ARTICLES
https://doi.org/10.1038/s41558-019-0474-0
nature climate change

Nudging out support for a carbon tax

David Hagmann[1*], Emily H Ho[2] and George Loewenstein[1]

A carbon tax is widely accepted as the most effective policy for curbing carbon emissions but is controversial because it imposes costs on consumers. An alternative, 'nudge,' approach promises smaller benefits but with much lower costs. However, nudges aimed at reducing carbon emissions could have a pernicious indirect effect if they offer the promise of a 'quick fix' and thereby undermine support for policies of greater impact. Across six experiments, including one conducted with individuals involved in policymaking, we show that introducing a green energy default nudge diminishes support for a carbon tax. We propose that nudges decrease support for substantive policies by providing false hope that problems can be tackled without imposing considerable costs. Consistent with this account, we show that by minimizing the perceived economic cost of the tax and disclosing the small impact of the nudge, eliminates crowding-out without diminishing support for the nudge.

The most effective policies for reducing carbon emissions rely on traditional heavy-handed government interventions, such as excise taxes, fuel efficiency standards for cars and subsidies for adopting renewable energy sources. The most comprehensive and effective of these is a carbon tax (or the closely related cap-and-trade approach). Despite growing alarm about climate change, however, carbon taxes are rare and have yet to be implemented effectively. In contrast, green energy 'nudges' are widespread. The most common of these, championed by the company O-Power, provides electric power users in the United States and many other countries with utility bills that compare their personal energy use to that of their neighbours. This information has been shown to decrease energy consumption[1]. Another green energy nudge, which involves defaulting consumers to green energy providers, has been shown to increase uptake of such plans[2]. Because these approaches impose nearly zero costs on consumers, they are popular policy tools[3–7]. More generally, nudges promise positive impacts on a range of problems at lower costs than those associated with standard economic policies[8–15].

Yet, relying on nudges raises the potential for behavioural spillovers that may ultimately undermine their effectiveness[16–18]. Influencing one aspect of behaviour may give people moral license to offset their behaviour elsewhere[19]. For example, residents who were nudged to decrease their water consumption increased their use of electricity[20]. Merely reminding people of their own past actions to reduce energy consumption has been found to decrease support for government action on climate change[21]. Other research has found that giving people a sense of making even minor progress toward tackling problems can diminish their motivation to do more[22].

We propose that nudges can also interact indirectly with more substantive policies by reducing support for them. As we show, the simple consideration of a green energy nudge can crowd-out support for more effective, but also more burdensome, environmental policies. Policymakers keen on the appearance of tackling climate change and voters concerned about the costs of policies such as carbon taxes may rely on nudges as alternatives, rather than low-cost complements, to traditional policies. The actual or potential implementation of a nudge may thereby reduce the likelihood that a policy of greater impact will be implemented. This subtle downside of nudges has been debated but remains empirically untested[23,24]. Here, we provide experimental evidence that such crowd-out occurs, focusing mainly on policies aimed at reducing carbon emissions.

Across six experiments, respondents were asked to decide whether or not to implement a carbon tax policy or a green nudge policy. We find that exposing survey respondents to the potential for a green energy nudge diminishes their support for a carbon tax (Studies 1A and 2B). This effect is only observed when the nudge is related to the same policy problem as carbon taxes (a green energy nudge) and not when the nudge is unrelated (a retirement savings nudge), consistent with a crowding-out effect (Study 2). However, the general phenomenon is robust across policy domains, such that a retirement savings nudge reduces support for expanding the social security tax to the same degree that a green energy nudge reduces support for a carbon tax (Studies 3A and 3B). If people are motivated to exaggerate the impact of the nudge, then correcting this belief should reduce or eliminate crowding-out. Similarly, if crowd-out occurs because the tax is seen as burdensome, then highlighting that funds can be used to offset other taxes should mitigate the effect. We find that both of these interventions do reduce crowding-out and thereby increase support for the carbon tax (Study 4), without diminishing support for the nudge.

Lower carbon tax support when green nudge is available

In Studies 1A and 1B, we introduced participants (1A: $n=201$, 49.75% female, mean age 34.70 yr; 1B: $n=800$, 56.12% female, mean age 35.69 yr) to a nudge defaulting residential consumers into a renewable energy plan[25] and a US$40 per ton carbon tax[26]. Participants were randomized to a hypothetical decision to implement the tax versus doing nothing (single implementation) or a decision to implement the tax, nudge, both or neither (joint implementation). The difference in support for the carbon tax will serve as our measure of crowding-out. In Study 1B, we added a second experimental intervention in which we framed the tax as more painful, making salient higher costs for half the respondents. This further manipulation allows us to see whether crowding-out depends on the perceived burden imposed by the tax.

Figure 1 shows the level of support for the carbon tax (or both the tax and the nudge) in both studies. In Study 1A, support for carbon tax is high when participants can only implement the tax (70.30%). However, when a green energy nudge becomes available to implement, far fewer respondents favour implementing either the tax only

[1]Department of Social and Decision Sciences, Carnegie Mellon University, Pittsburgh, PA, USA. [2]Department of Psychology, Fordham University, New York, NY, USA. *e-mail: hagmann@cmu.edu

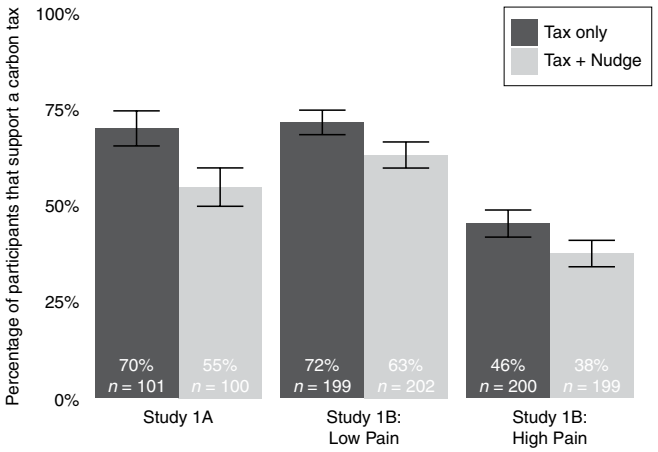

Fig. 1 | Introducing a green energy nudge reduces support for a carbon tax. Percentage of respondents that support implementing a carbon tax when presented with the tax only or the tax and the nudge (Study 1A, Study 1B: Low Pain) and under conditions in which the carbon tax is framed as more burdensome (Study 1B: High Pain). Error bars show ± one standard error.

or both policies (55.00%, Δmean (M) = 0.15, 95% confidence interval (CI) (0.02, 0.29), *t*-test (*t*)(197.23) = 2.26, $P = 0.025$). These findings also hold with logistic regression and various control variables (see Supplementary Note 1 and Supplementary Table 1). For this and all other statistical analyses, we report two-tailed test statistics.

