sup>2</sup> values for logistic regressions.



and SM figure 18). We found those asked to make a phone call were much less likely (99%) to intend to do so than those asked to sign a petition (Models 3a–5a). Greater climate change acceptance was associated with higher levels of intent to take action when controlling for demographics and when not (Model 5a and 4a, respectively). Additionally, the odds of intention to make a phone call or sign a petition were 2 times greater among those who expressed stronger belief in the efficacy of the action than those less convinced, when not controlling for demographics (Model 4a). Finally, we found the odds of intention were 1.5 times higher among those who reported higher self-efficacy than those who reported low self-efficacy, when controlling for demographics (Model 5a). No other significant predictors or interactions were observed.

#### 2.2.4. Action

Figure 4 depicts the effects of Campaign on action rates. Cost information resulted in lower action rates than neutral information (control) (table 3, Model 5b and figure 4), controlling for demographic variables. We also found those asked to make a phone call were much less likely (99% less likely) to do so than those asked to sign a petition (Models 3b–5b). We also found those who reported greater climate change acceptance and stronger beliefs in the effectiveness of the requested action were significantly more likely to take action when and when not controlling for demographics (Model 5b and 4b, respectively). No other significant predictors or interactions were observed. See SM section M for more details about differences across states.

### 2.3. Discussion

Overall, our participants who are members of climate advocacy groups held very positive views about clean energy and additional information about impacts did little to shift those views. We did not find support for H1 and H2. In support of H3, other factors seemingly

increased action rates, including whether the participant saw the action as being able to make a difference in their utility's practices and if they accepted climate change. Finally, on balance, people found it easier to sign a petition than make a phone call. See SM section N for additional Study 1 discussion. Whether these findings hold among parents who do not prioritize climate change or other environmental issues is an empirical question, which we investigate in Study 2.

## 3. Study 2—Public parent sample

### 3.1. Method

#### 3.1.1. Sampling and participants

Respondents were drawn from the GfK KnowledgePanel, which uses address-based random sampling methods to recruit individuals in US households. Data were weighted to account for probability of selection and any differences in the demographics of our sample compared to US Census benchmarks. Panelists completed Web-based surveys in return for compensation or free Internet. The target population consisted of adults (age 18 or older) who were or had ever been parents and are customers of the same utilities targeted in Study 1. Between 23 September 2016 and 3 October 2016, GfK invited 1890 people to participate, with 1254 completing the study for a completion rate of 66%<sup>15,16</sup>. According to self-reports, the participants' average age was 51 (SD=15), 54% were female ( $n=683$ ), 53% were White or Caucasian ( $n=670$ ), 26% had at least a bachelor's degree ( $n=324$ ), and 69% had a household annual income of \$40 k or

<sup>15</sup> An *a priori* power analysis using G\*Power [79] indicated a total sample of 1199 for a small effect size ( $\eta^2 = 0.10$ ) with 80% power, for ANOVA (fixed effects, main effects, and interactions) with alpha at 0.05.

<sup>16</sup> See SM section O for a description of GfK's sampling method and SM table 11 for a summary of the Study 2 sample.

**Table 4.** Study 2 summary statistics of dependent variables across experimental conditions.

Campaign	Action	Average change in fossil fuel attitude			Average change in clean energy attitude			Count of intentions		Count of actions	
		<i>n</i> <sup>a</sup>	Mean	SD	<i>n</i>	Mean	SD	<i>n</i>	Made Intention <sup>b</sup>	<i>n</i>	Took Action <sup>c</sup>
Control	Petition	110	-0.12	0.66	111	0.04	0.79	112	45	112	43
Cost	Petition	125	0.01	1.01	126	0.08	0.77	127	53	127	53
Health	Petition	116	-0.31	1.18	119	-0.08	0.84	120	51	120	50
Climate	Petition	113	-0.33	1.25	115	-0.07	0.85	118	61	118	56
Health + Climate	Petition	125	-0.22	1.06	126	0.06	0.86	129	58	129	56
Control	Voice message	125	-0.05	0.97	127	-0.01	0.89	132	13	132	5
Cost	Voice message	122	-0.23	1.00	126	0.17	0.83	126	11	126	5
Health	Voice message	134	-0.13	1.21	138	-0.05	0.98	140	15	140	5
Climate	Voice message	119	-0.11	1.10	120	0.00	0.84	120	15	120	3
Health + Climate	Voice message	127	-0.13	0.99	128	0.09	0.83	130	14	130	2

<sup>a</sup> Participants were not required to answer every question in the online survey. Therefore, we observe some small differences in the *n* values for different dependent variables within each condition.

