Original research article

Moderating spillover: Focusing on personal sustainable behavior rarely hinders and can boost climate policy support

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A B S T R A C T

A successful climate movement must make progress on two fronts: widely adopting behavior changes to reduce emissions and achieving structural changes through climate policy. Some research has suggested people might see sustainable behavior as a substitute (rather than a complement) for climate policy. Does reflecting on sustainable behavior strengthen or undermine climate policy support? In the present research we find that reflecting on sustainable behavior rarely harms policy support. It only occurs when policies are framed as having costs fall on individuals (rather than industry) *and* when reflection on one's behavior is not connected to one's values or identity. Here, people may reject a policy because they feel they already are taking action. Conversely, reflecting on behaviors in connection to one's values or identity actually *increases* climate policy support, and leads people to feel that policies like a carbon tax, even if personally costly, reflect their values and identity.

Addressing climate change will require both climate policy support from the public and widespread changes in lifestyles. Broad inaction on both fronts has led to a steady climb in greenhouse gas emissions, which will need to decline to zero soon to stabilize carbon dioxide concentration [1]. From a behavioral science perspective, climate change is a particularly difficult problem to solve precisely because it requires people to consistently take action across many domains. In this vein, recent work has investigated how personal behavior change can influence policy support and vice versa [2–4]. Psychologists conceptualize such influence in terms of "spillover" from one behavior to the other, that is, how adopting sustainable actions helps or hurts the support for climate policy. The hope is for "positive spillover", where people undertake pro-environmental behaviors and, upon reflecting on their actions, become more likely to support climate policies like a carbon tax. However, initial research has suggested that there may be "negative spillover" in the climate domain: people who focus on their sustainable behaviors may feel like they have done enough, weakening subsequent climate policy support [4]. Economists conceptualize these two versions of reciprocal influence in terms of people's perceptions of the two actions as either complements or substitutes [5], with complements enhancing each other (like the three courses of a meal, where the joint utility is larger than the sum of its parts), but substitutes taking away from each other (like multiple desserts might, if you only have room for

one). Do people think about behavior change and policy support as complements or substitutes? Under what circumstances do we get negative or positive spillover, and can this be avoided? Here we design multiple experiments to investigate how to foster positive spillover to facilitate progress on climate action.

The Intergovernmental Panel on Climate Change (IPCC) states we need major changes to how we use energy, land, and other natural resources to stabilize atmospheric carbon dioxide concentration [1,6]. Some argue this could be accomplished solely with changes in macroeconomic policy without targeting consumer behavior. For example, citing that just 100 companies are responsible for 70% of emissions from fossil fuel extraction [7] suggests that policies targeted at corporate action could remedy the situation. This perspective often argues that, at best, lifestyle changes make a small difference, and at worst they distract from climate policy which is the only consequential goal [8,9]. However, an estimated 80% of CO_2 emissions occur because of consumer demand [10], highlighting that these companies have a large carbon footprint precisely because individuals are purchasing their goods or services. This has led others to argue that behavior and lifestyle change will play a substantial role in meeting emissions reduction targets through campaigns of change that may or may not formally be incorporated into policy [11,12]. And that, while individual behavior changes alone are not sufficient to address climate change, they will be a

necessary part of the effort to change our use of resources and the embedded systems we find ourselves in.

To model pathways to stabilize CO_2 concentration, a range of socio-economic storylines were developed to assess what would need to happen for stabilization (Shared Socioeconomic Pathways or SSPs). Notably, many of these storylines require substantial behavior change such that consumption will be "oriented toward low material growth and lower resource and energy intensity" [13]. Without behavior change, there is greater need to depend on technologies like carbon capture and storage, which still need to be tested at scale and have uncertain feasibility [14,15]. In addition, some areas cannot be decarbonized without behavior changes or changes in consumer preferences, such as aviation, long distance transport, and quickly electrifying transportation [16].

Beyond these technical limitations that necessitate behavior change, voluntary behavior change may be favorable to regulating change by policy for ethical and pragmatic reasons in many high-impact decision domains, such as which food one eats, how one uses energy in one's home, and how many children one has [17]. Even in contexts where policy solutions are viable and ethical, many require successful behavior change, such as adoption of new technologies or participation in energy programs.

Given that behavior change will be required to successfully mitigate climate change, it is important to ensure that behavior change efforts are seen as complements rather than substitutes for support of key climate policies. Correlational research finds that people who take personal actions for the environment are more likely to support climate policies and take political action for the environment [18–20], and this relationship holds when controlling for demographic and socio-political variables like past policy support. But experimental investigations that preclude possible endogeneity are scant[1]. One recent experimental study found that survey respondents in Japan asked to reflect on energy saving behaviors they had undertaken (by selecting them in a checklist) were subsequently less likely to support a policy that would raise the national carbon tax [4]. While an important test of spillover in this domain, many key questions remain: Should we generally expect negative spillover for policy support as a result of reflecting on sustainable behavior, or are there boundary conditions for this effect, such as the specific policy in question, different presentations of the same policy, or different ways of prompting consideration of past behavior? And critically, is positive spillover in this domain possible?

