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1 **The role and limits of strategic framing for promoting sustainable**  
2 **consumption and policy**

3 **Lukas P. Fesenfeld<sup>a</sup>, Yixian Sun<sup>b</sup>, Michael Wicki<sup>a</sup>, and Thomas Bernauer<sup>a</sup>**

4 a. Center for Comparative and International Studies (CIS) & Institute of Science, Technology and  
5 Policy, ETH Zürich, Zürich, Switzerland

6 b. Department of Social and Policy Sciences, University of Bath, Bath, UK

7 **Paper accepted by *Global Environmental Change***

8

9 **Abstract**

10 Strategic issue framing is widely regarded as an effective communication strategy to alter public  
11 opinion and citizens' policy support. However, it is unclear to what extent strategic framing can  
12 increase support for ambitious demand-side actions and policies that make the cost of mitigation  
13 perceptible in citizens' everyday lives. Taking an exploratory approach, we conducted qualitative  
14 interviews and a comparative framing experiment with 9,750 survey respondents from China,  
15 Germany, and the United States. We analyzed strategic issue framing effects in two areas known  
16 to be key for increasing the sustainability of consumption: meat/fish consumption, and fossil-fuel  
17 car usage. Employing both classical linear regressions and advanced Bayesian sparse estimations,  
18 we show that in all three countries widespread arguments in favor of reduced meat/fish consumption  
19 and car use are unlikely to substantially alter citizens' concern, willingness to pay, behavioral  
20 intentions and policy support for demand-side action. Our findings suggest that in the absence of a  
21 broader behavioral change campaign, strategic issue framing alone is unlikely to be effective in  
22 changing entrenched attitudes and behaviors. On its own, it is also unlikely to increase public  
23 support for ambitious demand-side policies to reduce consumption. More careful research is needed  
24 to help policymakers understand the role and limits of different strategic framing techniques.

## 25 **Introduction**

26 The significant potential for reducing humanity's environmental impact lies particularly in  
27 contested areas where the costs of behavioral change are highest, such as reducing meat  
28 consumption and the use of fossil-fueled cars (Creutzig et al., 2018, 2016; Steg, 2018). A large  
29 body of research shows that such demand-side policy solutions are needed in addition to supply-  
30 side (e.g., technology-centered) policies to meet environmental and climate mitigation targets  
31 (ibid.). However, given the high visibility of costs related to demand-side environmental policy,  
32 such as higher taxes on fossil fuels or meat products, many governments face challenges of  
33 convincing citizens to accept policy interventions and changes in consumption areas like food and  
34 mobility. Arguably, the main hurdle to implementing such demand-side measures is their political  
35 feasibility, which depends on public support for policy interventions (Bernauer, 2013; Drews and  
36 van den Bergh, 2016). This, in turn, calls for a better understanding of how public support for such  
37 costly environmental policies and actions can be increased (Steg, 2018).

38 Accordingly, in the last decade social science researchers in various disciplines, including  
39 psychology, communication, and political science, have drawn on survey experiments to  
40 understand how political actors can influence public opinion by providing messages that motivate  
41 or justify policies and action (Aklin and Urpelainen, 2013; Bain et al., 2016; Bolderdijk et al.,  
42 2013a, 2013b; Chong and Druckman, 2007; Druckman, 2013; Druckman and McGrath, 2019;  
43 Nisbet and Mooney, 2007; Zhang et al., 2018). In this literature, political messages are usually  
44 called (policy) "emphasis frames" (Chong and Druckman, 2007). Emphasis framing takes place  
45 when political actors use messages to alter citizens' preferences through "(often small) changes in  
46 the presentation of an issue or an event" (Chong and Druckman, 2007, p. 104) rather than through  
47 the provision of completely new information. Many researchers agree that "framing is an effective  
48 communication strategy with identity-protective reasoning (and also more generally)" (Druckman  
49 and McGrath, 2019, p. 116), even though there is not always agreement about the direction,  
50 strength, and mechanisms of framing effects (Druckman and McGrath, 2019; Leeper and Slothuus,  
51 2018; Levine and Kline, 2017; Scheufele and Iyengar, 2014).

52 While there are many different types of frames (Chong and Druckman, 2007; Entman, 1993,  
53 Framework Institute, 2018), we focus in this paper on one of the most popular emphasis framing  
54 types: Strategic issue framing (Fesenfeld, 2020, Slothuus and De Vreese, 2010). Strategic issue  
55 framing is considered to take place when policymakers strategically emphasize specific subsets of  
56 arguments in favor of or against policy and behavior change (Chong and Druckman, 2007;  
57 Druckman and McGrath, 2019). Political actors do not always employ framing as a conscious and  
58 strategic communication strategy (Mace, 2014; Lakoff 2010). At the same time, an apparent  
59 consensus in the literature emerged that through strategic issue framing "elites can manipulate  
60 popular preferences" (Chong and Druckman, 2007, p. 120).

61 Nevertheless, it is an open empirical question to what extent strategic issue framing is effective in  
62 motivating ambitious demand-side environmental policy and sustainable consumption. Most  
63 research has focused on a single country and has not looked at the effects of issue framing for  
64 concrete behavioral implications of environmental policy. The paper at hand contributes to the  
65 literature by employing an exploratory comparative experimental research design to assess the  
66 effects of strategic issue framing on support for ambitious demand-side actions and policies across  
67 different cultures. Concerning deeply embedded cultural consumption habits, such a food and  
68 mobility behaviors, a comparative research design is important to assess the cross-country variance  
69 of framing effects on support for demand-side environmental policy (Wilk, 2002).

70 Moreover, while many researchers regard strategic framing as an effective communication strategy,  
71 it is less certain to what extent political actors can alter political attitudes and behaviors on personal  
72 meat consumption or the use of cars. This is, because such consumption changes require deep-  
73 seated cultural shifts and political measures that make the costs of mitigation visible, and are likely  
74 to become publicly salient. In such situations, respondents usually engage actively in debate and  
75 present more stable, preexisting attitudes (Bechtel et al., 2015; Ciuk and Yost, 2016; Druckman and  
76 Leeper, 2012; Slothuus, 2010). It is hence unclear if strategic issue framing can affect behaviors  
77 and public opinion about demand-side policies on such salient, culturally embedded and high-cost  
78 issues like meat consumption and car usage (Diekmann and Preisendörfer, 2003; Steg et al., 2014a).  
79 Thus, the main focus gap our paper is to evaluate the effectiveness of strategic issue framing in  
80 political debates to shift support for policies aimed at changing such entrenched behaviors. In other  
81 words, we did not aim to assess effectiveness of strategic framing used as part of a broader  
82 behavioral change campaign in directly nudging and shifting peoples' deep-rooted habits.