The Low Pain condition in Study 1B is a direct replication of Study 1A. When the nudge is unavailable, 71.86% support implementing the tax, whereas only 63.37% do when the nudge is introduced ($\Delta M = 0.08$, 95% CI (−0.01, 0.18), $t(397.85) = 1.82$, $P = 0.069$). When we frame the tax as more painful (High Pain), highlighting that it will increase the cost of basic necessities such as transportation and heating, we observe a drop in support compared to the Low Pain framing, both without the nudge (45.50%, $\Delta M = 0.26$, 95% CI (0.17, 0.36), $t(393.33) = 5.54$, $P < 0.001$) and with it (37.69%, $\Delta M = 0.26$, 95% CI (0.16, 0.35), $t(398.83) = 5.31$, $P < 0.001$). In this more painful framing, crowding-out is only directional but no longer significant ($\Delta M = 0.08$, 95% CI (−0.02, 0.18), $t(396.81) = 1.58$, $P = 0.114$). In a regression specification (Supplementary Table 2), we observe a main effect of introducing the nudge into the choice set as well as the High Pain framing but no interaction between the framing and the introduction of a nudge. Analyses with more control variables and a manipulation check are presented in Supplementary Note 2.

Furthermore, in Study 1A, the carbon tax was perceived as more painful than the green energy nudge ($M_{tax} = 2.61$, $s.d._{tax} = 1.11$ versus $M_{nudge} = 1.62$, $s.d._{nudge} = 0.85$, $M_d = -0.99$, 95% CI (−1.16, −0.82), $t(200) = -11.78$, $P < 0.001$, using a paired two-sample *t*-test). See Table 1 for summary statistics of these perceived painfulness and effectiveness measures for both nudge and tax policies across all studies. Unexpectedly, however, we find no difference in the perceived efficacy of the two policies ($M_{tax} = 3.16$, $s.d._{tax} = 1.19$ and $M_{nudge} = 3.23$, $s.d._{nudge} = 1.01$, $M_d = 0.06$, 95% CI (−0.08, 0.21), $t(200) = 0.86$, $P = 0.390$), although a tax would be substantially more effective at reducing carbon emissions.

Studies 1A and 1B support our central hypothesis that a green energy nudge can crowd-out support for a more effective carbon tax. Crowd-out does not seem to be moderated by the severity of the tax.

A retirement nudge does not reduce support for a carbon tax

To rule out the possibility that the results of Studies 1A and 1B arose not from crowd-out but from respondents' aversion to implementing more than one policy[27,28], in Study 2 some survey respondents were presented with a nudge in the retirement domain paired with a carbon tax. The crowd-out account predicts no effect on support for a policy of introducing a nudge in a different domain. Participants ($n = 802$, 53.74% female, mean age 35.54 yr) read either about the green energy nudge or a nudge defaulting employees into an employer-sponsored pension plan. Both groups then read about the painfully framed carbon tax policy from Study 1B. In both conditions, as in Studies 1A and 1B, half the participants again could only implement the carbon tax (versus nothing) and the other half could implement the tax, the nudge, both or nothing.

As before, we find high support for the carbon tax when participants could implement the carbon tax but not a nudge: 45.05% of participants supported the tax when they read about the green energy nudge and 43.72% when they read about the retirement savings nudge ($\Delta M = -0.01$, 95% CI (−0.11, 0.08), $t(398.94) = -0.27$, $P = 0.789$), shown in Fig. 2. When we introduced the relevant green energy nudge into the choice set, we replicate our previous result and find a reduction in support for the tax (26%, $\Delta M = 0.19$, 95% CI (0.10, 0.28), $t(394.74) = 4.06$, $P < 0.001$). When the nudge available for implementation is in the retirement savings domain, however, we find no similar displacement (44.28%, $\Delta M = -0.01$, 95% CI (−0.10, 0.09), $t(397.97) = -0.11$, $P = 0.910$). Regressions (see Supplementary Note 3 and Supplementary Table 3) show that there is a significant interaction: crowding-out occurs only when both the tax and nudge are in the environmental domain.

Robustness across policy domains

Studies 3A and 3B adopt a different methodology to test for crowd-out. Instead of asking respondents about their support for different configurations of policies, Studies 3A and 3B test whether asking their opinion about support for a nudge first leads to diminished support for a tax. In addition, to check the robustness of the crowd-out effect across policy domains, we test whether a nudge to promote retirement savings (a 401(k) default nudge) diminishes support for the more heavy-handed policy of expanding the social security tax. In Study 3B, we also extend our results to alumni of a public policy school, many of whom report involvement with policymaking. This allows us to generalize our finding to a sample of experts who have more informed policy views and who, consequently, might be less susceptible to being influenced by the availability of a nudge.

In Study 3A, we randomly assigned participants ($n = 1208$, 55.96% female, mean age 36.19 yr) to conditions in a between-subjects 2 x 3 design. Participants were presented either with the green energy nudge and the Low Pain carbon tax from Study 1 (Environment) or a 401(k) savings default nudge and an expansion of social security (Retirement). As a different approach to testing for crowding-out, we varied whether participants first learned about the nudge and got the choice to implement it before doing the same with the tax (Nudge First), vice versa (Tax First) or learned about both policies before having the opportunity to implement either one, both or neither as in our previous studies (Joint Implementation). We preregistered the study design, hypotheses and analyses on AsPredicted (https://aspredicted.org/).

The left panel of Fig. 3 shows the fraction of participants who supported implementing the tax in the two domains. Beginning with the environmental domain, we observe that support is greatest when the decision to implement the tax was offered first (60.89%) but drops when participants could first implement the nudge (42.51%, $\Delta M = 0.18$, 95% CI (0.09, 0.28), $t(406.95) = 3.77$, $P < 0.001$) or made both decisions simultaneously (45.27%, $\Delta M = 0.16$, 95% CI (0.06, 0.25), $t(400.75) = 3.17$, $P = 0.002$). We observe no difference between the Nudge First and the Joint Implementation conditions ($\Delta M = 0.03$, 95% CI (−0.07, 0.12), $t(405.46) = 0.56$, $P = 0.575$), which suggests that our findings are not merely a result of asking about two policies at once. The results are similar in the retirement domain, which points to the generality of the crowd-out effect.