To help answer these questions, we first explore under what circumstances we should expect spillover effects. How people choose to act in social dilemmas (where private interests may be at odds with public interests) is guided by many factors—some of which rise to conscious awareness while others do not [22,23]. One motivator is to be consistent with past behavior, thereby allowing people to maintain coherent relationships between their actions, attitudes, and beliefs [24]. People also infer their own attitudes and beliefs from their actions [25] (i.e. 'If I do that action, I must like that action or support that cause.'). These tendencies suggest that positive spillovers should be a common phenomenon, such that actions in one domain increase the odds of performing subsequent related actions and increasing related beliefs. On the other hand, "moral licensing" may be a barrier—that after accomplishing one action, it's also possible that people will feel entitled to take no further action and instead rest on their laurels [26]. This sense of entitlement may not only spur inaction, but also motivate taking selfish actions or acts that go against the implicit goal of the prior good deed [27,28] (e.g., eating cake after exercising), making for negative spillover.

Given that both consistency and licensing effects can govern people's actions, what determines which will occur and whether people will

exhibit positive or negative spillover? A theoretical and empirical analysis of spillover in environmental domains find that the way or mode by which we make initial decisions determines how they affect subsequent decisions: role-based decisions—made by considering values, identities, and roles and the rules of conduct associated with them—are more likely to result in positive spillover, while affect-based decisions—made to reduce negative emotions like guilt or fear—are more likely to result in negative spillover [2]. This work has a number of parallels to theoretical reviews on consistency and licensing effects, which find that consistency is more likely to occur when people think of their prior behavior in abstract ways that reflect commitment to goals, values, and self-identity, while licensing is more likely if prior behavior is thought of in more concrete terms that are void of connections to one's values or sense of self [29].

Given this understanding of spillover, we should expect some variability in when and why positive or negative spillovers occur. In the previously mentioned study that reported negative spillover from energy saving behavior to a carbon tax support, participants were instructed to use a concrete method of reflecting on their sustainable behavior: checking specific energy saving actions off a list if they did them [4]. We expect that after reflecting on many sustainable actions taken, an environmental policy with personal costs may seem unfair, as one has already done a great deal, almost as if being punished for doing a good deed (i.e. "I already do a lot—and now I have to pay more?"). By contrast, if people were to connect their pro-environmental actions to their values and identities, they might feel that even a policy with individual costs is in line with these qualities, possibly increasing policy support. We hypothesize that only having a checklist reflection task is likely to result in negative spillover, whereas a checklist task that is accompanied by deeper reflection that internalizes these actions (by connecting them to values, identities, or societal outlooks) may result in positive spillover.

Further, we might expect that the way the policy is framed may matter [30]. Specifically, research finds that negative spillover may be more common when the subsequent action or cause is seen as costly [2]. A carbon tax, the policy previously examined in spillover research, can be framed as either having costs fall on the individual, or as costs falling on industry (who then may pass it on to consumers)—but the former may feel more costly to the individual than the latter. When costs are discussed as falling on the individual, such as translating the cost into a dollar amount per home per year, these policies emphasize tangible personal expenses, which may lead to the aforementioned feeling that the policy is unfair if one already undertakes many pro-environmental actions, leading to negative spillover. By contrast, describing a policy in terms of costs to industry may avoid this feeling, since it feels like industry is now being asked to contribute, capitalizing on a sense of reciprocity [31] (i.e., "I already do a lot—industry should do its part too."). We hypothesize that a carbon tax framed as having costs fall on the individual will result in negative spillover, but framing costs as falling on industry will not show negative spillover, and may even produce positive spillover (see Table 1 for all hypothesized predictions).

In two online studies, designed to parallel the methodology of the original work that found negative spillover from personal behaviors to policy support, we surveyed participants about their sustainable behaviors and about their support for a state-level carbon tax in their home state. Respondents were residents from states served by the nation's largest energy grid operator in the U.S. (the PJM Interconnection) which serves much of the northeast and midwestern U.S.

1. Study 1: Impacts of reflection tasks and policy frames

In Study 1, Participants were assigned to one of six conditions in a 3 (reflection task type) by 2 (policy framing) design. Participants either completed a reflection task where they checked off each sustainable behaviors they had previously engaged in from a list of 13 common sustainable behaviors (referred to as "reflect only"), a reflection and

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[1] Notably, one experimental study finds partial evidence that positive spillover from sustainable behavior to certain political actions may be possible, as observed in a relatively small sample (N=125)[21].

Table 1
Hypothesized spillover outcomes by policy features and type of reflection.

Reflection[a]	Policy Framing[b]	
	Costs Fall on Individual(high / salient personal costs)	Costs Fall on Industry(low / not salient personal costs)
Reflect Only(acts not connected to values / identity)	● Decrease in policy support ● Increase in feeling "policy is unfair because I already do a lot"	● No decrease in policy support (possible increase) ● No increase in feeling "policy is unfair because I already do a lot" ● Increase in feeling "industry should do it's part too"
Reflect & Internalize(acts connected to values / identity)	● Increase in policy support relative to baseline & only reflecting ● Decrease in feeling "policy is unfair because I already do a lot" ● Increase in feeling policy reflects values and identity	● Like only reflecting, no decrease in policy support (possible inc.) ● No increase in feeling "policy is unfair because I already do a lot" ● Increase in feeling "industry should do it's part too"

Note: Unless otherwise stated, all expected spillover effects, "increases/decreases", are relative to baseline support for a policy with that frame if they did not reflect on their sustainable actions.