83 We test this open empirical question taking an exploratory approach in an original survey  
84 experiment with 9,750 respondents from China, Germany, and the US that used typical issue frames  
85 to motivate demand-side policies and action to promote sustainable consumption. Employing recent  
86 computational advances in Bayesian sparse regression approaches, in addition to classical linear  
87 models, we show that, in isolation and absent of a broader behavioral change campaign,  
88 emphasizing specific arguments in favor of sustainable consumption alone is unlikely to  
89 substantially increase public support for policies and actions to reduce consumption. Based on these  
90 findings, we discuss the implications for policy and future framing research.

## 91 **Debating the effectiveness of strategic issue framing in changing public opinion**

92 Framing theory explains that variability in the effectiveness of emphasis frames in changing  
93 opinions is due to the availability, accessibility, and applicability of policy-relevant arguments  
94 (Chong and Druckman, 2007; Nelson et al., 1997). In essence, the effectiveness of frames in altering  
95 participants' attitudes varies according to whether the related arguments are stored in individuals'  
96 memories, are retrievable, and are evaluated as appropriate in a given situation (Chong and  
97 Druckman, 2007; Nelson et al., 1997). To explain such variation in framing effectiveness,

98 researchers have also employed Bayesian updating and directional-motivated reasoning (Druckman  
99 and McGrath, 2019), which suggest that framing messages around prior beliefs, personal and  
100 cultural values increases the chance that individuals will update their attitudes in line with  
101 messages. Accordingly, social psychologists (Festinger, 1962; Kunda, 1990) suggest that  
102 individuals selectively focus on information that corresponds to prior attitudes and discard new  
103 evidence that challenges existing beliefs to reduce cognitive dissonance and effortful thinking.

104 Indeed, empirical research on environmental attitudes and behavior has indicated that frames that  
105 match individuals' values are more likely to motivate changes in attitudes and behaviors  
106 (Bolderdijk et al., 2013a; Boomsma and Steg, 2014; Borgstede et al., 2014; Graham and  
107 Abrahamse, 2017; Nilsson et al., 2016; Schultz and Zelezny, 2003). For instance, frames tailored  
108 to individuals' ideological beliefs have been evaluated as less threatening and can hence more  
109 effectively lead to the updating of environmental attitudes (Baumer et al., 2017; Druckman and  
110 McGrath, 2019; Hart and Nisbet, 2012; Wolsko et al., 2016). In the case of meat consumption, for  
111 example, it is assumed that a personal health frame appeals particularly to people with strong self-  
112 centered motives, while a animal-welfare frame more strongly to people with high self-transcended  
113 values (Cordts et al., 2014; Wellesley et al., 2015). In sum, a large number of individual-level  
114 factors could potentially moderate framing effects, including sociodemographic, ideological, and  
115 psychological variables, in line with directional motivated reasoning theory (Beiser-McGrath and  
116 Huber, 2018; Bolderdijk et al., 2013a; Drews and van den Bergh, 2016; Hornsey et al., 2016).

117 However, Druckman and McGrath (2019) have recently challenged the model of directional-  
118 motivated reasoning, arguing that existing evidence is also in line with an accuracy-motivated  
119 model in which individuals seek to assess the credibility of messages. Moreover, not all individuals  
120 consciously deliberate about the applicability of policy arguments they receive; according to dual-  
121 process theory, some individuals are persuaded by messages simply through being confronted with  
122 them (Eagly and Chaiken, 1993; Petty and Cacioppo, 1986). The degree of information processing  
123 and active deliberation appears to depend also on individual-level priors (Druckman and McGrath,  
124 2019). Moreover, issue-specific and contextual-level factors might change the effectiveness of  
125 frames in altering citizens' opinions. However, we currently lack comparative experimental  
126 evidence to assess the degree to which such context-level factors moderate effects.

127 Hence, we contribute to this debate by presenting results from a comparative and exploratory survey  
128 experiment across countries and consumption areas. Studies about the framing of environmental  
129 issues have centered primarily on the US (Aklin and Urpelainen, 2013; Bain et al., 2016, 2012;  
130 Bernauer and McGrath, 2016; Fesenfeld, 2020; Hardisty et al., 2010). Also, framing studies have  
131 rarely compared public opinion across countries with different economic, political, and cultural  
132 contexts (with some notable exceptions, e.g., Beiser-McGrath and Bernauer 2019a, Bernauer and  
133 Gampfer 2015, Whitmarsh et al. 2019). This narrow empirical focus leaves the potential of  
134 sustainability transitions in emerging economies underexplored, although the latter countries have  
135 rapidly increased their resource use and consumption footprints (He et al., 2018; Schleifer and Sun,

136 2018). Given that individuals' values and socio-economic and political conditions differ greatly  
137 between countries, framing effects may vary as well. For example, the availability, accessibility,  
138 and applicability of policy-relevant arguments for demand-side mitigation are likely to be different  
139 in China compared to the US and Germany, given the differences in the political communication  
140 cultures across those countries. Moreover, it has been argued that differences in socio-economic  
141 conditions and values explain why people in higher-income countries tend to prioritize  
142 environmental protection more than citizens in emerging economies (Franzen and Vogl, 2013;  
143 Inglehart, 1995). Such differences might also translate into cross-country differences in the  
144 effectiveness of frames in increasing support for demand-side environmental policies and actions.