<sup>b</sup> 'Made Intention' means participants indicated their intention to take action.

<sup>c</sup> 'Took Action' means participants took their assigned advocacy actions.

greater ( $n = 873$ ). In terms of party affiliation, 45% identified as Democrats ( $n = 557$ ), 2% identified as Independents or Undecided ( $n = 27$ ), and 53% identified as Republicans ( $n = 670$ ). All participants in Study 2 answered that they were parents, and of these 48% were also grandparents ( $n = 605$ ) and 74% were also aunts or uncles ( $n = 924$ ). Some participants reported having at least one child under the age of 18 living at home (363 out of 1254; 30%), and of these 35% had at least one child age 5 or under ( $n = 127$ ). In Study 2, 16% of participants were not involved in other community service activities ( $n = 229$ ), 64% were involved in 1–3 other activities ( $n = 794$ ), and 20% were involved in more than 3 activities ( $n = 201$ ).

### 3.1.2. Experimental protocol

Study 2 followed the same exact experimental protocol as that described in Study 1 (figure 1).

### 3.1.3. Variables

For Clean Energy Attitudes, we found a Cronbach's  $\alpha$  of 0.78 and 0.79 for before and after presentation of the campaign, respectively. We found a Cronbach's  $\alpha$  of 0.77 and 0.92 for Self-efficacy and Climate Change, respectively [66].

### 3.1.4. Analytic strategy

We performed the same exact set of analyses for Study 2 as we did for Study 1, with the inclusion of sampling weights to retain demographic representativeness<sup>17</sup>. To investigate how different parent segments reacted to the clean energy campaigns, we performed segmentation analysis on two group distinctions within this sample: (1) grandparents/non-grandparents and (2) parents with children under 18 years old/parents without children under 18 years old. We ran the same change of attitude regressions for Fossil Fuels and Clean Energy as well as logistic regressions for Intention and Action,

controlling for demographics. All results are included in SM section W.

## 3.2. Results

Table 4 provides summary statistics for our dependent variables across the experimental conditions in Study 2.

### 3.2.1. Balance and randomization check

Similar to Study 1, a chi-square test of independence indicated a balanced experimental design [ $\chi^2$  (4,  $N = 1254$ ) = 1.80,  $p = 0.773$ ] and a 2 way ANOVA with Campaign x Action on Perception suggested successful randomization [ $F(4, 1247) = 0.95$ ,  $p = 0.433$ ]<sup>18</sup>.

### 3.2.2. Attitudes

Health information resulted in significantly less favorable attitudes towards clean energy (table 5, Model 7), seemingly driven by parents in Florida<sup>19</sup>. Unplanned post hoc analyses found those presented with the health impacts viewed clean energy (Contrast = -0.34, SE = 0.12,  $p = 0.005$ ) and fossil fuels (Contrast = -0.41, SE = 0.167,  $p = 0.009$ ) less favorable than those presented with the cost benefits of utilities switching to renewables and increasing efficiency. However, coupling health with climate information resulted in more favorable views towards clean energy than those shown health information alone (Contrast = 0.29, SE = 0.12,  $p = 0.017$ )<sup>20</sup>.

<sup>18</sup> See SM tables 14 and 15 for additional balance and randomization check results for Study 1.

<sup>19</sup> Looking at state differences, we found that in Florida showing the health information increased negative views of both clean energy (before = 4.32, after = 3.95) and fossil fuels (before = 3.04, after = 2.51). In Michigan, however, views on clean energy remained virtually unchanged (before = 4.48, after = 4.45) but did become less favorable for fossil fuels (before = 3.05, after = 2.63).

<sup>20</sup> See SM tables 16 and 17 for additional post-hoc analysis results for Study 2.

<sup>17</sup> See SM section S for unweighted results.

**Table 5.** Study 2 (general public) linear regression predicting changes<sup>a</sup> in attitudes towards fossil fuels and clean energy<sup>b</sup>.