[a] Hypotheses pertaining to reflection with and without internalization are primarily derived from theories on consistency and licensing effects [29].

[b] Hypotheses about policy frames including whether notable perceived costs are framed as falling the individual or not, are derived from theories of spillover in environmental domains [2].

internalization task where they did the same reflection task but were also asked to reflect on how those behaviors related to their values in a free response question ("reflect and internalize"), or a control with no reflection. Then participants were asked about their support for the carbon tax, framed either as having costs fall on individuals or on industries ("individual-framed" and "industry-framed", respectively).

2. Methods

2.1. Participants

Adults ($N = 3373$) were recruited from Amazon Mechanical Turk for a "6–9-minute Psychology Survey" for $0.95. Each participant had a unique IP address from a state in the PJM Interconnection, which includes Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia. This sample achieved two goals: 1) to see if spillover effects could be found in a major US context, and 2) to inform the development of climate policy interventions that are being designed specifically for PJM states. After drop criteria (discussed below) the target sample size was 3000 participants (500 participants per condition), which would be 80% powered to detect effects as small as d = 0.18 in policy support.

To address quality concerns regarding possible "bot," "click-farm," and other suspicious survey activity observed on Amazon's Mechanical Turk [32], we coded participants' responses for potential evidence that participants were not from the U.S. using geolocation information and free response quality. Two independent coders were told to examine two criteria before any data analysis was undertaken to determine if the MTurk participant came from the United States or was participating from an international "click farm". First coders examined whether participants shared the same geolocation with other participants (which could be an artifact of using a proxy server used to get around the survey location qualifications). Second, coders scrutinized participants' free responses in the survey for a failure to answer in a coherent fashion (e.g. entering numbers or gibberish, very poor grammar, copying and pasting the survey text in the answer, etc.). If both were determined to be questionable, coders marked the participant as likely being from a click farm and/or being outside the U.S.. Coders achieved a high reliability (Kappa = 0.97). This method is similar to others that have been used in research and validated [33,34]. Out of our total sample, 3.0% (1 0 0) responses were coded as likely coming from non-U.S. participants and were dropped from analysis.

We also included a very simple attention check. After participants indicated their support for the carbon tax, we asked them what the

policy was they had been asked about. There were seven options, including a carbon tax and six others which were in completely different policy domains (e.g. immigration). Participants who failed the attention check (2.8%) were removed from analyses. We find no significant condition differences for whether participants passed the attention check χ^2 (5, N = 3373) = 6.10, p = 0.297, or for the click farmer coding, χ^2 (5, N = 3373) = 1.66, p = 0.894. We also find that leaving in these participants did not change the primary results (see Supplemental Note 1)

Of the 3,182 participants remaining, 55.4% self-identified as female, 44.0% as male, and 0.5% as non-binary. The mean age for participants was 38. The median household income was $40,000-$80,000 and the median education level was holding a college degree. In political orientation, 48.3% of participants self-identified as liberal, 22.6% as moderates, and 29.1% as conservatives. Compared to the general U.S. population, this sample is, on average, younger, more educated, more liberal, and more female [35]. While not a representative, this sample has substantial diversity and is well-suited to answer our research questions.

2.2. Procedure

In the first portion of the study, participants were randomly assigned to one of three behavioral focus conditions: 1) a reflection task where they were asked to report which behaviors they did to help conserve natural resources using a checklist, 2) a reflection and internalization task where they completed the same checklist task, but also were asked an open ended question about how these behaviors related to their values, and 3) a control that had no reflection task.

In the reflection task participants were asked "Which of the following actions do you take to conserve energy? (Select all that apply.)" and shown a list of 13 behaviors in a checklist. These included actions such as "Use low energy light bulbs (such as CFLs, LEDs)", "Using your heating and cooling less when you are not at home", "Avoid using the coldest setting on the fridge", "Turn off fans when leaving the room". These actions were found to be some of the most common sustainable behaviors in pilot research and participants could select as many (or as few) as they wished. In the reflect and internalize condition, participants were then additionally asked to connect these actions to "your values and who you are" and write 1–2 sentences on this prompt.

Next, participants were randomly assigned to see one of two state-level carbon tax measures–either an individual-cost or industry-cost framed carbon tax. Both measures pertained to a potential carbon tax in their home state that were $50 per metric ton of CO_2 emitted and were expected to reduce emissions by 40%. The individual-cost framed carbon tax emphasized that individuals would have to pay more for goods

and services that produced carbon emissions as a result of the tax, including the expected cost per household. The industry-cost framed carbon tax emphasized that industries that produced carbon emissions would have to pay for these emissions as a result of the tax, and included a list of specific types of industries that greatly contribute to carbon emissions (e.g. the cement industry). For example, participants in the individual-cost frame condition read:

The [insert participant state] Carbon Tax is a policy that aims to avoid the negative outcomes of climate change by reducing our use of fossil fuels.

If individuals do not reduce their use of energy that comes from fossil fuels like coal, oil and natural gas, they will have to pay for the carbon dioxide emitted. This will cost individuals $50 per metric ton of carbon dioxide emitted. While the amount each person pays would depend on how much they conserve, this policy is expected to increase the cost for the average consumer by around $60 each month. This policy is expected to reduce emissions by roughly 40%.