Table 1 | Summary statistics (means and, below them, standard deviations) for painfulness and effectiveness of policies for all studies

Study		Painfulness				Effectiveness			
		Nudge	Tax	*P* value	Cohen's *d*	Nudge	Tax	*P* value	Cohen's *d*
Study 1A		1.62	2.61	<0.001	1.00	3.23	3.16	0.557	0.06
		0.85	1.11			1.01	1.19		
Study 1B	Low Pain	1.67	2.06	<0.001	0.38	3.20	3.12	0.324	0.07
		0.92	1.11			0.98	1.16		
	High Pain	1.77	3.16	<0.001	1.32	3.16	3.00	0.037	0.15
		0.98	1.12			1.05	1.18		
Study 2	Related	1.71	3.24	<0.001	1.42	3.25	2.90	<0.001	0.35
		0.95	1.18			0.99	1.03		
	Unrelated	1.71	3.19	<0.001	1.34	3.65	2.92	<0.001	0.69
		0.93	1.25			0.93	1.17		
Study 3A	Retirement	1.98	2.86	<0.001	0.80	3.17	2.96	0.001	0.19
		1.07	1.10			1.02	1.11		
	Environment	1.67	3.01	<0.001	1.31	3.28	2.91	<0.001	0.35
		0.91	1.12			1.02	1.08		
Study 3B	Retirement	1.59	2.69	<0.001	1.19	3.12	2.96	0.040	0.16
		0.83	1.00			0.94	1.05		
	Environment	1.53	2.44	<0.001	0.98	3.27	2.94	<0.001	0.30
		0.83	1.02			0.98	1.28		
Study 4	Tax First	1.76	2.18	<0.001	0.39	3.07	2.80	0.008	0.27
		1.02	1.15			1.03	1.00		
	Nudge First	1.65	2.36	<0.001	0.65	3.13	3.08	0.624	0.05
		0.88	1.25			0.98	1.15		
	Nudge Ineffective	1.61	2.33	<0.001	0.73	2.44	3.10	<0.001	0.62
		0.82	1.12			0.93	1.18		
	Tax Attractive	1.59	1.99	<0.001	0.42	3.21	3.35	0.180	0.14
		0.84	1.09			0.99	1.03		

P values test for a difference between the tax and the nudge in an experimental condition.

Support for expanding social security is greater when the choice was offered first (59.20%), compared to when the nudge could be implemented first (41%, $\Delta M = 0.18$, 95% CI (0.09, 0.28), $t(398.99) = 3.70$, $P < 0.001$) or when the decision for the two policies was made jointly (42.64%, $\Delta M = 0.17$, 95% CI (0.07, 0.26), $t(395.72) = 3.34$, $P = 0.001$). Here, too, we observe no difference between the last two conditions ($\Delta M = 0.02$, 95% CI (−0.08, 0.11), $t(394.83) = 0.33$, $P = 0.741$). For results with logistic regression, see Supplementary Note 4 and Supplementary Table 4.

To rule out that respondents were merely averse to implementing two policies on one issue (single-action bias[27,28]), we examine whether evaluating the more substantive policy first reduces support for the nudge. We find no evidence that it does either in the environmental domain, in which support for the nudge averages 86% across the three conditions ($F(2,607) = 0.45$, mean square error (MSE) = 0.12, $P = 0.640$, $\hat{\eta}^2_G = 0.001$) or the retirement domain, in which 75% support the nudge ($F(2,595) = 0.59$, MSE = 0.19, $P = 0.553$, $\hat{\eta}^2_G = 0.002$). See also Supplementary Fig. 1 and Supplementary Table 5.

For Study 3B, we recruited alumni of a public policy school ($n = 641$, 46.80% female, mean age 46.90 yr). The sample is highly educated (87.99% have a Master's degree and 11.86% have a PhD) and 54.13% report holding or having held a position in which they influenced public policy. We pre-registered the study design, hypotheses and analyses on AsPredicted.

As with our non-expert sample, we find that respondents in this study thought the carbon tax was more painful than the green energy nudge ($M_{tax} = 2.69$, $s.d._{tax} = 1.00$ versus $M_{nudge} = 1.59$, $s.d._{nudge} = 0.83$, $\Delta M = -1.09$, 95% CI (−1.24, −0.95), $t(620.43) = -15.10$, $P < 0.001$) and the social security expansion more painful than a 401(k) nudge ($M_{tax} = 2.44$, $s.d._{tax} = 1.02$, versus $M_{nudge} = 1.53$, $s.d._{nudge} = 0.83$, $\Delta M = -0.91$, 95% CI (−1.06, −0.77), $t(610.57) = -12.40$, $P < 0.001$). Curiously, this sample believed the carbon tax to be less effective than the green energy nudge ($M_{tax} = 2.96$, $s.d._{tax} = 1.05$, versus $M_{nudge} = 3.12$, $s.d._{nudge} = 0.94$, $\Delta M = 0.16$, 95% CI (0.01, 0.32), $t(631.90) = 2.06$, $P = 0.040$) and an expansion of social security to be less effective than the 401(k) savings nudge in promoting retirement savings ($M_{tax} = 2.94$, $s.d._{tax} = 1.28$, versus $M_{nudge} = 3.27$, $s.d._{nudge} = 0.98$, $\Delta M = 0.34$, 95% CI (0.16, 0.51), $t(596.54) = 3.74$, $P < 0.001$).

The right panel of Fig. 3 shows the fraction of participants who supported implementing either the carbon tax (Environment) or expanding the social security tax (Retirement). When the tax was presented first, we see greater support for its implementation in both the environmental domain (76.25% versus 59.01%, $\Delta M = -0.17$, 95% CI (−0.27, −0.07), $t(313.08) = -3.35$, $P = 0.001$) and in the retirement domain (64.43% versus 54.39%, $\Delta M = -0.10$, 95% CI (−0.21, 0.01), $t(314.91) = -1.83$, $P = 0.068$), albeit statistically significant only in the environmental domain. For logistic regressions, see Supplementary Tables 7 and 8 showing an absence of crowd-out

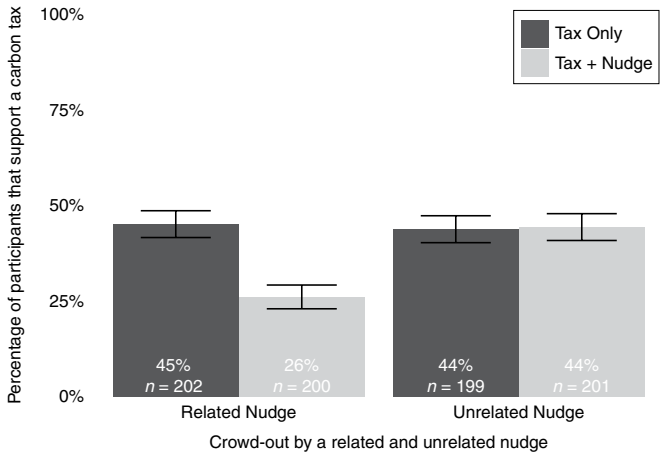

Fig. 2 | Support for a carbon tax in the presence of a related or unrelated nudge in Study 2. Percentage of respondents that support implementing a carbon tax when the tax is presented alone or in the presence of a related (green energy) or unrelated (retirement savings) nudge. Error bars show ± one standard error.