Variables	Model 6 (Fossil Fuels)( <i>n</i> = 1205)			Model 7 (Clean Energy)( <i>n</i> = 1222)		
	<i>B</i> (95% CI)	SE	<i>t</i>	<i>B</i> (95% CI)	SE	<i>t</i>
Campaign (Ref. = Control)						
Cost	0.16 (−0.10, 0.41)	0.13	1.18	0.09 (−0.16, 0.34)	0.13	0.71
Health	−0.26 (−0.53, 0.01)	0.14	−1.88	−0.25 (−0.48, −0.01)*	0.12	−2.06
Climate	−0.17 (−0.52, 0.18)	0.18	−0.97	0.14 (−0.17, 0.44)	0.16	0.90
Health + Climate	−0.04 (−0.32, 0.25)	0.15	−0.26	0.04 (−0.20, 0.28)	0.12	0.34
Action (Ref. = Petition)						
Voice message	0.09 (−0.13, 0.31)	0.11	0.81	0.04 (−0.13, 0.22)	0.09	0.51
Knowledge	0.00 (0.00, 0.01)	0.00	0.47	0.00 (0.00, 0.00)	0.00	−0.16
Credibility	−0.11 (−0.21, −0.01)*	0.05	−2.10	0.07 (−0.01, 0.14)	0.04	1.69
Comprehension	−0.10 (−0.23, 0.03)	0.07	−1.50	0.15 (0.05, 0.26)**	0.05	2.79
Constant	0.74 (0.00, 1.47)*	0.37	0.05	−0.65 (−1.25, −0.06)*	0.30	−2.17
<i>R</i> <sup>2</sup>	0.07			0.06		

\*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ .

<sup>a</sup> Here changes in attitudes were calculated by subtracting attitudinal responses after participants viewed the campaigns and were asked to take an action from their original responses.

<sup>b</sup> Demographics controlled for in Model 6 and Model 7 include Age, Income, Number of Children, Experience with climate change-related weather, and whether or not the participant suffers from respiratory illness.

### 3.2.3. Intention

A main effect was observed for intention with those asked to make a phone call being much less likely (~90%) to intend to do so than those asked to sign a petition (table 6, Models 8a–10a). We also found the odds of intending to take action were two times higher among those who believed the campaign to be credible than those who did not believe it to be credible (Model 8a). Those who accepted climate change and expressed a stronger belief in the efficacy of the action were more likely to intend to take action when and when not controlling for demographics (Model 9a and 10a, respectively). No significant other main effects or interactions were observed.

### 3.2.4. Action

A main effect was observed for action with those asked to make a phone call being much less likely (~90%) to do so than those asked to sign a petition (table 6, Models 8b–10b). No other significant main effects or interactions were observed. We also found those who believed the campaign to be more credible, expressed stronger beliefs in the efficacy of the action, and accepted climate change were more likely to take action when and when not controlling for demographics (Model 9b and 10b, respectively). No other significant predictors were observed. See SM section V for more details about state differences.

### 3.2.5. Segmentation analysis

*Parents who are not grandparents.* Parents who are not also grandparents presented with health information reported significantly less favorable attitudes towards fossil fuels ( $B = -0.43$ ,  $p = 0.029$ ) than those presented with neutral information. Moreover, for these parents, stronger reported self-efficacy was associated with less action taking ( $B = -0.60$ ,  $p = 0.30$ ). We did observe, however, similarities between parents who are and who are not also grandparents with those being asked to make a phone call being much less likely

to intend to or to actually do so than sign a petition. We also found that across all parents, greater perceived campaign credibility, action efficacy, and belief in climate change was associated with greater intention and action. No other significant effects were observed ( $p > .05$ ).

*Having a child under the age of 18 at home.* Parents who have children under the age of 18 years old presented with health information reported significantly less favorable attitudes towards fossil fuels ( $B = -0.51$ ,  $p = 0.044$ ) than those presented with neutral information. Moreover, for these parents, greater message comprehension was predictive of greater action ( $B = 0.69$ ,  $p = 0.024$ ). We also observed similarities between parents who have children under the age of 18 and those who do not, with those being asked to make a phone call being much less likely to intend to or to actually do so, than those asked to sign a petition. We also found that across all parents, greater perceived campaign credibility, action efficacy, and belief in climate change was associated with greater intention and action. No other significant effects were observed ( $p > .05$ ).

## 3.3. Discussion

Overall, our participants recruited from the general public held relatively neutral opinions on energy sources. Here, among those shown health information, we found more negative attitudes towards clean energy than the control group as well as more negative attitudes towards both fossil fuels and clean energy than the cost group (in partial support of H1). We did not find support for H2; we found the campaigns had no effect on intention or action rates. In support of H3, we found climate change acceptance and beliefs about campaign credibility among the participants to be more predictive of intention and action than the campaign materials. Our segmentation analysis demonstrated that parents should be treated as a heterogeneous group.