145 However, while both individual- and contextual-level factors potentially moderate issue framing  
146 effects across countries, it is unclear whether such differences are substantially relevant when  
147 focusing on a contested and publically salient issue such as demand-side environmental policy in  
148 the food and transport sector. In line with the above-outlined framing theory and the elaboration  
149 likelihood model of persuasion (Petty and Cacioppo, 1986), typical policy arguments are more  
150 readily available, accessible, and applicable to citizens than in the context of salient and contested  
151 issues rather than less contested issues. According to Petty and Cacioppo, for highly salient and  
152 personally relevant issues, individuals "scrutinize and elaborate upon externally provided message  
153 arguments in light of associations available from memory; draw inferences about the merits of the  
154 arguments for a recommendation based upon their analysis; and consequently derive an overall  
155 evaluation" (Petty and Cacioppo, 1986, p. 128). In other words, individuals have greater incentives  
156 to engage in cognitively more-demanding than less-demanding, heuristic-based decision-making  
157 (Kahneman, 2011) when their personal stake is bigger and an issue more proximate to their  
158 everyday lives (see also related discussions about the effects of construing proximate and distant  
159 actions (Liberian and Trope, 2008)). This argument is in line with prior research that has shown  
160 that framing is less likely to change beliefs if citizens have already engaged in debate and have  
161 strong related preexisting attitudes (Bechtel et al., 2015; Ciuk and Yost, 2016; Druckman and  
162 Leeper, 2012; Slothuus, 2010). It is also in line with the low-cost hypothesis that postulates  
163 environmental attitudes and normative considerations to be less important predictors of  
164 environmental behavior when the cost of behavioral change increases (Diekmann and  
165 Preisendörfer, 2003; Steg et al., 2014a).

166 In sum, although past studies have found that strategic issue framing can change public opinion on  
167 various issues, it remains unclear whether and how this framing strategy is effective in the context  
168 of costly demand-side policies and actions and to what extent their effects vary across different  
169 cultures. We, therefore, designed an exploratory, cross-country survey experiment to empirically  
170 assess the effects of strategic issue framing in the area of sustainable consumption.

## 172 **Research design and data analysis**

### 173 **Case selection**

174 We conducted our comparative survey experiment (n=9,750) in three countries with large  
175 environmental footprints that are also central players in global environmental governance: China,  
176 Germany, and the US. These three countries belong to the ten countries with the highest total  
177 ecological footprint worldwide (Global Footprint Network, 2018). They vary substantially in terms  
178 of population size, socio-economic, cultural, and political systems, while they can shape global  
179 production and trading systems through changes in domestic demand. Thus, domestic policies in  
180 those countries can substantially impact global environmental change and potentially trigger policy  
181 feedback in other countries (Spilker et al., 2017). A potential limitation of our case selection is,  
182 however, that Germany is much smaller than China and the US and embedded into the EU multi-  
183 level, supra-national governance system. In contrast, the other two countries are not embedded in  
184 such a supranational political system.

185 In particular, we focus on costly- and demand-side mitigation policies and action in two  
186 consumption areas known to be key to achieving greater sustainability of consumption and which  
187 are also intertwined with citizens' everyday lives: meat/fish products, and cars that run on fossil-  
188 fuels (Godfray et al., 2018a; McCollum et al., 2018). Around twenty-six percent of worldwide  
189 greenhouse gas (GHG) emissions and seventy-eight percent of global eutrophication is associated  
190 with food systems (Poore and Nemecek, 2018). In particular, (red) meat products are a major driver  
191 of biodiversity loss (Godfray et al., 2018b; Springmann et al., 2018; Willett et al., 2019) and a  
192 principal source of global emissions of methane – a powerful greenhouse gas that increases the risk  
193 of self-accelerating climate change in the near term (Fesenfeld et al., 2018). Similarly, the vast  
194 increase in the number and use of cars that run on fossil fuels has significantly contributed to local  
195 air pollution and global climate change (Creutzig et al., 2015; Fuglestvedt et al., 2008; Howey,  
196 2012; Lelieveld et al., 2015; Mills et al., 2009). However, while the burden of consumption habits  
197 on the global ecosystem calls for a rapid transition towards more sustainable lifestyles, ordinary  
198 people may perceive such change as inconvenient, interventionist, and costly (Creutzig et al., 2018;  
199 Steg, 2018). These perceptions make these two areas particularly suitable in the study of whether  
200 strategic issue framing is an effective strategy for increasing public support for ambitious demand-  
201 side mitigation. Participants were randomly assigned to either a questionnaire about meat/fish  
202 consumption or the use of fossil-fuel-powered cars.

### 203 **Sampling**

204 To obtain representative samples in terms of age, occupation, gender, education, income, rural-  
205 urban, and region, we used quota sampling (see further details in the supplementary information  
206 (SI), Tables A-3-China, A-3-Germany and A-3-USA). Our survey experiments were internet-based  
207 and drew on samples provided by Ipsos in the three countries. While the panels maintained by Ipsos  
208 are not probability-based, they are non-convenience samples as Ipsos actively manages and

209 refreshes them to target respondents that match census statistics. For our survey, Ipsos pre-selected  
210 respondents from their panels according to the quota and constructed samples that were  
211 representative of the national voting age population in the three countries. More specifically, we  
212 used a hard quota in our sampling in an attempt to match distribution by gender, age, and region,  
213 according to each country's latest census data (China in 2010, Germany in 2013, and the US in  
214 2015; see details, SI). Additionally, we also employed a soft quota for education, income, rural-  
215 urban population, and occupation to ensure that the samples were not extensively skewed towards  
216 certain sociodemographic groups.

217 The quota worked well in Germany and the US such that our samples in these two countries closely  
218 followed distribution by income, education, rural-urban divide, and occupation in the national  
219 population (see details, SI-Tables 6b, 6c). Chinese respondents were recruited from tier I and II  
220 cities. The sample was thus skewed towards a higher-income and urban population, as rural low-  
221 income populations in China remain under-represented in all existing internet-based samples (see  
222 details, SI-Table 6a). However, due to uneven economic development in China, our sample  
223 primarily represented the most relevant population subgroup of the urban middle-class whose  
224 consumption patterns have the most significant environmental impact in the country (Wiedenhofer  
225 et al., 2017; Zhang et al., 2016) – the consumption-based carbon footprint of the urban middle-class  
226 in China (more than 6.4 tCO<sub>2</sub>/cap) is comparable to that of citizens in industrial countries like those  
227 in the EU (Wiedenhofer et al., 2017). Our samples in all three countries were thus representative of  
228 politically relevant citizens that represent the voting-age population in the two democratic cases,  
229 US and Germany, as well as the politically important, middle-class and urban population with large  
230 environmental footprints in China. The survey was conducted in the three countries during the same  
231 period – between February 15, 2018, and March 8, 2018. The median average time for survey  
232 completion was 18 minutes in the US, 17 minutes in Germany, and 14 minutes in China. We  
233 invalidated responses that were submitted within six minutes to ensure that only those respondents  
234 who had paid enough attention to the questionnaire were included in the final sample, which was  
235 thus comprised of 9,750 responses in total (i.e., 325 respondents x 5 treatment/control groups x 2  
236 consumption areas x 3 countries).