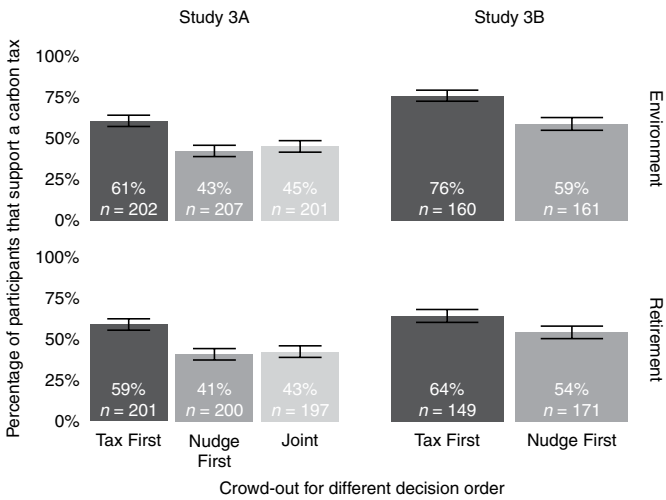

Fig. 3 | Effect of nudge option on tax support across policy domains in Study 3. Percentage of respondents that support carbon tax (top row) or expansion of social security tax (bottom row) when presented with the tax first, a related nudge (green energy or retirement savings) first or both options simultaneously. Results are consistent in a general population sample (left panel) and a sample trained in public policy (right panel). Error bars show ± one standard error.

for the nudge. Looking separately at the subset of participants who report applied policymaking experience, we observe significant crowding-out in both domains (see Supplementary Fig. 2 and Supplementary Tables 9 and 10). Further details of the experimental design are described in Supplementary Note 5.

Information provision reduces crowding-out. Finally, in Study 4 we look at two potential mechanisms that could lead to crowding-out. People might believe the nudge to be more effective than it is or they might be motivated to avoid a painful tax. In two conditions, we present further information about the nudge and the tax aimed at reducing crowding-out. We pre-registered the study design, hypotheses and analyses on AsPredicted.

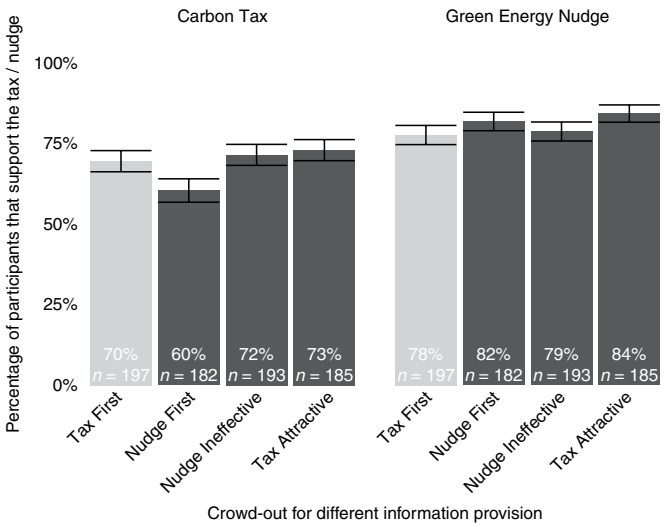

Fig. 4 | Support for carbon tax and green energy nudge in Study 4. Percentage of respondents that support a carbon tax (left panel) or green energy nudge (right panel) when presented with the Tax First (grey) or the Nudge First under different information provision conditions (black). Error bars show ± one standard error.

In the Tax First condition, we ask participants about their support for the carbon tax, followed by their support for the green energy nudge. The three remaining conditions ask about the nudge first, either providing no more information (Nudge First), highlighting the small total effect of the green energy default and that most carbon emissions are due to other sources (Nudge Ineffective) or making the tax seem less costly by highlighting that revenue can be used to offset other taxes (Tax Attractive). Manipulation checks and analyses using logistic regressions are presented in Supplementary Note 6.

Figure 4 shows, in the left panel, that support for the carbon tax declines from 70% to 60% when we change the ordering of the policies from Tax First to Nudge First, a smaller difference than in previous studies that is only statistically significant at the 10%-level ($\Delta M = 0.09$, 95% CI (−0.01, 0.19), $t(369.75) = 1.86$, $P = 0.064$). Presenting the nudge and its relative ineffectiveness first, however, increases support for the tax significantly (72%, $\Delta M = -0.11$, 95% CI (−0.21, −0.01), $t(365.97) = -2.27$, $P = 0.024$), as does highlighting that other taxes could be lowered to offset the extra costs (73%, $\Delta M = -0.13$, 95% CI (−0.22, −0.03), $t(360.45) = -2.56$, $P = 0.011$). As before, we observe no difference in support for the nudge across conditions ($F(3,753) = 1.11$, MSE = 0.16, $P = 0.345$, $\hat{\eta}^2_G = 0.004$). Notably, although adding information about the impact of the nudge does affect support for the tax, it does not affect support for the nudge (82% and 79%, respectively, $\Delta M = 0.03$, 95% CI (−0.05, 0.11), $t(373.00) = 0.76$, $P = 0.450$). See Table 2 for tax and nudge support across conditions, Supplementary Fig. 3 for ratings of effectiveness and painfulness across the two policies and four conditions, and Supplementary Table 11 for logistic regressions.

Discussion

Across six studies, support for a carbon tax declines when a green energy nudge is introduced, confirmed by an internal meta-analysis of the environmental studies (random effects; $d_+ = 0.30$, 95% CI = (0.22, 0.37), $z = 7.89$, $P < 0.001$, Q(6) = 13.65, $P = 0.03$, $I^2 = 48.25\%$). We find no consistent heterogeneous treatment effects that would suggest that such crowding-out is more pronounced for those more opposed to government intervention, less certain that climate change is occurring or who believe the nudge is more effective than the other policy (see Supplementary Note 7, Supplementary Figs. 4–8 and Supplementary Table 12).

