Title:

Using Deliberative Democracy to Identify Energy Policy Priorities in the United States

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4 **Abstract:**

5 Energy policies to mitigate and adapt to climate change need public support to be successful.
6 Deliberative democracy forums serve to both better inform the public of the available options
7 and provide a way for policymakers to assess support for proposed policies. This work uses a
8 pilot study in Pittsburgh to generate hypotheses regarding how a deliberative democracy process
9 affects residents' perceptions of and support for City-wide energy policies to address climate
10 change. A convenience sample completed pre and post-surveys during a Deliberative Forum:
11 "Building a Resilient Pittsburgh: Climate Challenges and Opportunities". The surveys focused
12 on knowledge, perceptions, and opinions related to the existence of climate change as well as
13 energy policies to mitigate and adapt to climate change. Results suggest that the Forum was
14 useful in shifting perceptions, but did not significantly influence objective knowledge or policy
15 support. Participants had a slight preference for energy efficiency strategies over renewable
16 energy and public information. More research is needed to evaluate deliberative democracy
17 approaches and expand these findings to a more diverse population.
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22 **Keywords:** deliberative democracy; climate; resilience; public engagement
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1. Introduction

Worldwide, 97% of scientists agree that climate change is occurring and partially caused by man [1], and yet major polling entities such as Gallup, Yale, Stanford, and Reuters consistently demonstrate that 20-50% of the US public does not agree with this statement [2]. Many strategies to mitigate or adapt to climate change exist [3-5], with varying degrees of success. For instance, the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating has very strong public support, likely due to proven savings in maintenance that translate into higher property values [6-7]. In contrast, while nuclear power has the ability to generate power with zero greenhouse gas emissions, the Fukushima disaster and related public opinion have caused major setbacks [8]. Still other newer technologies, such as carbon capture and sequestration, face significant inertia in overcoming negative opinions even with significant education [9].

Central to these difficulties is public opinion; to be successful, energy policies to mitigate and adapt to climate change clearly need significant public support. Support for energy policies is related to (1) the presentation of the policy, (2) the characteristics of the constituency, and (3) trust. Policies that are presented with incentives and have little perceived impact on behavior (e.g. efficiency measures such as driving a hybrid car) tend to be perceived as more acceptable and effective than policies that use penalties or shift behavior (e.g. curtailment measures that lead to driving less) [10-11]. In addition, studies find that greater support for mitigation policies is associated with increased knowledge and perceived local risk of climate change, trust in environmentalists, higher income, being black and being older [12-14]. Finally, citizens must trust that the implementers of a policy, whether that is government or industry, are competent and share their values [15-16]. Evidence suggests that government agencies are perceived as more credible and trustworthy when they engage citizens earlier in the decision-making process, provide an opportunity to ask questions, and demonstrate that citizen input will be taken seriously [17].

While one cannot change the characteristics of the constituency, one can affect presentation of the policy. Approaches for soliciting public opinion on policies vary with topic and audience, and include methods such as passive mechanics (e.g., comment boxes), polling methods (e.g., surveys, elections), interview methods (individual, group, etc.), and deliberative democracy [18]. Specifically, the phrase *deliberative democracy* is used to describe civic engagement practices that share a number of features, despite differences in particular protocols [19]. Participants reflect on the diversity of the communities impacted by the outcomes of the deliberation; engage in structured small-group discussions; and have an opportunity to compare values and experiences, consider a range of policy options, and engage relevant arguments and information. The goal of deliberative forums is to help participants develop an opinion informed by relevant facts, expert information, and an understanding of multiple perspectives held by others in their community. This process encourages citizens to engage in a structured discussion on polarizing issues, better informing the public and providing a way for policymakers to assess support for various proposed [20-24].