237

## 238 **Experimental and survey design**

239 Before fielding the survey, we conducted explorative, semi-structured interviews with experts  
240 (N=11) and citizens (N=33) in all three countries to identify typical issue frames that might  
241 realistically motivate citizens to support relevant sustainable consumption behavior and policies  
242 (see details in the SI, Tables SI-1a and SI-1b). In all three countries and across the two consumption  
243 areas of interest we found that arguments in favor of sustainable consumption center on four broad  
244 types of risk and benefit; namely, the protection of: animal welfare/wildlife habitat (1), the global  
245 climate (2), the local environment (3), and personal health (4) (see Figure 1). We hence designed



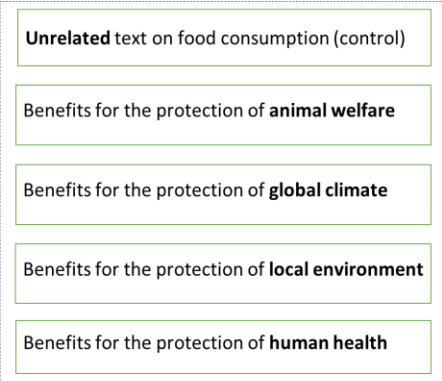
our treatments for the experiment along the lines of these real-world arguments to identify realistic policy implications concerning the effects of strategic issue framing on public support for demand-side mitigation policy and action. To increase the comparability of results across the two consumption areas, we formulated the treatments very similar concerning meat/fish consumption and car use. For example, the global climate frame read as follows in both areas:

*“A large body of scientific evidence has shown that [consumption of meat and fish products (such as farmed beef, lamb, pork, chicken, and fish)/ the use of cars that run on fossil fuels (such as diesel or gasoline)] has a negative effect on the climate worldwide. Notably, [meat and fish farming/ road traffic] results in substantial emissions of so-called greenhouse gases. Greenhouse gases such as methane and carbon dioxide cause climate change (also known as global warming), which in turn leads to sea-level rise and increases the frequency and intensity of droughts, floods, storms, and other extreme weather events in countries around the world. Reducing [consumption of meat and fish, and with this also meat and fish farming/the use of cars, and with this also road traffic], would thus help to avoid dangerous climate change that affects all countries worldwide”.*

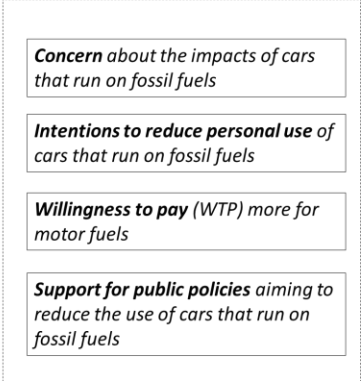
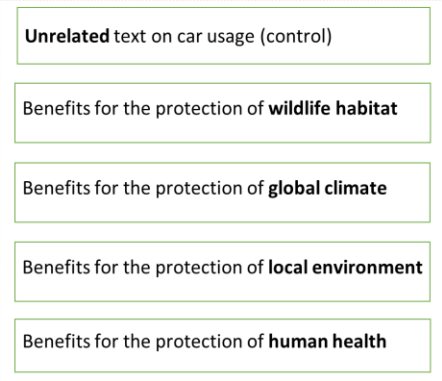
In contrast, the local environmental protection frame, for example, referred to more tangible, local environmental impacts like local soil and water pollution in the home country of the respondent. While the health frame emphasized self-centered motives and major potential personal health problems, the animal welfare frame focused on self-transcendent values and the negative effects of consumption on animals and wildlife habitat. While both animal welfare (meat case) and the protection of wildlife habitats (car case) share an underlying appeal to self-transcendent values, these two frames are not perfectly comparable (see exact wording in SI, p. 4ff). After conducting several expert and citizens interviews, we, however, decided to opt for these two framing conditions as citizens perceive them to be realistic arguments focused on changing either food or mobility behaviors.

We combined treatment texts with graphical illustrations to ensure that individuals fully understood the treatment message (Beiser-McGrath and Bernauer, 2019). Participants assigned to the control group received a placebo text and an illustration of the same length and style, but with unrelated content (see full treatment/control group wordings and graphical illustrations in the SI, p.4ff). We employed a factual manipulation check (Kane and Barabas, 2018) to ensure that participants had understood the essential information in the related frames and treatments worked as expected. Approximately 91% of respondents successfully passed the factual manipulation checks (see details per country and treatment group in SI, p.12 and p.13). To examine the effects of strategic issue framing on participants’ support for demand-side policy and action, we examined framing effects according to the more conservative intention-to-treat logic for all participants, including those who failed the manipulation check.

**Survey experiments on meat/fish consumption.**  
 Four treatments and one control in each country:  
*n* = 1626 (China)  
*n* = 1624 (Germany)  
*n* = 1624 (United States)



**Survey experiments on use of cars that run on fossil fuels.**  
 Four treatments and one control in each country:  
*n* = 1624 (China)  
*n* = 1626 (Germany)  
*n* = 1626 (United States)



*Figure 1: Experimental Design.*

283 Before providing the treatments, we measured several individual-level covariates that potentially  
 284 explain environmental policy preferences and could moderate framing effects (Bain et al., 2012;  
 285 Beiser-McGrath and Huber, 2018; Bolderdijk et al., 2013a; Drews and van den Bergh, 2016;  
 286 Druckman and McGrath, 2019; Graham and Abrahamse, 2017; Steg et al., 2014b). Respondents  
 287 first answered a series of questions designed to collect general sociodemographic data about items  
 288 such as their gender, age, income, education, number of adult and non-adult family members, and  
 289 several items on their political ideology (the questions about political ideology could not be asked  
 290 in China due to government restrictions on such survey activity). All items were measured via  
 291 established question scales (e.g., variables for left-right ideology, party identification, and degree  
 292 of government intervention were based on measures taken from the US General Social Survey,  
 293 Gallup, and the German GESIS database).