Table 2 | Percentage of participants who supported implementing the tax and nudge across studies and conditions

		Support Tax	Support Nudge
Study 1A	Tax	70.30	
	Tax + Nudge	55.00	77.00
	P	0.025	
	Cohen's *d*	0.32	
Study 1B	Low Pain—Tax	71.86	
	Low Pain—Tax + Nudge	63.37	81.68
	P	0.069	
	Cohen's *d*	0.18	
	High Pain—Tax	45.50	
	High Pain—Tax + Nudge	37.69	80.40
	P	0.114	
	Cohen's *d*	0.16	
Study 2	Related Nudge—Tax	45.05	
	Related Nudge—Tax + Nudge	26.00	82.50
	P	<0.001	
	Cohen's *d*	0.41	
	Unrelated Nudge—Tax	43.72	
	Unrelated Nudge—Tax + Nudge	44.28	81.09
	P	0.910	
	Cohen's *d*	0.01	
Study 3A	Environment—Tax First	60.89	86.63
	Environment—Nudge First	42.51	84.06
	P	<0.001	0.463
	Cohen's *d*	0.37	0.07
	Environment—Tax + Nudge	45.27	87.06
	P	0.002	1.898
	Cohen's *d*	0.32	0.01
	Retirement—Tax First	59.20	77.11
	Retirement—Nudge First	41.00	72.50
	P	<0.001	0.288
	Cohen's *d*	0.37	0.11
	Retirement—Tax + Nudge	42.64	75.63
	P	0.002	0.898
	Cohen's *d*	0.34	0.03
Study 3B	Environment—Tax First	72.53	86.88
	Environment—Nudge First	54.65	85.71
	P	0.014	0.763
	Cohen's *d*	0.38	0.03
	Retirement—Tax First	67.86	81.21
	Retirement—Nudge First	48.84	84.80
	P	0.012	0.397
	Cohen's *d*	0.39	0.10
Study 4	Nudge First	60.44	81.87
	Tax First	69.54	77.66
	P	0.064	0.309
	Cohen's *d*	0.19	0.10
	Tax Attractive	72.97	84.32
	P	0.011	0.532
	Cohen's *d*	0.27	0.07
	Nudge Ineffective	71.50	78.76
	P	0.024	0.450
	Cohen's *d*	0.23	0.08

P values test for a difference between conditions. In Study 3A, the tests compare Tax First with each of the other two conditions and in Study 4 Nudge First with each of the other three conditions.

It appears that, while people are generally concerned about societal problems such as climate change, they may not be willing to incur large costs to achieve a solution[29,30]. With the perceived existence of a low-cost solution (a nudge), motivated reasoning may tempt some to exaggerate its ultimately small environmental impact. This may explain why participants generally thought the nudge was as or more effective at reducing pollution than the carbon tax. However, even those who knew that the carbon tax is more effective than the green energy nudge were discouraged from implementing the tax when a nudge became available, suggesting that crowding-out is not merely the result of incorrect perceptions of relative effectiveness. When these perceptions are corrected at the time of decision, however, motivated reasoning is difficult and crowding-out disappears.

The effects documented in these studies are probably generalizable beyond the domains of climate change and retirement savings or nudges and more substantive policies. An information campaign teaching people how they can personally cut their emissions, for example, might be perceived as even less invasive than a green energy nudge and crowd-out support for the latter[31]. However, a mere ordering effect cannot explain the presented findings: such an alternative account would suggest that a carbon tax would crowd-out support for the nudge, which was not the case.

The six studies presented respondents with hypothetical decisions and elicited their support for policies using subjective measures. Although the findings replicated even among participants trained in public policy and among a subset with policymaking experience, we cannot know whether the legislative or regulatory processes involved in crafting and implementing environmental regulation might limit its impact on policy. However, as Reisch and Sunstein write, 'public officials are inevitably responsive to what people think'[32] and to that extent, reduced support for a carbon tax may indeed render it less likely to be implemented.

An ideal world would have a place for both nudges and more heavy-handed interventions to combat climate change. However, our results indicate that an effort to deploy both can backfire by reducing the likelihood that the most effective policies will be implemented. Such a policy cost must be accounted for when determining the potential benefit of nudges in combating climate change[33]. Our last study suggests that we may be able to avoid this cost by informing the public that nudges are not a substitute for more substantive policies, even if they are cost-effective. Encouragingly, this disclosure does not diminish support for the nudge, suggesting that it may provide a means for capitalizing on both tools.

Online content

Any methods, additional references, Nature Research reporting summaries, source data, statements of code and data availability and associated accession codes are available at https://doi.org/10.1038/s41558-019-0474-0.

Received: 19 May 2018; Accepted: 8 April 2019;
Published online: 13 May 2019

References

1. Allcott, H. Social norms and energy conservation. *J. Public Econ.* **95**, 1082–1095 (2011).
2. Hedlin, S. & Sunstein, C. Does active choosing promote green energy use? Experimental evidence. *Ecol. Law Q.* **43**, 107–141 (2016).
3. Benartzi, S. et al. Should governments invest more in nudging? *Psychol. Sci.* **28**, 1041–1055 (2017).
4. Camerer, C., Issacharoff, S., Loewenstein, G., O'Donoghue, T. & Rabin, M. Regulation for conservatives: behavioral economics and the case for 'asymmetric paternalism'. *Univ. Pa. Law Rev.* **151**, 1211–1254 (2003).
5. Hall, M. G. et al. Public support for pictorial warnings on cigarette packs: an experimental study of US smokers. *J. Behav. Med.* **41**, 398–405 (2018).
6. Thaler, R. H. & Sunstein, C. R. Libertarian paternalism. *Am. Econ. Rev.* **93**, 175–179 (2003).