Participants were asked how much they supported or opposed the tax on a 7pt scale (*Strongly oppose - Strongly support*).

Following this, participants were then asked about their perceptions of the law and emissions reductions. This included asking to what extent they agreed to three statements: 1) that "Raising costs on carbon emissions feels unfair to me because I already do many things to conserve natural resources.", 2) that "This law reflects my values that it is important to conserve natural resources.", and 3) that "People do a lot to conserve energy, and I believe industry should do its part too.". Each item was answered on a 7pt scale (Strongly disagree- Strongly agree). Participants were then given the attention check measure previously mentioned.

Next, participants were asked five items about their beliefs about the role of behavior and policy in addressing climate change more generally. Specifically, they were asked whether lifestyle changes, policy changes, both or neither were required to address climate change using a categorical measure. Then, all participants were asked four additional continuous measures. One asked if they believed that lifestyle changes make policy changes to address climate change unnecessary. Another asked the inverse: if they believed policy changes make lifestyle changes to address climate change unnecessary. They were also asked to what extent they believed both were needed, and to what extent neither were needed to address climate change. Next, participants were asked how important climate change was to them personally, and how central it was in determining how they will vote in national, state, and local elections. We asked participants these five items and analyzed them all separately because we wanted to assess whether there was any discernible change on these general measures in how people feel about the necessity of climate policy versus lifestyle change as a result of reflecting on one's behavior.

Then participants were asked about a policy issue that did not have direct financial costs: they were told about the benefits of large high voltage transmission lines in terms of energy efficiency, and asked how willing they would be to have these large power lines visible from their home, using a 7pt scale (*Very unwilling* to *Very willing*). In the final portion of the survey, participants completed demographic measures (See Supplemental Note 8 for the full survey text).

3. Results

3.1. Support for a carbon tax

Fig. 1 (panel A) shows the support for the carbon tax by condition in Study 1. As expected, we replicated the negative spillover effect previously reported [4]: comparing the two leftmost conditions plotted, participants who reflected on their sustainable actions and were shown a tax framed as having costs fall on the individual had lower support for the carbon tax as compared to participants in the no reflection control, t (3176) = -2.84, $p = 0.005$, $d = -0.16$, 95% CI of d = [-0.28, −0.04] (see Supplemental Fig. 1 and Supplemental Note 2 for moderation analyses by political orientation and number of environmental actions reported, respectively).

However, as hypothesized, there appear to be multiple boundary conditions that neutralize this effect. First, when individuals reflected on their sustainable behaviors in a way that allowed them to internalize these actions, there was no decrease in policy support for the individual-framed policy compared to the control group, t(3176) = 1.10, $p = 0.273$, $d = -0.06$, 95% CI of d = [-0.18, 0.06] (this is also true of the industry-framed policy). Notably, for the individual-framed policy, reflecting on and internalizing one's behavior led participants to have significantly greater support than simply reflecting on behavior via a checklist, t (3176) = 3.93, $p < 0.001$, $d = 0.23$, 95% CI of d = [0.11, 0.35]. Second, for the industry-framed carbon tax, reflecting on one's sustainable behavior—even without any internalization—shows no reduction in policy support t(3176) = -0.57, $p = 0.569$, $d = -0.04$, 95% CI of d = [-0.15, 0.08]. Additionally, comparing the two control groups, we find that framing the policy as having costs fall on industries that emit

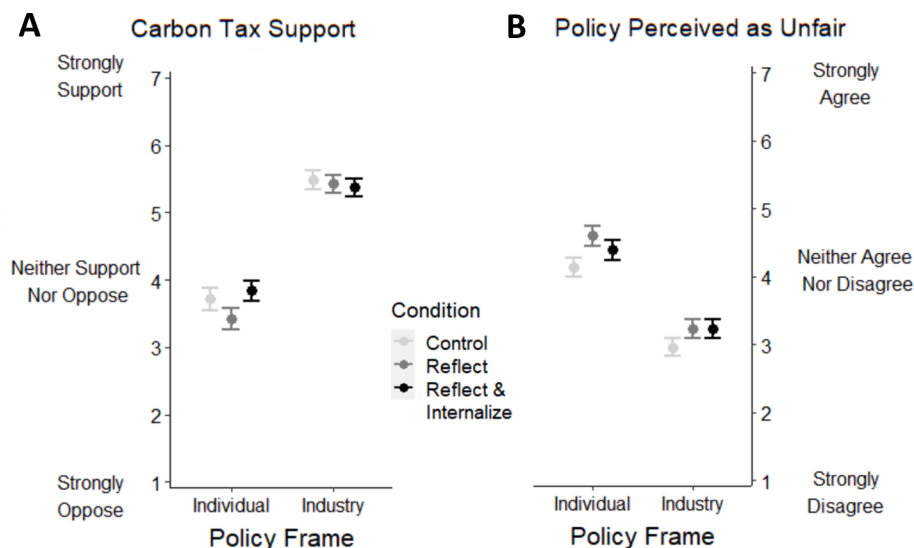**Fig. 1.** Panel A: Mean support for climate policy depends on how one reflects on sustainable acts and policy frame. Panel B: Perceptions of climate policy being unfair depends on how one reflects on sustainable acts and policy frame. Error bars represent 95% confidence intervals.