294 Second, participants were asked to report their current pattern of personal meat/fish consumption  
 295 or personal use of cars, depending on the questionnaire to which they had been randomly assigned.  
 296 Namely, they were asked to indicate the average amount and type of meat/fish they eat per week or  
 297 the yearly driving distance and type of car they drive most often.

298 Third, we inquired about the potential criteria participants apply when choosing food products or  
 299 means of transport (e.g., sustainability-related criteria such as a product’s impact on the  
 300 environment and health, but also other more egotropic choice criteria like product prices). Also, we  
 301 measured to what extent individuals would perceive it personally challenging to stop their

302 consumption of meat/fish products or use of cars (depending on the personal consumption behavior,  
303 as indicated in the previous section of the survey), and how much they perceived that consuming  
304 those goods is important for their personal quality of life. We also measured their prior awareness  
305 of potential sustainability problems associated with meat/fish consumption or fossil-fuel-powered  
306 car use, as highlighted by the respective framing treatment. Please note that we have only asked  
307 respondents about their prior awareness about the potential sustainability impact of their  
308 consumption behavior related to the respective framing treatment they received in order to avoid  
309 any potential pretreatment effects. To avoid any pretreatment effects, we also did not ask this  
310 question in the control group.

311 Fourth, we used the Environmental Portrait Value scale, which is based on the Human Value scale  
312 (Bouman et al., 2018; Bouman and Steg, 2019; Schwartz et al., 2001), and is an established measure  
313 for assessing how personal values (i.e., hedonic, egoistic, biospheric, and altruistic values) affect  
314 environmental attitudes and behaviors across cultures and countries. Prior research suggests that  
315 the effectiveness of frames in motivating sustainable behavior and policies varies specifically  
316 concerning such personal values (see e.g., Bolderdijk et al., 2013a).

317 After the treatments, we employed four outcome measures. While stated-preference outcomes face  
318 the risk of social desirability and ceiling effects, we designed the dependent variables in a way to  
319 minimize these risks. The first outcome variable is individuals' concern about the impact of  
320 unsustainable consumption with two items, which we used to construct an additive index. The order  
321 of these items was randomized to prevent ordering effects. Both items were measured on a seven-  
322 point Likert scale and asked individuals to evaluate how concerned they are about the impact of  
323 either consuming meat/fish products or using cars that run on fossils for themselves and their  
324 families.

325 Second, we measured support for public policies to reduce the consumption of meat/fish products  
326 or use of cars that run on fossil fuels. Here, we asked respondents to indicate their level of support  
327 for those policies with costly implications in everyday life on a seven-item Likert scale ("strongly  
328 oppose" to "strongly support").

329 Third, we measured respondents' willingness to pay more for meat/fish products or motor fuel as  
330 part of an increase in tax on those products. In line with the literature on environmental taxes (see  
331 e.g., Klenert et al., 2018; Springmann et al., 2017), we assume that higher prices discourage  
332 consumption of those products. We first showed respondents a realistic average price for meat/fish  
333 or motor fuel in their country and asked them to indicate on a scale from 0 to 100 percent how much  
334 more they would be willing to pay for the respective product. To increase the external validity of  
335 our findings and reduce potential social desirability bias, we connected respondents' responses (as  
336 percentages) to the respective price increase. We showed them how much money on average they  
337 would personally have to pay for meat/fish or motor fuels under the related tax scenario.

338 The fourth outcome variable is individuals' intentions to change personal behavior. To measure it,  
339 we reminded respondents about the amount of meat/fish products they personally consume or their  
340 personal average driving distance (as reported by respondents before the treatments). In addition,  
341 we asked them if and by how much they would be willing to reduce their individual consumption  
342 on a scale from 0 to 100 percent. A slider was used to illustrate the respective reduction in the  
343 amount of meat/fish they would consume (or personal driving distance) to help them relate their  
344 response to real data and their everyday lives. As the cognitive interviews during the survey pretests  
345 showed, the design of this question was user-friendly and supported the external validity of  
346 findings.

347 Overall, the survey and treatment design followed the established process for conducting survey-  
348 embedded framing experiments, and we carefully used qualitative and quantitative pretests to  
349 ensure a high level of treatment and question comprehensibility and external validity. The full  
350 treatment texts and graphs, as well as full question wordings, are attached to the supplementary  
351 information (SI).