7. Thaler, R. H. & Sunstein, C. R. *Nudge: Improving Decisions about Health, Wealth, and Happiness* (Yale Univ. Press, 2008).
8. Allcott, H. & Rogers, T. The short-run and long-run effects of behavioral interventions: experimental evidence from energy conservation. *Am. Econ. Rev.* **104**, 3003–3037 (2014).
9. Yoeli, E. et al. Behavioral science tools to strengthen energy & environmental policy. *Behav. Sci. Policy* **3**, 68–79 (2017).
10. Loewenstein, G. & Chater, N. Putting nudges in perspective. *Behav. Public Policy* **1**, 26–53 (2017).
11. Marteau, T. M., Ogilvie, D., Roland, M., Suhrcke, M. & Kelly, M. P. Judging nudging: can nudging improve population health? *BMJ* **342**, d228–d228 (2011).
12. Levitt, S. D., List, J. A., Neckermann, S. & Sadoff, S. The behavioralist goes to school: leveraging behavioral economics to improve educational performance. *Am. Econ. J. Econ. Policy* **8**, 183–219 (2016).
13. Madrian, B. C. et al. Behaviorally informed policies for household financial decisionmaking. *Behav. Sci. Policy* **3**, 26–40 (2017).
14. Thaler, R. H. & Benartzi, S. Save more tomorrow: using behavioral economics to increase employee saving. *J. Polit. Econ.* **112**, S164–S187 (2004).
15. Rogers, T. & Feller, A. Reducing student absences at scale by targeting parents' misbeliefs. *Nat. Hum. Behav.* **12**, 335–342 (2018).
16. Nash, N. et al. Climate-relevant behavioral spillover and the potential contribution of social practice theory. *WIREs Clim. Change* **8**, e481 (2017).
17. Thøgersen, J. Spillover processes in the development of a sustainable consumption pattern. *J. Econ. Psychol.* **20**, 53–81 (1999).
18. Truelove, H. B., Carrico, A. R., Weber, E. U., Raimi, K. T. & Vandenbergh, M. P. Positive and negative spillover of pro-environmental behavior: an integrative review and theoretical framework. *Glob. Environ. Change* **29**, 127–138 (2014).
19. Meijers, M. H. C., Verlegh, P. W. J., Noordewier, M. K. & Smit, E. G. The dark side of donating: how donating may license environmentally unfriendly behavior. *Soc. Influ.* **10**, 250–263 (2015).
20. Tiefenbeck, V., Staake, T., Roth, K. & Sachs, O. For better or for worse? Empirical evidence of moral licensing in a behavioral energy conservation campaign. *Energy Policy* **57**, 160–171 (2013).
21. Werfel, S. H. Household behaviour crowds out support for climate change policy when sufficient progress is perceived. *Nat. Clim. Change* **7**, 512–515 (2017).
22. Fishbach, A., Dhar, R. & Zhang, Y. Subgoals as substitutes or complements: the role of goal accessibility. *J. Pers. Soc. Psychol.* **91**, 232–242 (2006).
23. Loewenstein, G. & Ubel, P. Economics behaving badly. *The New York Times* A31 (15 July 2010).
24. Loewenstein, G. et al. A behavioral blueprint for improving health care policy. *Behav. Sci. Policy* **3**, 53–66 (2017).
25. Sunstein, C. R. Do people like nudges? *SSRN* https://doi.org/10.2139/ssrn.2604084 (2016).
26. Interagency Working Group on Social Cost of Greenhouse Gases. *Technical Update on the Social Cost of Carbon for Regulatory Impact Analysis—Under Executive Order 12866* (Office of Management and Budget, 2013).
27. Weber, E. in *Psychological Perspectives to Environmental and Ethical Issues in Management* (eds Bazerman, M., Messick, D., Tensbrunsel, A. & Wade-Benzoni, K.) 314–341 (Jossey-Bass, 1997).
28. Hansen, J., Marx, S. & Weber, E. *The Role of Climate Change Perceptions, Expectations, and Forecasts in Farmer Decision Making: The Argentine Pampas and South Florida* (International Research Institute for Climate Prediction, 2004).
29. Campbell, T. H. & Kay, A. C. Solution aversion: on the relation between ideology and motivated disbelief. *J. Pers. Soc. Psychol.* **107**, 809–824 (2014).
30. Tannenbaum, D., Fox, C. R. & Rogers, T. On the misplaced politics of behavioural policy interventions. *Nat. Hum. Behav.* **1**, 0130 (2017).
31. Davidai, S. & Shafir, E. Are 'nudges' getting a fair shot? Joint versus separate evaluation. *Behav. Public Policy* https://doi.org/10.1017/bpp.2018.9 (2018).
32. Reisch, L. A. & Sunstein, C. R. Do Europeans like nudges? *SSRN Electron. J.* **11**, 310–325 (2016).
33. Dolan, P. & Galizzi, M. M. Like ripples on a pond: behavioral spillovers and their implications for research and policy. *J. Econ. Psychol.* **47**, 1–16 (2015).

Acknowledgements

We thank R. Thaler and C. Sunstein for helpful comments and discussions. D.H. is grateful for funding from the Swiss National Science Foundation's Doc.Mobility fellowship.

Author contributions

All authors contributed equally to the development of the ideas and authoring of the paper. D.H. implemented the surveys and managed the data collection. E.H. performed the statistical analyses and D.H. assisted.

Competing interests

The authors declare no competing interests.

Additional information

Supplementary information is available for this paper at https://doi.org/10.1038/s41558-019-0474-0.

Reprints and permissions information is available at www.nature.com/reprints.

Correspondence and requests for materials should be addressed to D.H.

Journal peer review information: *Nature Climate Change* thanks M. Galizzi, A. Maki and S. Werfel for their contribution to the peer review of this work.

Publisher's note: Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Methods

Studies 1A and 1B. In Study 1A, we recruited 201 participants via Amazon Mechanical Turk (https://www.mturk.com) for a 'Study on Decision Making' that was expected to take 5 min to complete and offered a fixed payment of 50¢. See Supplementary Methods for the materials used in all studies. We began by asking participants whether they agreed that global average temperatures had been increasing over the past 50 years (independent of the cause) and, for all but those who strongly disagreed, we asked whether they believed human activity to be the primary cause.

We next presented them with a brief description explaining default nudges. Participants were informed that mandating a default can lead to an option being chosen more frequently, without prohibiting people from choosing differently. We then introduced them to the green energy nudge, using the description from previous work examining attitudes toward this nudge[25]. Participants then rated how effective they believed the policy to be at reducing pollution and carbon emission on a five-point Likert scale from 'Not effective at all' to 'Extremely effective'. On the same screen, they also rated how painful they thought the policy would be for someone like them, on a five-point Likert scale from 'Not painful at all' to 'Extremely painful'. Next, we introduced them to a US$40 ton^{-1} carbon tax that would be levied on companies and individuals. This tax was described as capturing the economic costs of carbon emissions[26]. Participants then evaluated this policy on the same two dimensions as the nudge.

We then randomly assigned participants to one of two conditions. In the Tax Only condition, participants imagining themselves in the role of a policymaker were asked to choose whether to implement the carbon tax policy. They were told that the alternative, if the policy is not implemented, is that no other policy would be implemented. They could then choose to implement the tax or not implement the tax. In the Tax and Nudge condition, participants were also asked to imagine themselves as policymakers. However, they had more choices: they could implement the tax, the nudge, both or neither. They were also told that if neither of the policies were implemented, no other policy would be passed in their place. The survey concluded with basic demographic questions: gender, age, ethnicity, education and political orientation.

In Study 1B, we recruited 800 new participants via Amazon Mechanical Turk for a 5-min study on decision-making that paid 50¢. Participants were randomly assigned to one of four conditions: 'Low Pain, Tax Only', 'Low Pain, Tax and Nudge', 'High Pain, Tax Only' and 'High Pain, Tax and Nudge'. The two Low Pain conditions were identical to the two conditions reported in Study 1A and are direct replications. The two High Pain conditions differed in that they included more descriptive information about the carbon tax conveying the cost to consumers. In particular, for those in the high-cost condition, we point out that this policy would substantially raise the price not just on transportation but also on heating and air conditioning, on electricity and on other goods and activities.