Building on previous work that has focused on college campuses [25], this work is a pilot test to explore how City government can use this process to engage citizens. This type of hypothesis-generating research serves to structure future studies. In this study, we investigate how this

deliberative democracy process shifts people's knowledge and perceptions of climate change policies. We have three primary questions:

1. Do the participants' perceptions, knowledge or opinions shift after the Forum?
2. Do participants have coherent policy preferences in terms of perceptions and preferences?
3. Do participants perceive the Forum elements as effective?

2. Methods

2.1. Procedure

On October 14, 2014, Carnegie Mellon University, the City of Pittsburgh, the Pittsburgh Environmental Council, and the Pittsburgh Climate Initiative cohosted a deliberative forum entitled "Building a Resilient Pittsburgh: Climate Challenges and Opportunities" (see Appendix A). The forum, Building a Resilient Pittsburgh, was developed to gather participants informed opinion on what policies and strategies the City of Pittsburgh should pursue to minimize and adapt to the local effects of climate change, as well as to identify which primary and co-benefits of CO₂ emission reduction strategies were important to the participants.

Protocols for this deliberative forum involved five elements: (1) participants completed a pre-survey, (2) received briefing materials on the topics to be discussed at the forum, (3) engaged in small group discussions facilitated by trained moderators, (4) had their questions addressed by a panel of experts, and (5) completed a post-survey.

Shortly after arriving at the forum, participants completed a pre-survey and were assigned to a table for small-group discussions. Moderators at each table then encouraged participants to read the briefing materials prepared for the forum (see Appendix A). The forum officially began with introductory remarks followed by a "pedagogical introduction" provided by the director of the Steinbrenner Institute for Environmental Education and Research (see Appendix C). This introduction explained the extent and human cause of global temperature increases, and provided an overview of the projected impact of CO₂ emissions reductions. In addition, using a McKinsey Cost Curve [26] participants were introduced to the potential emission reductions, co-benefits (e.g. public health, saving money), and costs of differing strategies for reducing CO₂ emissions.

After the introduction, the moderator at each table presented an overview of the timing and agenda for the forum's small-group discussions. The agenda included discussion of four prompts (see Appendix D), with twelve minutes allocated to the discussion of each. Moderators were supplied with additional resources to support participants' discussion of each prompt (e.g., a chart detailing primary and direct co-benefits of differing strategies). At the close of the small-group discussions, participants at each table agreed on one question that the groups' members wished to ask the resource panel. In a plenary session, each table's question was addressed by the expert panel. After the plenary session, moderators asked participants to reflect on the questions and the panelists' responses before each participant completed a post-survey.

2.2. Survey questions

The pre and post-survey were each approximately 20 questions long (see Appendix B and E). For **climate change science**, we measured *perceived understanding* ("How well do you feel you understand the issue of climate change compared to the average person?") and *importance*