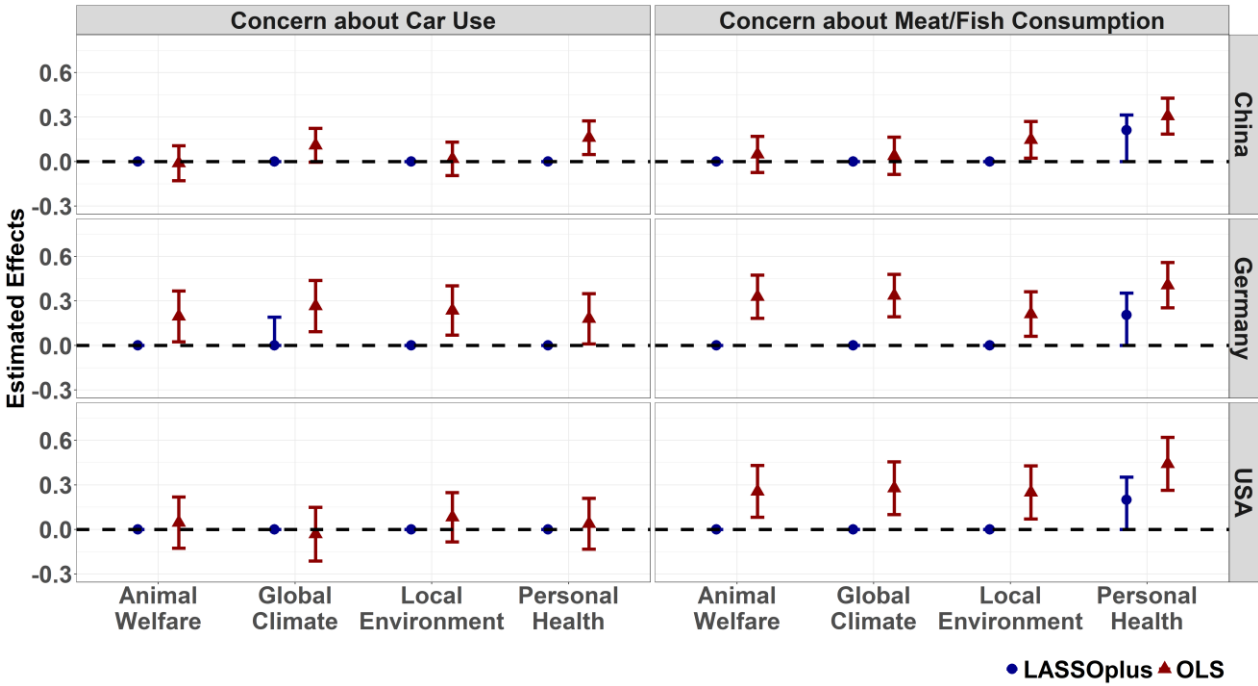
## 352 **Data analysis**

353 We focused our main analyses on individuals who eat meat and/or fish products or drive a car  
354 themselves. Given that these respondents are particularly affected by demand-side mitigation  
355 measures, it is particularly important to assess the effects of strategic issue framing for this  
356 subsample. Moreover, following an obvious logic, we could only ask respondents for their  
357 willingness to pay and intention to change behavior if they had already indicated that they either  
358 consume meat/fish products or drive a car that runs on fossil fuels. In essence, to enable easy and  
359 valid comparability across the different outcome variables, we focused the presentation of results  
360 for all outcomes on the subsample of individuals who stated that they eat meat and/or fish products,  
361 or drive a car themselves. Moreover, robustness tests (see Tables SI-2a-Robust and SI-3a-Robust)  
362 show that the results do not change substantially when computing effects based on the full sample.  
363 This is because most respondents in our sample do eat meat and/or fish products (97% of all  
364 respondents, N=4738), or drive a car themselves (86% of respondents, N=4223; see country-level  
365 details in SI, Tables SI-7a and SI-7b). We employed classical ordinary least squares (OLS)  
366 regressions with robust standard errors to estimate treatment effects. All dependent variables were  
367 standardized (z-transformed) to allow for a comparative assessment of effect sizes.

368 It is important to highlight that effect sizes in message and framing research are often  
369 misunderstood, and "the effect size - a quantitative representation of the effect of a variable on an  
370 outcome is often confused with the size of the effect of a message on an outcome" (O'Keefe, 2017,  
371 p. 210). In our experiment, we are interested in both the potential differences between different  
372 framing treatments as well as in comparison to a placebo control group. Using a placebo control  
373 group allows us to distinguish between the effect size as a difference between treatment conditions  
374 and the size of our framing treatments on an outcome compared to the control group. To ensure

375 sufficient statistical power to detect even small to moderate framing effects we build on Cohen's d  
376 standardized estimates from meta-analytical reviews of emphasis framing experiments in the  
377 political domain. According to Amsalem and Zoizner (2020) the standardized mean effect size of  
378 emphasis frames on individuals' political attitudes is  $d = 0.4$ . Based on this meta-analytical estimate  
379 for Cohen's d, we reach 0.95 statistical power (using two-tailed student's t-test,  $\alpha = 0.05$ ) with  
380 164 respondents per treatment group. Given our experimental design with an average of 325  
381 respondents per condition, our findings are clearly based on sufficient statistical power.

382 To check for the robustness and substantive relevance of framing effects, we went beyond the use  
383 of standard linear regression. We employed a recently developed Bayesian sparse regression  
384 method, LASSOplus, to identify not only relevant main, but also heterogeneous treatment effects  
385 (Ratkovic and Tingley, 2017). Sparse regression tools like LASSOplus use a "regularization  
386 parameter" to shrink or remove weak and irrelevant estimates from the model in order to avoid  
387 overfitting and focus on the key predictors for the outcome variable in question. In other words,  
388 LASSOplus penalizes weak and noisy effects to reduce variance. This penalization lowers the risk  
389 of reporting false positives and substantially irrelevant effects. While this approach leads to very  
390 conservative estimations of main effects, the method is a particularly suitable tool for testing  
391 heterogeneous treatment effects in a situation of limited N. Specifically, it allows for the estimation  
392 and selection of multiple effects simultaneously, without engaging in potentially arbitrary sub-  
393 setting of data. Thus, compared to classical linear regressions, LASSOplus provides more  
394 conservative and robust estimates with credible intervals and permits the efficient estimation of  
395 interaction effects that can be interpreted independently of their lower-order terms (see further  
396 details on its prior structure and regularization parameters in Ratkovic and Tingley 2017). We use  
397 LASSOplus in addition to classical OLS models to assess the robustness and substantial relevance  
398 of results more carefully. Such advanced sparse regression and machine learning techniques should  
399 not substitute theoretically driven selection of model parameters, but be seen as a complementary  
400 method for assessing the relevance and robustness of estimated treatment effects, especially  
401 interaction effects, to predict policy support and behavioral intentions. Our premise is that  
402 substantially relevant treatment effects should be detectable when using both OLS and LASSOplus  
403 regressions. This is, the differences between treatment effects that are only detectable by OLS  
404 regressions but not the more conservative LASSOplus regressions tend to be weak and not  
405 substantially relevant for shifting policy attitudes and behavior in real-world settings.