Table 2
Attitudes towards policies across conditions in study 1.

Policy Attitudes	Individual-Framed Policy			Industry-Framed Policy		
	Control	Reflect Only	Reflect & Internalize	Control	Reflect Only	Reflect & Internalize
Policy feels unfair as one already takes action	4.13	4.60	4.39	2.96	3.23	3.23
	(1.72)	(1.70)	(1.75)	(1.62)	(1.65)	(1.69)
Policy reflects one's values	4.69	4.56	4.50	5.41	5.28	5.32
	(1.73)	(1.62)	(1.71)	(1.54)	(1.49)	(1.48)
Endorses "industry should do its part too"	6.04	6.13	6.12	6.00	6.04	6.07
	(1.23)	(1.17)	(1.16)	(1.32)	(1.24)	(1.20)

Note: values are condition means with standard deviations in parentheses.

carbon, rather than on individuals, improves support, $t(3176) = 16.60$, $p < 0.001$, $d = 0.98$, 95% CI of d = [0.86, 1.11].

3.2. Attitudes towards policy

Table 2 shows the levels of policy attitude measures across conditions. As seen in Fig. 1 (panel B), participants in the reflect only condition more strongly felt that the individual-framed policy was unfair because they already did many things to conserve resources compared to the control, $t(3176) = 4.48$, $p < 0.001$, $d = 0.27$, 95% CI of d = [0.15, 0.39], and this statistically mediates the condition differences in policy support between these conditions (see Supplemental Note 3). Participants in the reflect and internalize condition also more strongly felt this way, as compared to the control, $t(3176) = 2.44$, $p = 0.015$, $d = 0.15$, 95% CI of d = [0.02, 0.27], but felt less so as compared to the reflection only condition, $t(3176) = -2.04$, $p = 0.041$, $d = 0.12$, 95% CI of d = [0.00, 0.24]. Comparing the two control groups, we find that framing the policy as having costs fall on industries reduces this feeling that the policy is unfair, $t(3176) = -11.43$, $p < 0.001$, $d = 0.70$, 95% CI of d = [0.58, 0.83].

Contrary to expectations, those in the reflect and internalize condition felt that the individual-framed policy did not reflect their values as strongly as those in that policy's control, $t(3176) = 1.98$, $p = 0.048$, $d = -0.11$, 95% CI of d = [-0.23, 0.00]. One possible explanation is that roughly one-third of participants explicitly mentioned "money" as a motivating factor in their values related to conservation behavior. Hence, a law that will likely cost oneself more money could be seen as contrary to one's values of frugality. Comparing the two control groups, we find that participants in the industry-framed group felt the policy reflected their values more strongly, than those in the individual-framed group, $t(3176) = 7.36$, $p < 0.001$, $d = 0.44$, 95% CI of d = [−0.31, −0.56].

While the industry-framed policy control group had greater appeal in terms of not feeling unfair and better reflecting people's values, it did not lead people to feel more strongly that industry should "do its part too" compared to the individual-framed control, $p > 0.60$, -d = 0.02, 95% CI of d = [−0.15, 0.09]. However, this measure was near its ceiling, making it difficult for the industry-framed question to improve on this metric.

3.3. Support for a (non-pecuniary) policy: High voltage transmission line visibility

Do we see spillover with other climate policies, such as those that do not involve financial costs to the individual? To answer this question, we examined a willingness to have high voltage transmission lines closer to one's home to improve the energy grids efficiency, which has no direct financial costs, but may have aesthetic costs, and is important to climate policy as high voltage transmission lines improve transmission efficiency and flexibility for increased intermittent energy generation from renewables [36]. We find that reflecting on one's sustainable behavior had no effect on participants' willingness to have high voltage transmission lines visible from their home comparing those in the control (M = 4.59, SD = 1.71) to those in the reflect condition (M = 4.55, SD =

1.64), d = 0.02, 95% CI of d = [-0.06, 0.11], or to those in the internalize condition (M = 4.54, SD = 1.68), d = 0.03, 95% CI of d = [-0.06, 0.11], all ps > 0.50.

3.4. Beliefs about mitigating climate change via policy and lifestyle change

Beyond specific policies, we also assessed whether reflecting on one's sustainable actions led to changes in explicit attitudes towards the role of lifestyle and policy support in addressing climate change. We find that reflecting on one's behavior also did not have any impact on participants' beliefs that both lifestyle and government action were needed to address climate change. Across all three reflect conditions, >85% of participants reported categorically that both lifestyle changes and policy changes were needed to address climate change. Further, we find this did not differ by reflection condition, $\chi^2(6, N = 3182) = 7.03$, p = 0.318. Additionally, in independent continuous Likert items, participants across conditions expressed both policy and behavior change were needed to a great extent (M = 3.89 out of 5 point scale, SD = 1.23), and neither the reflection nor internalization condition differed from the control, all ps > 0.280, all ds < 0.05. Across all conditions, participants generally did not feel that lifestyle changes would mean that policy changes were not needed to address climate change (M = 1.74, SD = 1.16), or vice versa (M = 1.74, SD = 1.10), or that neither were needed to address climate change (M = 1.54, SD = 1.09). In all three cases, the median response was "not at all", and these ratings did not vary between either reflection task and the control, all ps > 0.180, all ds < 0.06.