**Table 6.** Study 2 (general public) logistic regression predicting intention and action<sup>a</sup>.

Variable	Intentions						Actions											
	Model 8a (n=1237)			Model 9a (n=1200)			Model 10a (n=1168)			Model 8b (n=1237)			Model 9b (n=1200)			Model 10b (n=1168)		
	B	SE	OR <sup>b</sup> (e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )	B	SE	OR(e <sup>B</sup> )
Campaign (Ref. = Control)																		
Cost	-0.34	0.35	0.71	-0.14	0.39	0.87	-0.18	0.40	0.84	0.09	0.42	1.09	0.46	0.47	1.58	0.42	0.48	1.52
Health	0.17	0.35	1.19	-0.03	0.38	0.97	0.12	0.39	1.13	0.53	0.40	1.70	0.45	0.44	1.57	0.60	0.46	1.82
Climate	0.31	0.36	1.36	0.47	0.37	1.60	0.52	0.36	1.68	0.24	0.37	1.27	0.49	0.41	1.63	0.50	0.42	1.65
Health + Climate	0.02	0.41	1.02	-0.10	0.45	0.90	-0.15	0.47	0.86	-0.22	0.44	0.80	-0.36	0.47	0.70	-0.46	0.50	0.63
Action (Ref. = Petition)																		
Voice message	-2.19***	0.27	0.11	-2.42***	0.32	0.09	-2.66***	0.33	0.07	-3.55***	0.33	0.03	-4.07***	0.39	0.02	-4.37***	0.41	0.01
Knowledge	0.00	0.01	1.00	0.00	0.01	1.00	0.001	0.01	1.00	0.01	0.01	1.01	0.01	0.01	1.01	0.01	0.01	1.01
Credibility	0.77***	0.15	2.16	0.38*	0.17	1.46	0.44*	0.18	1.55	0.92***	0.14	2.51	0.58***	0.15	1.79	0.63***	0.16	1.88
Comprehension	0.26	0.17	1.30	0.28	0.19	1.32	0.25	0.20	1.28	0.22	0.19	1.25	0.35	0.20	1.42	0.36	0.22	1.43
Action-Efficacy				0.69***	0.13	1.99	0.75***	0.12	2.12				0.82***	0.14	2.27	0.87***	0.14	2.39
Self-Efficacy				-0.10	0.18	0.90	-0.18	0.18	0.84				-0.30	0.20	0.74	-0.37	0.21	0.69
Climate Change				0.49***	0.13	1.63	0.49**	0.15	1.63				0.42**	0.13	1.52	0.38**	0.14	1.46
Demographics <sup>c</sup>	No			No			Yes			No			No			Yes		
Constant	-3.43***	0.70	0.03	-5.85***	1.09	0.00	-5.17***	1.23	0.01	-4.5***	0.80	0.01	-6.77***	1.31	0.00	-6.21***	1.55	0.00
R <sup>2</sup> <sup>d</sup>	0.23			0.32			0.37			0.35			0.44			0.47		

\*\*\*  $p < .001$ , \*\*  $p < .01$ , \*  $p < .05$ .

<sup>a</sup> We chose not to include Climate x Action interaction term in these regression models.

<sup>b</sup> A significant odds ratio with a value below 1 indicates that the specified independent variable reduces the odds of a participant stating an intention to act (i.e. Intention = 1). An odds ratio greater than 1 indicates an increase in these odds. Therefore, we can subtract 1 from the ratio and multiply by 100 to determine the percent change in the odds of intending to take an action. The same can be done for the observed action regressions.

<sup>c</sup> Demographics controlled for in this regression include age, income, number of children, experience with climate change-related weather, and whether or not the participant suffers from respiratory illness.

<sup>d</sup> These represent pseudo R<sup>2</sup> values for logistic regressions.

## 4. General Discussion

*Attitudes.* On the whole, parents who are members of the advocacy groups, Climate Parents and Moms Clean Air Force, held negative views towards fossil fuels and positive views towards clean energy (Study 1). Alternatively, parents recruited from the general public were more ambivalent (Study 2). When compared to neutral information (control), cost information had little effect on general public parents' attitudes. However, we were surprised to find that advocacy group parents reported more favorable views of their utilities using fossil fuels after being presented information describing the potential for reduced electricity bills when utilities switched to cleaner energy sources. This could suggest a boomerang effect, supported by Self-Perception Theory, which posits that clean energy campaigns heralding monetary benefits, an extrinsic motivation, may not work well with self-defined intrinsically motivated environmentalists [27, 36].