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4 (“How important is the issue of climate change for society?”) (Likert scale 1-5). *Climate*
5 *knowledge* was assessed via 7 true/false questions (e.g. “Reducing carbon emissions helps to
6 reduce the effects of climate change.”) and one multiple-choice question (Which energy use in
7 Pittsburgh leads to the most carbon emissions?”).
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10 For **support for energy policies**, we assessed perceptions of policy benefits as well as policy
11 support. We measured *City responsibility* (“Do you think the City of Pittsburgh has a
12 responsibility to encourage and promote strategies to deal with climate change (often called
13 adaptation)?”) for adaptation and mitigation policies (Likert scale 1-4). We measured *importance*
14 *of benefits* (“How important is each benefit when considering strategies for dealing with and
15 preventing climate change?”) for four benefits including (1) reducing carbon emissions, (2)
16 saving you money, (3) improving air quality and (4) improving water quality (Likert scale 1-4).
17 We assessed *benefits knowledge* (“How effective is increasing renewable energy (such as wind
18 and solar) at achieving these benefits?”) for three strategies including (1) renewable energy, (2)
19 energy efficiency, and (3) information (Likert scale 1-5). We solicited *policy support* (“Do you
20 think the City of Pittsburgh should do any of the following?”) differently between the pre and
21 post survey (Likert scale 1-5). The pre-survey included strategy categories (renewable energy,
22 energy efficiency, information) while the post-survey assessed specific strategies (e.g. “Use solar
23 energy on all City buildings with solar access by 2020.”). In addition, we assessed *willingness to*
24 *pay* for a stormwater utility fee (“Would you be willing to pay a similar monthly fee in
25 Pittsburgh?” (Likert scale 1-4).
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31 For **forum evaluation**, participants reported their perception of the individual elements of the
32 forum, which included the written materials, small group discussions, and expert panel. We
33 measured *positive experience* via 4 questions (“To what degree did participating in this
34 conversation feel engaging? Enjoyable? Intellectually stimulating? Frustrating?”), where
35 “frustrating” was reverse coded (Likert scale 1-4). The questions were combined into a single
36 score, with a Cronbach’s alpha of 0.64. We measured the *effectiveness of the discussion* via 6
37 questions (e.g. “Did the small group deliberation broaden your understanding of the challenges
38 of climate change?”) (Likert scale 1-4), which were combined into a single score with a
39 Cronbach’s alpha of 0.88. We measured *effectiveness of panel* via the same 6 questions and
40 combined them into a single score with a Cronbach’s alpha of 0.89. We also assessed *perceived*
41 *usefulness* of each element (e.g. “How informative did you find the written materials?”) (Likert
42 scale 1-4).
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47 In addition, we measured *demographic information* in the pre-survey. In the post-survey, we
48 measured *trust* (“To what degree do you trust the following groups in the context of the issues
49 discussed today?”) (Likert scale 1-4) and *pro-environmental attitudes* via a shortened New
50 Ecological Paradigm (NEP) scale [12]. Surveys were administered via paper, and double coded
51 to minimize interpretation errors.
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54 2.3. Sample

55 We recruited 75 participants in a convenience sample from both Carnegie Mellon University and
56 the Pittsburgh area via advertisements on mailing lists for neighborhoods, interest groups,
57 courses and departments. All participants over age 18 were invited to participate in pre and post-
58 surveys focused on knowledge, perceptions, and opinions related to climate change as well as
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mitigation and adaptation strategies. Of these, 60 participants completed the post-survey. Based on the pre-survey, 55% of participants were affiliated with Carnegie Mellon University. The average age was 34.9 ($SD = 18.2$) and ranged from 18 to 75. The participants were 49.3% female and 27.5% non-white. Most participants identified as either a Democrat (34.7%) or Independent (33.3%). The sample was very well educated, with 34.7% having completed a graduate degree. Participants also tended to have pro-environmental views, with a mean New Ecological Paradigm score of 3.96 out of 5 ($SD = 0.64$).

3. Results

Paired t-tests were conducted to assess changes between the pre and post-surveys for each variable. We examined changes in understanding and perceptions of climate change as well as support for policies to mitigate and adapt to climate change impacts. In addition, we assessed correlations between the effectiveness of forum elements, including the written materials, small group discussions, and resource panel, and observed changes in perceptions over the course of the forum.

3.1. Understanding and Perceptions of Climate Change

After the Forum, participants reported a higher perceived understanding of climate change ($M=3.96$, $SD=0.99$ vs. $M=4.37$, $SD=0.64$), $t(59)=3.86$, $p<.001$. In addition, participants felt that climate change was a more important issue, ($M=4.81$, $SD=0.49$ vs. $M=4.85$, $SD=0.48$), $t(59)=2.06$, $p=.04$, and more likely to affect them personally, ($M= 4.32$, $SD= 1.00$ vs. $M=4.66$, $SD=0.69$), $t(59)= 2.96$, $p=.005$. There was no change in perceived likelihood of local impacts ($M = 4.69$, $SD = 0.65$), $p > .05$, although, in the post-survey, more participants acknowledged that most of the climate change impacts would be far from Pittsburgh, ($M = 2.27$, $SD = 1.29$ vs. $M = 2.57$, $SD = 1.53$), $t(58) = 2.89$, $p=.006$.