4. Discussion

In Study 1, we find that negative spillover from behavior to policy like a carbon tax only occurs when such a policy is framed as having high costs fall on the individual and when reflecting on one's pro-environmental actions is done without being internalized. Only when both of these conditions are met, people may feel a costly policy is unfair because they already do a great deal to conserve energy. In line with these findings, we do not see any negative spillover from a policy with non-pecuniary costs: tolerance for increased visibility of high voltage transmission lines. Finally, we see no evidence of a shift in people's general beliefs that policy should play an integral role in addressing climate change.

5. Study 2: Internalizing behavior can aid climate policy support

Study 2 sought to test whether a stronger internalization task than the one used in Study 1 would lead to positive spillover, rather than just no spillover. In Study 2, participants were randomly assigned to one of three conditions: a reflection only task like Study 1, an improved reflect and internalize condition, or a control. The internalization task was improved in two ways. First, given that many participants in Study 1 said that they conserve natural resources to save money (and as with such a value focus on frugality, positive spillover could lead to opposition to a carbon tax), we simply revised the internalization task instructions to acknowledge that saving money may be one motive, but

asked respondents what motives they had besides saving money. Second, even though participants in Study 1 were asked to relate their sustainable behavior to values and identities, they rarely discussed identities. To address this, we expanded the task so that participants in Study 2 were asked three separate questions—how the personal behavior they had reported related to their i) values, ii) identity, and iii) views on how people in society should be (the latter was inspired by research that shows that reflecting on societal roles and rules can lead to greater positive spillover [2]). We anticipated the improved internalization task would increase policy support compared to the control. Indeed, in a pilot for Study 2 we found the improved internalization task had significantly greater policy support as compared to a control (see Supplemental Note 4). All participants were shown the individual-framed policy from Study 1.

6. Method

6.1. Participants

Adults ($N = 1763$) were recruited from Amazon Mechanical Turk for a "3–5 min Psychology Survey" for $0.60. Each participant had a unique IP address from a state in the PJM Interconnection. After drop criteria (discussed below) the target sample size was 1635 participants (545 participants per condition), which is 80% powered to detect effects as small as d = 0.17 in policy support—roughly the size of the negative spillover effect found in Study 1.

The same methods in Study 1 to remove possible non-US click farmers were used in Study 2. Out of our total sample, 7.1% (1 2 5) responses were coded as likely coming from non-U.S. participants and were dropped from analysis. The same attention check was also used in Study 2, and 2.3% of participants failed and were removed from analyses. We find no significant condition differences for whether participants passed the attention check χ^2 (2, N = 1763) = 4.85, p = 0.089, or for the click farmer coding, χ^2 (2, N = 1763) = 0.82, p = 0.665. We find including these participants does not change the primary results (see Supplemental Note 5).

Of the 1,599 participants remaining, 56.8% self-identified as female, 42.4% as male, and 0.8% as non-binary. The mean age for participants was 34. The median household income was $40,000-$80,000 and the median education level was holding a college degree. In political orientation, 50.0% of participants self-identified as liberal, 23.0% as moderates, and 27.0% as conservatives. Like study 1, compared to the general U.S. population, this sample is, on average, younger, more educated, more liberal, and more female [35]. However, this sample has substantial heterogeneity and is well-suited to answer our research questions.

6.2. Procedure

Like Study 1, participants were first randomly assigned to one of three behavioral focus conditions: 1) a reflection task like Study 1, 2) a reflection and internalization task similar to Study 1, but with the addition of asking participants how these behaviors related to their sense of identity and views of how society should be, and 3) a control that had no reflection task. The reflect and internalize condition also differed in one more key way: a large portion of participants in Study 1 commented that they did not do these behaviors to help conserve resources, but instead to save money. To the extent that this condition attempts to lead people to be consistent with their values and goals, noting frugality during this measure is counterproductive since being consistent / frugal about a carbon tax would mean opposing it. Therefore, in an attempt to strengthen this manipulation in Study 2, we asked participants why they do these behaviors *besides* saving money. This led participants to report non-frugality related values.

All participants then saw the individual-cost framed carbon tax policy support measure from Study 1. This was followed by asking

participants how important climate change was to them personally, and how central it was in determining how they will vote, like in Study 1. In the final portion of the survey, participants completed demographic measures (see Supplemental Note 9 for full survey text).

7. Results

7.1. Support for a carbon tax

In Study 2, we find that this improved reflect and internalization task increased support for the carbon tax compared to the control, $t(1596) = 2.74$, $p = 0.006$, $d = 0.17$, 95% CI of d = [0.05, 0.29] (see Fig. 2). Secondly, we are not able to replicate the significant negative spillover finding from Study 1 for the reflection only task (M = 3.86, SD = 1.88), $t(1596) = -1.46$, $p = 0.145$, $d = 0.09$, 95% CI of d = [-0.03, 0.21], even under what prior work [2,4] and Study 1 suggest may be "ideal" conditions to detect this effect (see Supplemental Note 6 for moderation analysis by political orientation). In practical terms, if we examine the proportion of participants who fell on the "support" side of the scale, we find that just under half (49.8%) of the control supported the bill and 45% of the reflect only condition supported it, while 57% of the reflect and internalize condition supported the bill. We also find a positive relationship between the number of sustainable actions one takes and policy support for the reflect and internalize condition, but not for the reflect only condition (see moderation analysis in Supplemental Fig. 2).