Surprisingly, we also found general public parents expressed less favorable attitudes towards their utilities using clean energy when shown health information compared to when they were presented with neutral or cost information, with those in Florida seemingly driving this effect. However, when health was coupled with climate information, attitudes towards clean energy improved among general public parents. According to the Centers for Disease Control and Prevention National Asthma Control Program, Florida had asthma rates lower than the national average in 2011<sup>21</sup>, but has experienced the highest number of flood insurance claims since 1978 among our three targeted states of Florida, Michigan and California (and 3rd in the nation) [68–69]. Thus, one possible explanation is that Florida parents are more concerned about the climate and sea level rise, due the availability heuristic, rather than the health implications of burning fossil fuels [70, 71]. We also found that younger parents (e.g. those parents who were not also grandparents and/or who have children under the age of 18 years old) reported significantly less favorable attitudes towards fossil fuels when shown health information, compared to the control. This could also be due to the availability heuristic or the issue of co-benefits [72], suggesting that some parents will respond well to information that has direct relevance for themselves and their family (i.e. health) compared to information often perceived as abstract (i.e. climate change).

*Intentions and Behaviors.* Few differences were observed between advocacy and general public parents with behavioral intent and action. On balance, people expressed greater intent and action rates when asked to sign a petition versus leaving a voice message.

Previous research also suggests that as the level of perceived or actual effort required increases<sup>22</sup>, the level of civic engagement decreases [73]. Self- and action-efficacy enhances this effect; participants who perceive having agency in a matter should express more persistent efforts, manifested in our study by higher action rates [74, 75]. This also echoes the common finding in public health that messages both conveying the risk and providing a plausible solution enhance pro-health behaviors [76]. We also found that greater acceptance of climate change, perceiving the information as credible, and seeing the proposed action as effective were associated with enhanced behavioral intention and action rates. Risk communications research suggests that trust in the source and the information itself determine whether people pay attention, and perhaps more importantly in this context, take action [77, 78].

Another difference is that advocacy parents tended to have higher action rates across all campaign types whereas general public parents tended only to be responsive when exposed to cost, health or climate information (as shown in figure 4). This suggests potentially two phenomena. First, advocacy parents may be less susceptible to the influence of messaging due to their existing dedication to advocacy action. Moreover, factors such as social influences and peer behavior, recent news headlines, and familiarity with petitions may play a larger role than do the messages for the advocacy parents. The second is that public parents can be influenced by messages. Our findings suggest that these parents are responding differently to different messages largely due to their individual differences (e.g. climate change acceptance); recognizing these differences is essential for more impactful targeting of the general population. This general conclusion is also supported by findings in our brief segmentation analysis presented in section 3.2.5 and other widely accepted segmentation analyses regarding climate change acceptance and messaging [29–67].

## 5. Conclusion

We found promising results in our study of how clean energy campaign framing moves parents to take civic action and urge their utilities to provide clean energy. Parents, regardless of their involvement in climate advocacy groups, are open to changing their perception of energy sources when presented with relevant information. However, unintended consequences can

<sup>21</sup> Lifetime asthma rates among adults in Florida were 10.2% in 2011 compared to the national average of 13.3% and child current asthma prevalence was 8.3% compared with the national average of 9%.

<sup>22</sup> In an attempt to reduce the varying levels of perceived effort to complete these actions (e.g. increased embarrassment from expressing personal qualms with fossil fuels in a voice message, increased amount of time required to make a phone call, and general ignorance regarding contacting utilities), we provided the participants with a suggested script that included the utility's contact information. We also specified that they would be recording a message that we would deliver later, assuring them that they wouldn't be speaking with a live person.



occur with people expressing seemingly contradictory viewpoints and inaction. We also found that beliefs about action-efficacy, climate change, and information credibility matters. Hence, sensitivity to the heterogeneity that exists among parents in terms of knowledge, values, and culture is paramount when developing and executing a campaign—this point is underscored by our segmentation analysis, which illustrated differences among younger and older parents. Future study could examine how parents are influenced by campaigns delivered by a host of messengers and mediums (e.g. campaigns delivered directly by electric utilities or government agencies) to take a broader set of clean energy actions (e.g. installing their own on-site generation or switching utilities)<sup>23</sup>. Ultimately, we find that campaigns can influence energy attitudes and parents are willing to take action on the topic if the advocacy action seems like an effective approach.

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## ORCID iDs

Nichole Hanus  <https://orcid.org/0000-0001-5584-9165>

Gabrielle Wong-Parodi  <https://orcid.org/0000-0001-5207-7489>

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<sup>23</sup> See SM section Z for additional discussion of study limitations and suggestions for future study.



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