The change in knowledge scores for the pre-test ($M=0.63$, $SD=0.25$) and post-test ($M=0.58$, $SD=0.35$) was not statistically significant, $p>0.05$. However, performance significantly improved for the question on scientific disagreement, ($M = 0.73$, $SD = 0.45$ vs. $M = 0.82$, $SD = 0.38$), $t(57) = 2.06$, $p=.04$. Figure 1 shows how accuracy and confidence (implied by the percent of participants who reported being “not sure”) varied across the true/false knowledge questions. Overall, participants performed better on the concept statements (e.g. “Humans are currently experiencing the effects of climate change”) and struggled with statements about specific impacts (e.g. “The summer of 2014 had the highest average temperature for the entire globe”). It is of note that participants were generally more confident, but wrong, regarding the influence of natural events on climate change. For the multiple-choice question on source of emissions, significantly more participants correctly identified that electricity use was the main source of carbon emissions after the forum, ($M = 0.47$, $SD = 0.50$ vs. $M = 0.74$, $SD = 0.44$), $t(57) = 4.32$, $p<.001$. This is primarily attributed to participants shifting their answer from gasoline to electricity use.

3.2. Support for Energy Policies

Participants felt that the City of Pittsburgh has a responsibility to invest in both adaptation ($M = 3.85$, $SD = 0.41$) and mitigation ($M = 3.83$, $SD = 0.42$) strategies. Participants rated the importance of various benefits when considering strategies for climate change. The benefits, in order of importance, were (1) reducing emissions, (2) improving water quality, (3) improving air

quality, and (4) saving money. Although there was no change in importance of improving water quality ($M = 3.79$, $SD = 0.41$) and air quality ($M = 3.78$, $SD = 0.42$), the importance of reducing emissions, ($M = 3.86$, $SD = 0.35$ vs. $M = 3.95$, $SD = 0.22$), $t(59) = 2.06$, $p = .04$, and saving money increased in the post-survey, ($M = 2.87$, $SD = 0.86$ vs. $M = 3.24$, $SD = 0.70$), $t(59) = 3.83$, $p < .001$.

Participants also rated the effectiveness of different strategies at achieving the benefits. As shown in Figure 2, energy efficiency was perceived as the most effective strategy, closely followed by renewable energy. Increasing public information was perceived as the least effective, except for saving money. However, the perceived effectiveness increased for the public information strategy across all benefits in the post-test. There was little change in perceived effectiveness for energy efficiency and renewable energy. However, there was a small significant increase in the post-test for renewable energy in achieving reduced emissions and saving money.

As shown in Figure 3, participants had a slight preference for energy efficiency strategies over renewable energy and public information. In addition, participants supported a stormwater fee ($M = 3.52$, $SD = 0.69$). There was no evidence of a shift in support after the Forum, $p > .05$. As summarized in Table 1, support for strategies was strongly correlated with perceived environmental effectiveness. The only strategy support associated with perceived effectiveness for saving money was online tools. In considering information providers, participants perceived scientists at universities and environmental groups ($M = 3.57$, $SD = 0.60$) as much more trustworthy than government and industry groups ($M = 1.60$, $SD = 0.63$) in the context of climate change issues.

3.3. Perceived Effectiveness of Forum Elements

Participants who perceived the forum more positively tended to report improved understanding across all elements, particularly for the small group discussion and resource panel (Table 2). The usefulness of the written materials was most closely associated with the usefulness of the small group discussions in increasing understanding. There was a weaker correlation with the usefulness of the panel. Participants who found the small group discussion informative, tended to also report that the discussion improved their understanding of the issues. The same was true for the resource panel.

We found weak correlations between perceived effectiveness of the forum elements and observed changes in perceptions. Participants who found the discussion more informative tended to have a slightly higher change in perceived understanding of climate change after the Forum, $r(51) = 0.28$, $p = .046$. Participants who found the panel more informative tended to have a slightly higher change in importance of saving money, $r(50) = 0.32$, $p = .024$. No other changes in perceptions were correlated to perceived effectiveness of forum elements.