7.2. Attitudes towards policy

Table 3 shows the policy attitudes by condition. Like in Study 1, we find that participants in the reflect only condition more strongly felt that this policy was unfair because they already did many things to conserve resources as compared to the control, $t(1596) = 5.59$, $p = 0.010$, $d = 0.16$, 95% CI of d = [0.04, 0.28]. Participants in the reflect and internalize condition did not differ from the control group on this measure, $p > 0.9$, $d = 0.00$, 95% CI of d = [-0.12, 0.12], and felt so less than the reflection only group, $t(1596) = -2.53$, $p = 0.012$, $d = -0.15$, 95% CI of d
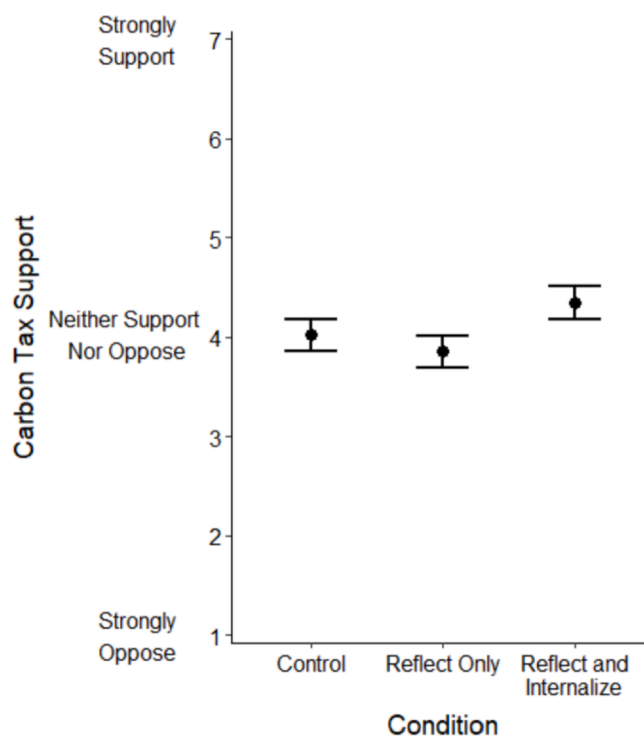

Fig. 2. Reflecting and internalizing one's sustainable acts increases climate policy support. Error bars represent 95% confidence intervals.

Table 3
Attitudes towards policies across conditions in study 2.

Policy Attitudes	Control	Reflect Only	Reflect & Internalize
Policy feels unfair as one already takes action	4.03 (1.64)	4.30 (1.75)	4.03 (1.75)
Policy reflects one's values	4.81 (1.67)	4.73 (1.61)	5.00 (1.61)
Policy reflects one's identity	4.39 (1.68)	4.23 (1.73)	4.59 (1.74)
Policy reflects one's societal views	4.92 (1.66)	4.94 (1.63)	5.08 (1.65)

Note: values are condition means with standard deviations in parentheses.

$= [-0.28, -0.03]$ (see Supplemental Figure 3 for moderation analysis by reported number of conservation acts taken).

Further, participants in the reflect and internalize condition reported that the policy was marginally more consistent with their values as compared to the control, $t(1596) = 1.87$; $p = 0.063$ ($p = 0.032$ one-tailed), $d = 0.11$, 95% CI of d = [-0.01, 0.23]. Those in the reflect and internalize condition also reported that the policy was marginally more consistent with their identity as compared to the control, all $t(1596)s = 1.85$; $p = 0.064$ ($p = 0.032$ one-tailed), $d = 0.11$, 95% CI of d = [-0.01, 0.23]. They also reported that the policy was more consistent with their views on how people should conserve resources as compared to the control, but not significantly so, $t(1596)s = 1.56$; $p = 0.120$, $d = 0.09$, 95% CI of d = [-0.03, 0.22]. Together these three measures statistically mediate the condition differences in policy support between the control and reflect and internalize conditions in a simultaneous mediation analysis (see Supplemental Note 7).

8. Discussion

In Study 2, we find positive spillover whereby people who internalize their sustainable actions (via answering questions about how they connect those acts to their values, identities and views on how they think people in society should be) have greater policy support for a carbon tax. In the reflect and internalize conditions, participants did not feel that the costly policy is unfair, instead we find partial evidence they see the policy as reflecting their values, identity, and societal outlook.

9. Conclusion and general discussion

Two studies using large, well-powered samples show that focusing attention on one's sustainable behaviors rarely results in a decrease in support for a climate policy like a carbon tax. The only circumstances where this may be a concern is when there are notable financial costs of the policy that are framed as falling on the individual, and people only reflect on their behavior in a way that is devoid of activating their personal or social values and identity. Even under these "ideal" conditions for negative spillover, this effect did not reach significance in Study 2. However, a *meta*-analysis of this effect size across both studies finds an effect that does exclude zero: d = 0.124, 95% CI of d = [0.04, 0.21], perhaps suggesting it is simply a small and somewhat noisy effect. Further, participants reported they strongly felt that both lifestyle and policy are needed when asked what is needed to address climate change, and these attitudes did not falter when reflecting on their sustainable behavior. Conversely, we find that support for a carbon tax can be increased when people reflect on their behavior in a way that is more likely to internalize these actions (by associating it with values, identity, and beliefs about what others should do). One possibility is that the well documented positive correlation between taking sustainable actions and environmental policy support [19–20] reflects that people commonly experience positive spillover in this domain (more so than the inverse).