407

408 *Figure 2: Comparison of framing treatment effects on concern about meat/fish consumption and use of*  
 409 *cars that run on fossil fuels from classical linear regressions (marked in red) and Bayesian LASSOplus*  
 410 *sparse regressions (marked in blue).*

411 *Note: Red triangles and error bars represent treatment effects and 95 percent confidence intervals obtained from OLS*  
 412 *regressions with robust standard errors using the R “estimatr” package. Blue circles and error bars represent the*  
 413 *posterior median and 95 percent credible intervals obtained from Bayesian LASSOplus regressions using the R*  
 414 *“sparsereg” package, with the default settings of 200 saved posterior samples, and a burn-in of 200 samples using*  
 415 *thinning (retaining every tenth sample).*

416 Turning to the empirical findings, Figure 2 shows that when using classic linear regression models  
 417 with robust standard errors (OLS estimates and 95% confidence intervals marked in red), in China,  
 418 a personal health message increased respondents’ concern about the impact of using cars that run  
 419 on fossil fuels only slightly, by 0.16 standard deviations. While in Germany all frames slightly  
 420 boosted average concern compared to the control group by 0.18 and 0.27 standard deviations, in  
 421 the US none of the frames increased concern about the impact of fossil-fueled car use. Also using  
 422 OLS regressions, we find that in China respondents’ concern about the impact of meat/fish  
 423 consumption increased by 0.31 and 0.15 standard deviations for respondents in the health and local  
 424 environmental treatment group, respectively. In Germany and the US, when conducting classical  
 425 linear regression analyses all frames increased concern by 0.21 and 0.44 standard deviations  
 426 compared to the control group. Importantly, differences between framing treatment conditions were  
 427 not significant across countries and consumption areas, with the exception of the health frame that  
 428 significantly increases concern of Chinese respondents about the impact of meat/fish consumption.

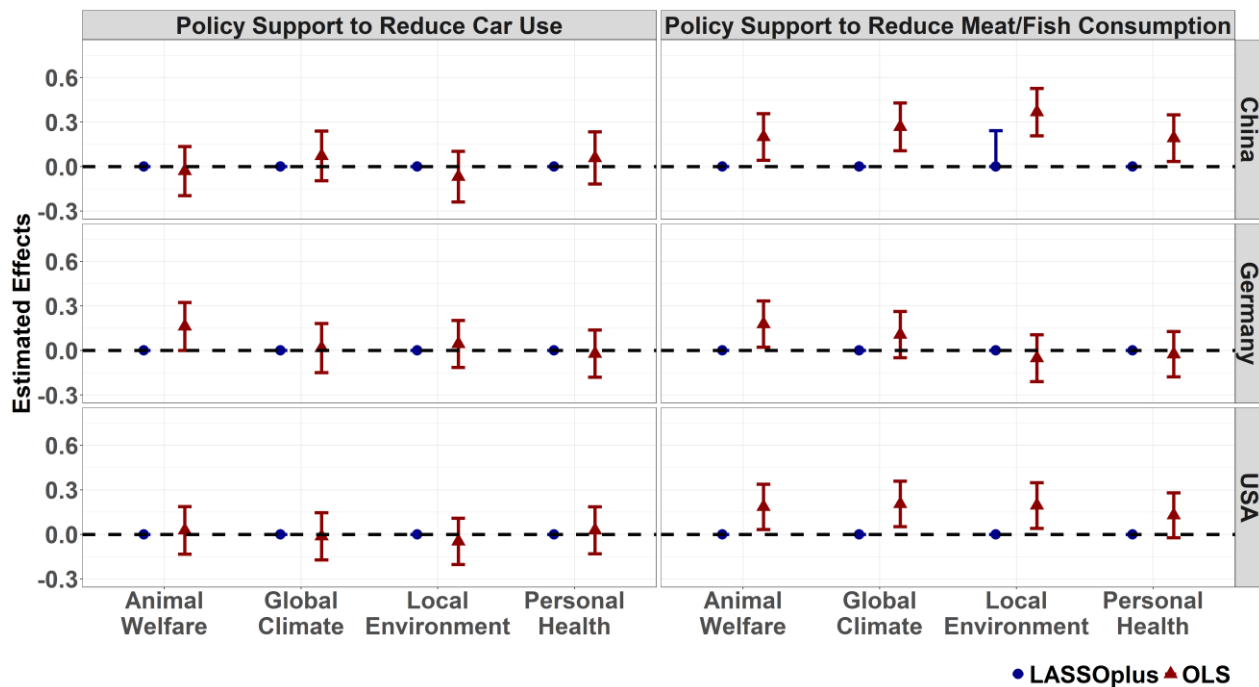
429 When using a more conservative sparse regression estimation approach (LASSOplus-based  
 430 posterior median and 95% credible intervals marked in blue), only the personal health frame still  
 431 had a robust and positive effect (compared to the control group) on citizens’ concern about the

432 impact of meat and fish consumption in all three countries. The estimated posterior median of the  
433 health-framing effects in China, Germany, and the US ranged between 0.18 and 0.21, while all  
434 other framing effects across countries and consumption areas converged to a posterior median of  
435 nil and are thus effectively irrelevant when using the more conservative estimation approach of  
436 LASSOplus. In other words, this result implies that the health frame is the most likely strategic  
437 issue frame to substantially increase individuals' level of concern about meat/fish consumption in  
438 real-world settings across all three countries.

439 Moreover, LASSOplus permits the estimation of a large-set of potential interactions between  
440 individual-level characteristics and framing conditions without risking over-fitting or arbitrary  
441 subsetting of data. However, including a large number of potential moderating variables did not  
442 lead to any significant interaction effects with the frames in the three countries and two consumption  
443 areas (see all evaluated moderators in the survey design section and detailed regression results in  
444 SI-Tables 2b). These results challenge directional-motivated reasoning theory and existing studies  
445 (Bolderdijk et al., 2013a; Boomsma and Steg, 2014; Borgstede et al., 2014; Graham and  
446 Abrahamse, 2017; Nilsson et al., 2016), which suggest that individuals with high biospheric values  
447 react significantly more to framing arguments centered on such values (e.g., animal welfare, local  
448 environmental- or global climate protection), and the personal health frame is expected to  
449 particularly appeal to individuals with strong egoistic values. In fact, our empirical findings do not  
450 show any relevant and significant interaction effects between individuals' personal values and any  
451 of the treatment effects in all three countries and in both the context of meat/fish or fossil-fueled  
452 car use (see posterior median is zero for all interactions between personal values and treatment  
453 conditions in SI-Tables 2b).