In addition to the surveys, some information about the effectiveness of the Forum's elements comes from a brief moderator de-briefing session. As a group, moderators were asked to provide their reflections on the participants' engagement and on how the participants' responded to the different elements of the Forum. In general, moderators indicated that the participants were able to engage one another in productive conversations, which involved individuals sharing reasons

from multiple perspectives. Generally, too, moderators suggested that the participants found the different elements of the Forum helpful in ways that facilitated their discussions. However, several moderators indicated that participants found it difficult to make connections between the contents of the pedagogical introduction and the prompts on the agenda for the small-group discussions.

4. Discussion & Conclusion

This work highlights preliminary findings from a pilot study of a Deliberative Forum designed to solicit public opinion on City energy policies in response to climate change. Participants participated in small group discussions and asked questions of an expert panel in order to encourage informed opinions regarding climate change issues and City priorities. We evaluated perceptions, knowledge, and opinions via a pre and post survey to identify any shifts that could be related to participation in the deliberative forum. We evaluated the responses to identify (a) shifts in perceptions, knowledge, and opinions, (b) correlations between perceptions of policies and policy support, and (c) correlations between perceptions of forum elements.

Participation in the forum was associated with increased perceived understanding, importance of climate change, and likelihood of personal impacts. This suggests that the Forum may have been effective in making climate change seem more salient and relevant to the participants. This effect may have been heightened due to the use of a convenience sample that tended to be pro-environmental. Participants rated climate change perceptions above the scale midpoint before the Forum, so the Forum may have amplified existing perceptions. Nevertheless, the use of deliberation may provide an opportunity for anti-environmental individuals to make pro-environmental choices [27].

Participants' objective knowledge scores did not significantly shift before and after the Forum. Although there was no observed change in overall knowledge score, performance improved for specific questions and uncertainty decreased. However, misconceptions seemed to persist. For example, even after the Forum, approximately half of the participants still considered natural events to be a major cause of climate change. This suggests that more work is needed to identify these types of pervasive misconceptions and develop educational materials to address them. Existing methods, such as mental models [28], have been developed to assess and develop materials in such cases. Integrating these types of materials into the written materials and moderator training may improve the effectiveness of Deliberative Forums.

The Forum did not appear to influence policy support. Participants rated both the perception of policies (in terms of importance of benefits and effectiveness of policies) and the policies themselves. Given the pro-environmental stance of the participants, it is not surprising that they rated reducing carbon emissions as the most important benefit and saving money as the least important overall. However, after the Forum, participants rated saving money as a more important benefit. Energy efficiency strategies were perceived as effective across all benefits, with no change after the Forum. Renewable energy strategies were perceived as effective in achieving environmental benefits, but the least effective in saving money. This effect was amplified in the post-survey. Public information strategies were perceived as least effective in achieving the environmental benefits, but perceptions of effectiveness increased across all benefits in the post-survey. This shift may have been related to the use of more specific examples