Study 2. We recruited 1,208 participants from Amazon Mechanical Turk for a 5-min study on decision-making in exchange for a fixed payment of 50¢. When participants entered the survey, they were informed that they would be asked to evaluate two policies aimed at addressing longstanding problems. Half the participants were then randomly assigned to the Related Nudge condition. They first read about the green energy nudge from Study 1A, in which the government would require large electricity providers to enrol consumers into plans with environmentally friendly energy suppliers but noting that consumers could opt-out if they wished. We then asked them to evaluate how effective the policy would be if it were implemented and how painful it would be for someone like them. Both responses were reported on a five-point Likert scale from 'Not effective (painful) at all' to 'Extremely effective (painful)'. The other participants were assigned to the Unrelated Nudge condition and instead read about a retirement nudge in which large employers would be required to enrol employees into a pension plan but would allow them to opt-out if they wished[25]. They, too, evaluated these policies according to their effectiveness and painfulness.

Next, all participants read about the same carbon tax policy: a US$40 ton^{-1} tax. We used the High Pain phrasing from Study 1B, noting that the policy would substantially raise the price on transportation, on heating and air conditioning, on electricity and on other goods and activities. Participants evaluated this policy, too, on the effectiveness and painfulness dimensions. Finally, participants were asked to imagine themselves as a policymaker and were given a decision to implement a policy. In the Tax Only condition, we asked them if they wanted to implement the carbon tax. We noted that no other policy would be passed if they decided not to do so. In the Tax and Nudge condition, we offered them four choices: implement the carbon tax only, implement the nudge only, implement both the tax and the nudge, or implement neither the tax nor the nudge. Which nudge participants got to implement depended on which one they had randomly been assigned to read about: either the green energy nudge or the retirement savings nudge.

Study 3A. In Study 3A, we recruited 1,208 participants and randomly assigned them to conditions in a 2×3 between-subjects design. On the first dimension, we varied whether participants faced policies in the domain of climate change (Environment) or retirement savings (Retirement). In all conditions, participants were asked to evaluate on five-point Likert scales how effective and how painful each of two policies would be (from 'not at all' to 'very').

In the Environment domain, we began by introducing the threat of climate change and told participants that they would be asked to evaluate two policies aimed at combating it. The two policies were the green energy nudge (identical to previous studies) and a carbon tax. For the tax, we used the framing from Study 1A and, identically, the Low Pain condition of Study 1B. In the Tax First condition, participants began by evaluating the carbon tax, then made a decision about whether or not to implement it. They then were presented with the green energy nudge and, after evaluating it, were asked about whether or not they would implement that policy. In the Nudge First condition, we reversed the order: participants first decided whether to implement the nudge, then made the decision about the tax. Finally, the Joint Implementation condition matches our previous design: participants first read about the nudge, then about the tax and only at the end got to decide which of the policies, if any, to implement.

In the Retirement domain, we introduced the problem of undersaving and told participants that they would be asked to evaluate two policies that may increase the income people have available in retirement. In the Tax First condition, participants evaluated an expansion of the social security programme. The programme would increase contribution rates for employees and employers but would also increase benefits and eliminate uncertainties about the availability of future benefits. They then read about a 401(k) savings nudge, in which large employers would be required to enrol workers into a retirement plan and contribute 8% of their income by default. Employees would have the option to change the savings rate or opt-out entirely. In the Nudge First condition, we reversed the order in which the two policies were presented: participants first read about (and got to implement) the 401(k) savings nudge, then read about (and got to implement) the expansion of the social security programme. Finally, in the Joint Implementation decision, participants read about and evaluated first the 401(k) savings nudge, then the expansion of the social security programme and only at the end had the option to implement one of the policies, both or neither.

We concluded the survey with basic demographic questions from the previous studies (gender, age, ethnicity, education and political affiliation). The experimental design, sample size, hypotheses and planned analyses were pre-registered on AsPredicted (https://aspredicted.org/8b8hx.pdf).

Study 3B. For Study 3B, we recruited a sample of participants with training in public policy. We contacted all 4,455 alumni of the Heinz College of Public Policy at Carnegie Mellon University whose email addresses were on file with the alumni office. Of those contacted, 835 clicked on the link in the email and 641 completed the survey. The average age was 46.90 yr and 53.20% were male. The sample was highly educated: 87.99% had a Master's degree, 11.86% a doctorate and 41.34% had taken a graduate-level behavioural economics class.

Many respondents reported active involvement in the shaping of public policy: 54.13% stated that their current or past roles involved public policy either directly or indirectly. We refer to this subgroup as 'policymakers' and perform all our analyses separately on them as an extra robustness check. In this sample of policymakers, the average age was 45.75 yr and 58.79% were male. Among policymakers, 83.57% obtained Master's degrees, 16.14% obtained doctorates and 42.65% had taken a graduate-level behavioural economics class.

The design follows closely that of Study 3A and aimed to replicate its findings with a more informed sample. However, as we did not want to risk being underpowered on our main comparison of interest, we dropped the Joint Implementation condition, leaving the Tax First and Nudge First conditions. Moreover, participants saw a tax and a nudge in each of the two policy domains (Environment and Retirement). We randomized between-subjects the order in which the policies and the domains were presented, using a Latin Square design. Those who first saw the tax and then the nudge in the first domain subsequently first saw the nudge, followed by the tax, in the second domain. This allows us to test for spillover across domains (see Supplementary Table 6), where the decision to implement policies in the retirement domain might allow them to anticipate the policies they will face in the environmental domain and vice versa. Without spillover, we could collapse across the domain ordering and increase our sample size. In addition to analysing the full sample of respondents, we perform separate analyses on the subset of respondents who reported being directly involved in shaping public policy.

In both the domains of climate change and retirement savings, participants read about two kinds of policies: taxes and default nudges. In the environmental domain, the standard policy imposed a carbon tax on companies on the basis of how much emissions they create, which in turn raises the price of goods. The nudge consisted of a mandate on large energy providers to automatically enrol consumers into a green power plan, although consumers could elect to opt-out if they wish. The standard economic policy for retirement savings consisted of an increase in the social security tax for both employees and employers, along with a commensurate increase in social security benefits. The corresponding nudge was a mandate for employers to enrol workers into contributing 8% of their salary into a 401(k) plan but allowing workers to opt-out or change their allocation.

After reading about each of the four policies, participants were asked how effective the policy would be at increasing retirement savings or reducing pollution

and mitigating CO_2 emissions and whether they wished to implement the policy. They then proceeded to the next policy. The survey concluded with demographic questions. The study and analyses, including the test for spillover across the two domains and the subgroup analysis for policymakers, were pre-registered on AsPredicted (https://aspredicted.org/ki822.pdf). The pre-registration report mistakenly notes that we had already collected some data, which is inaccurate; the timestamp of the pre-registration report precedes the distribution of emails by two days.