In addressing climate change, these findings suggest that there is no strong reason to shrink away from campaigns designed to increase

individual action to reduce GHG emissions as they are often seen as complements rather than substitutes for transformative climate policy. Individual behavior change is a necessary part of the overall solution, although not sufficient alone, and we find engaging or reflecting on such change rarely leads to a belief that climate policy is unnecessary. In fact, our studies suggest that campaigns to make lifestyle changes can help reach policy goals if they lead people to reflect on their behaviors in a way that is connected to their values or identity. For instance, in Study 2 we find that just under half of people (49.8%) supported a statewide carbon tax when they did not reflect on their sustainable behavior, while those who did reflect on it and internalized these acts supported a carbon tax by around 57%. Like in this example, and in real-world examples like the failed carbon tax in Washington state in 2018, these margins can mean the difference between passing or failing to pass meaningful climate legislation [36].

Future work could continue to examine the best ways to ensure positive spillover effects in environmental contexts, perhaps contrasting multiple internalizing methods. As found in Study 1, many participants (about one-third) remarked that they took sustainable actions for monetary reasons when asked what values or identities motivated these acts. Thus, it would be helpful to scaffold these decisions onto other values that are more likely to create positive spillover when considering policies that may be costly, perhaps as we did in Study 2 by asking participants about non-monetary values that may have motivated their choices. Further, spillover dealing with reflection on past behavior may differ from recently adopted behavior. Research expanding on the reflection methods used here and in prior work on spillover [4] can also investigate if incorporating positive spillover practices directly into campaigns that advocate people to adopt novel sustainable behaviors is helpful in improving climate policy support.

What populations and policy contexts will these effects generalize to? Methodological research on online survey experiments in social-political contexts find that online convenience samples like the one used in the present research can (and often) generalize to broader national populations and therefore can serve an important step in developing theory [37,38]. But to more precisely know who these effects will generalize to future work would benefit by using a highly powered representative sample to examine if there is heterogeneity in these effects among different subpopulations. Similarly, we might wonder which policies these effects will generalize to. To answer this, future work could also assess spillover over a wider array of environmental policies than those tested here. We find policies without larger personal pecuniary costs (e.g. willingness to site high voltage power lines close to one's home) showed less spillover. And we find that spillover effects may be impacted by framing the same policy in different ways. But future research is needed to test whether there are other policy features and framing choices moderate effects. For example, past literature finds that negative spillover is more likely to occur when people initially act to avoid negative affect [2], but more research is needed to assess if framing actions or policies as achieving positive outcomes (rather than avoiding negative ones) may produce different outcomes.

While the present work examined spillover from personal behaviors to policy support, future work is needed to examine other important climate action domains, such as collective actions, including community organizing, collective conservation projects and protest. While plausible, it remains to be seen if the spillover effects from personal environmental behaviors to policy documented here also spillover to collective actions in the same way. Likewise, research is needed to test if collective actions have unique spillover consequences to policy support as compared to personal actions.

More research is also needed to examine whether features of the social context alter spillover effects. For example, in cases of negative spillover where one has a sense that they have "done a lot already" it may be that their conception of "a lot" is implicitly defined as whether they feel they do more than others. This suggests a further boundary condition for negative spillover effects: in cases where one's peers act

more sustainably than oneself, reflecting on one's sustainable behavior may not sufficiently trigger a sense that they already do a great deal and thus not reduce support for climate policy. One could also imagine that trust in institutions may moderate results of positive spillover: we might not expect positive spillover from sustainable behavior to policy support when those policies or the institutions carrying them out are not seen as authentic or are not trusted. Generally, more work is needed to understand how spillover may be further moderated by norms, trust in institutions, as well as across international contexts, all of which have been shown to be factors of the social context that impact environmental decision making more broadly [39–41].

In addition to generally giving policy makers and practitioners license to develop programs to encourage sustainable personal behavior without fear of taking away from policy support, our results also reveal the pivotal impact of factors that moderate consistency and spillover effects. Finding a context where both positive and negative spillover have been successfully experimentally manipulated compared to a control has been extremely elusive: one review claimed that being able to fully flip the effect would be the "Holy Grail" of spillover findings [29]. Here we find that combining specific techniques examined in past literature was effective at obtaining both positive and negative spillover: reflecting on behavior in a very concrete way and then framing the policy as personally costly led to negative spillover, while reflecting in a more abstract way connected to values, identities, and societal rules led to positive spillover. This theoretical development provides a practical answer to one of the most difficult questions in mitigating climate change: How do we get people to take repeated action, both political and personal, on multiple fronts over a sustained period of time? Here, we find the answer is to connect one's actions to their identity, values, and vision for society.

Author contribution

G.S., S.Z.A. and E.U.W. designed the research, G.S. collected the data, G.S. analyzed the data, and G.S., S.Z.A. and E.U.W. wrote the paper.

Declaration of Competing Interest

Acknowledgments

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.erss.2021.102150.

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