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4 in the post-survey, which seemed more effective than a broad notion of increasing access to
5 information.
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8 More broadly, the Forum was effective in showing how this type of meeting can be used to
9 identify City priorities for energy policies to address climate change. Participants reported that
10 the City of Pittsburgh has a responsibility to invest in both adaptation and mitigation strategies.
11 Results indicated that there was higher support for policies related to City operations, such as
12 installing LED streetlights and investing in Energy Star certification. In addition, there was
13 slightly higher support for energy efficiency policies over renewable energy and public
14 information campaigns. Participants tended to support strategies that they perceived to be more
15 effective. However, policy preferences may shift as goals shift. For example, participants rated
16 saving money as the least important benefit, but other groups may perceive it as the most
17 important.
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21 The results suggest that the small group discussions and resource panel have different benefits
22 and encourage reflection on different aspects of the issues. Although more research is needed to
23 draw any conclusions, small group discussions may not be as effective alone. Reflecting on these
24 difficulties, moderators suggested that the organization of information in the pedagogical
25 introduction and the agenda for the small-group discussions be more closely aligned; they also
26 suggested that the sequencing of the prompts for the small group discussions should be re-
27 evaluated.
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31 Cities are in an advantageous position to address climate change across the world. Cities are able
32 to implement changes to reduce carbon emissions more easily than state and federal agencies due
33 to fewer barriers (both legal and political) and the smaller scale of infrastructure [29-30].
34 Although this work focuses on the City of Pittsburgh, other cities across the U.S. and the world
35 face similar challenges in reducing carbon emissions. While Pittsburgh can best reduce carbon
36 emissions by reducing electricity consumption (due to the fossil fuel intensive grid in the region),
37 other places may benefit from focusing on other levers such as shifting transportation modes
38 [31].
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42 Given the nature of this convenience sample, more research is needed to extend these results to a
43 broader population. This sample was highly educated and environmentally aware, which is
44 associated with support for climate change policies [12, 14]. Although the design precludes any
45 causal analysis, we were able to generate hypotheses. Future work should examine the effect of
46 the protocol's elements, both in isolation and in their relation to one another, use a random
47 sample, and explore improved methods for correcting misconceptions.
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FIGURES

Figure 1. Climate change knowledge questions. Although participants were very confident and performed well on most concept questions, they struggled with fact questions that focused on a specific time or place.

Figure 2. Ratings of effectiveness of strategies at achieving benefits for pre and post survey. Overall, increasing public information was perceived as the least effective, except for saving money. A ranking of 5 is highest and 1 is lowest.

Figure 3. Support for specific climate change policies categorized as energy efficiency, renewable energy, or public information. The specific strategies included (f) install LED streetlights in business districts, (e) install LED streetlights in residential districts, (d) cooperative purchasing program, (b) City purchase 25% renewable, (g) Energy Star certification for City-County building, (i) commercial building energy disclosure, (h) energy efficiency loans, (j) online tools, (c) 10MW renewable capacity, and (a) solar energy on City buildings. A ranking of 4 is highest and 1 is lowest.

TABLES

Table 1. Pearson correlations between perceived effectiveness of strategies and strategy support. Perceptions of environmental effectiveness (emissions, air quality, water quality) were highly correlated with strategy support.

Strategy Support		Perceived Effectiveness of Strategy			
		reducing emissions	saving money	air quality	water quality
Renew. Energy	City install solar energy (a)	0.46***	-0.01	0.46***	0.49***
	City purchase 25% (b)	0.02	0.20	0.50***	0.46***
	Install 10MW in city (c)	0.26	0.18	0.44**	0.39**
	Coop purchasing program (d)	0.35**	0.12	0.19	0.26
Energy Efficien cy	LED residential streetlights (e)	0.35**	0.07	0.35**	0.38**
	LED business streetlights (f)	0.40**	-0.01	0.48***	0.55***
	Energy-Star for City-County building (g)	0.19	0.05	0.34*	0.39**
	Energy efficiency loans (h)	0.30*	0.15	0.28*	0.29*
Public Info	Commercial energy disclosure (i)	0.14	0.03	0.18	0.16
	Online tools (j)	0.49***	0.45***	0.49***	0.50***

Note: *p<.05,**p<.01,***p<.001

Table 2. Pearson correlations for forum evaluation. Participants who perceived the forum more positively tended to report improved understanding.

	1	2	3	4	5	6
1. written materials informative	1					
2. discussion informative	0.57***	1				
3. panel informative	0.12	0.34*	1			
4. positive experience	0.45***	0.57***	0.55***	1		
5. panel improved understanding	0.31*	0.3*	0.53***	0.53***	1	
6. group discussion improved understanding	0.58***	0.7***	0.24	0.53***	0.62***	1

Note: *p<.05, **p<.01, ***p<.001