Study 4. We recruit participants from Amazon Mechanical Turk for a 5-min study in exchange for a 50¢ fixed payment. We targeted a sample of 800 people who passed an attention check included at the end of the experiment. After recruiting 954 participants, we ended up with 757 participants who passed. The sample size, exclusion criteria, along with the following experimental design, hypotheses and analyses were pre-registered on AsPredicted (https://aspredicted.org/53hs7.pdf).

We began by introducing all participants to the threat of climate change and the effect of pollution on premature deaths. Next, participants read that they would be asked to evaluate two policies that governments might considered to combat pollution and global climate change. We then randomly assigned them to one of four between-subjects conditions. In the Tax First condition, participants read about the US$40 per ton carbon tax from the previous studies and rated it on effectiveness and painfulness (again on a five-point Likert scale from 'Not at all' to 'Very'). On the next screen, they were then asked if they would vote to implement the carbon tax (using the Low Pain framing from Study 1A and Studies 3A and 3B). Independent of their answer, they were then presented with the green energy nudge, also identical to the previous experiments. Similarly, they evaluated it on effectiveness and painfulness and stated whether they would vote to implement it.

The experimental survey then asked a series of demographic questions: gender, age, ethnicity, education, political affiliation and political orientation. We also asked participants how they believe their carbon emissions compared to the average household (more, less or the same) and which one of four statements most closely reflected their views on climate change. They could express that climate change was primarily caused by human activity and governments should take measures to reduce emissions; primarily caused by human activity but actions to reduce should be left to individuals; primarily caused by natural factors but governments should take measures to reduce emissions; and primarily caused by natural factors and governments should not take measures to reduce emissions. We did not pre-register any hypotheses related to these questions but collected the responses for descriptive purposes.

Participants in the Nudge First condition faced a survey that was identical except in that they first evaluated the green energy nudge, then the carbon tax. The remaining two conditions, Nudge Ineffective and Tax Attractive, followed the same order as the Nudge First condition. However, participants in those two conditions received more information. In the Nudge Ineffective condition, we told participants that green energy nudges have been found to only shift a fraction of the population toward green energy, that residential electricity use is responsible for only a small part of carbon emissions and that the policy would hence have very little impact on emissions. This information was truthful[2].

In the Tax Attractive condition, we instead provided more information about the carbon tax. We told participants that British Columbia had implemented a similar tax and uses part of the revenue to lower income taxes. We further highlighted that revenue could be used to lower other taxes and fund projects we thought would be appealing to participants. Moreover, we noted that a previous ballot initiative in Washington would have returned the revenue to residents, which would lead households that emit less carbon than average to receive a greater rebate than what they paid in taxes.

The survey concluded with an attention check. We first showed participants an image of a bell pepper and asked them what they saw in the image. Anyone whose response included the word 'pepper' was marked as having passed the attention check. We then asked participants to write the date '08/06/2018' in words. We treat anyone whose response included the word 'August' as having passed the attention check.

Ethical approval. For all studies, we obtained ethical approval from the internal review board at Carnegie Mellon University and complied with all relevant ethical regulations for research with human participants. None of our studies involved deception.

Reporting Summary. Further information on research design is available in the Nature Research Reporting Summary linked to this article.

Data availability

The raw data from all our experiments and statistical code for all analyses and figures reported in the paper and the supplementary information are available via the Open Science Framework at: https://osf.io/w4u5q/.

nature research

Corresponding author(s): David Hagmann

Last updated by author(s): 3/28/2019

Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see Authors & Referees and the Editorial Policy Checklist.

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed	
☐	☒	The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒	A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒	The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒	A description of all covariates tested
☐	☒	A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒	A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒	For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐	For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐	For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐	Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	We used the Qualtrics survey platform to administer the experimental surveys.
Data analysis	Data were analyzed using R 3.5.2

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors/reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

The raw data from all our experiments and statistical code for all analyses and figures reported in the paper and the supplementary information are available via the Open Science Framework at: https://osf.io/w4u5q/.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☒ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	All our studies are between-subjects experimental designs and we analyze responses using quantitative analyses (t-tests, ANOVA, and regressions).
Research sample	For Studies 1a, 1b, 2, 3a, and 4, we recruited participants from Amazon Mechanical Turk who were based in the United States. The population is fairly representative of the United States. For study 3b, our participants are alumni of the public policy school at Carnegie Mellon University.
Sampling strategy	Studies 1a-3a and 4: we posted invitations to participate in a survey on decision making on Amazon Mechanical Turk. The invitation remained open until we reached our pre-determined sample size of 100 per condition for testing main effects (studies 1a and 3a) and 200 per condition when we looked at interaction effects (studies 1b and 2). We did not perform power analyses, but relied on our past experience with experiments on the platform. The survey automatically stopped accepting new participants when the number of completes was reached. For study 3b, we contacted the entire alumni database in late September and sent one reminder email in late October. We closed the survey in December, when we observed no further completes.
Data collection	Data for all studies were collected using the Qualtrics survey platform and for Studies 1a-3a using the TurkPrime service for managing Amazon Mechanical Turk postings. Participants were able to complete the study from anywhere with internet access and they were not monitored while participating in the research.
Timing	Data for Studies 1a-3b were collected between June 2017 and December 2017. Study 4 took place October 31 to November 2, 2018.
Data exclusions	For Studies 1a-3b, we used data from all participants who completed the studies. For Study 4, we included an attention check and excluded 156 participants who failed it, as pre-registered.
Non-participation	In total, we had 3,965 participants complete our studies via Amazon Mechanical Turk. An additional 62 participants failed to complete the survey and were not included in the analyses. We do not know why they chose not to complete the survey. In addition to the 641 policy alumni who completed our study, 186 did not complete the survey and were not analyzed. We do not know why they chose to stop participating. The number is likely higher than on Amazon Mechanical Turk because these participants were not paid to participate in the study and may not have had the time to fully participate.
Randomization	Participants were randomly allocated to our experimental conditions using the Qualtrics survey platform.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology
☒	☐ Animals and other organisms
☐	☒ Human research participants
☒	☐ Clinical data

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Human research participants

Policy information about studies involving human research participants

Population characteristics	See above.
Recruitment	For Studies 1a, 1b, 2, 3a, and 4, participants were recruited for a study on decision making via the Amazon Mechanical Turk platform. We did not further disclose the nature of the study to minimize selection bias. For study 3b, alumni of a policy school were recruited via an email sent to all email addresses in the alumni database. The email asked for participation in a "survey dealing with behavioral economics and public policy."
Ethics oversight	Carnegie Mellon University

Note that full information on the approval of the study protocol must also be provided in the manuscript.