454 Likewise, while individuals' ideological beliefs have been mentioned as important moderators of  
455 framing effects (Baumer et al., 2017; Druckman and McGrath, 2019; Hart and Nisbet, 2012;  
456 Wolsko et al., 2016), in Germany and the US we do not find any significant interactions effects. In  
457 both consumption areas, the framing effects did not significantly differ between individuals with  
458 different ideological predispositions (see posterior median is zero for all interactions between  
459 individuals' ideological positions [e.g., left-right position] and treatment conditions in SI-Tables  
460 2b). Please note that we could not gather any information on ideological positions of Chinese  
461 respondents due to the country's regulation. We also find no robust evidence that framing effects  
462 vary systematically across countries. Yet, some differences exist between the two consumption  
463 contexts: the health frame increases concern primarily in respect to meat/fish consumption, but not  
464 with the use of fossil-fueled cars.

465



466

467 *Figure 3: Comparison of framing treatment effects on policy support to reduce meat/fish consumption*  
 468 *and use of cars that run on fossil fuels from classical linear regressions (marked in red) and Bayesian*  
 469 *LASSOplus sparse regressions (marked in blue).*

470 *Note: Red triangles and error bars represent treatment effects and 95 percent confidence intervals obtained from OLS*  
 471 *regressions with robust standard errors. Blue circles and error bars represent the posterior median and 95 percent*  
 472 *credible intervals obtained from Bayesian LASSOplus regressions. The dashed line represents the control group.*

473 Figure 3 shows that based on classic linear regression models with robust standard errors (OLS  
 474 estimates and 95% confidence intervals marked in red) only the wildlife habitat/animal welfare  
 475 treatment in Germany slightly increased policy support for reducing the use of cars that run on  
 476 fossil fuels (0.16 standard deviations). None of the other treatment conditions had any effect on  
 477 policy support across all three countries. All effects drop to nil, including the wildlife habitat/animal  
 478 welfare treatment effect in Germany, when employing more conservative Bayesian LASSOplus  
 479 regressions (posterior median and 95% credible intervals marked in blue). Moreover, there are no  
 480 significant effect differences between the various framing conditions on policy support to reduce  
 481 car use countries when using both OLS and LASSOplus.

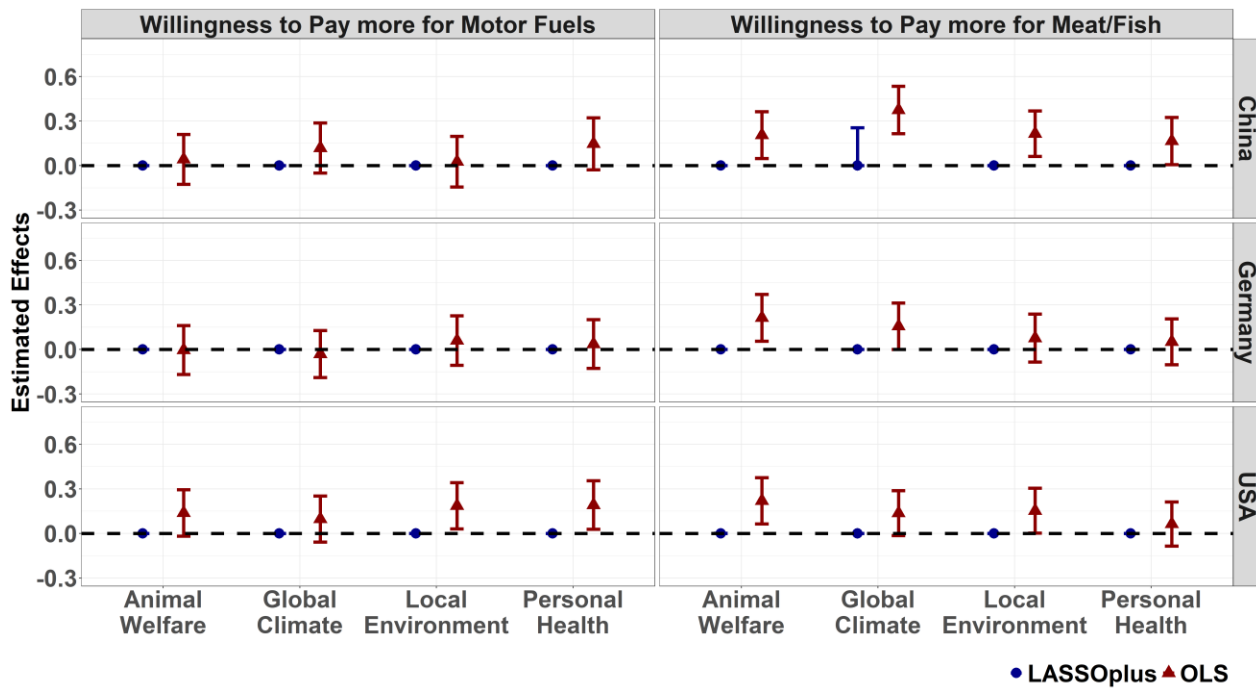
482 In contrast to the lack of policy support for reducing car use, in all framing conditions Chinese  
 483 respondents increased their policy support for reducing meat/fish consumption by 0.19 to 0.37  
 484 standard deviations compared to the control group when using OLS regressions. However, those  
 485 effect estimates are again not substantially relevant in size and not significantly different compared  
 486 to each other. Using LASSOplus regressions shows that the posterior median for all frames drops  
 487 to nil. In essence, it is very likely that the positive framing effects detected through OLS regressions  
 488 are false positives or of negligible size in real-world settings. We see a similar pattern when looking  
 489 at the German and US sample. While based on OLS regressions in Germany the animal welfare  
 490 frame has a positive effect of 0.18 standard deviations compared to the support level for policies



491 aimed at reducing meat consumption in the control group, the posterior median of the animal  
492 welfare frame is zero when using LASSOplus regressions. In the US, based on OLS regressions all  
493 frames, but the health frame, have positive effects on policy support that range between 0.19 and  
494 0.21 standard deviations compared to the control group. However, again for all treatments we do  
495 not find any significant differences between framing conditions. Moreover, LASSOplus reveals  
496 that the posterior median is zero. In essence, the positive framing effects (compared to the control  
497 group) identified through classical OLS models are likely false positives or reveal effect sizes that  
498 are substantially-speaking negligible.

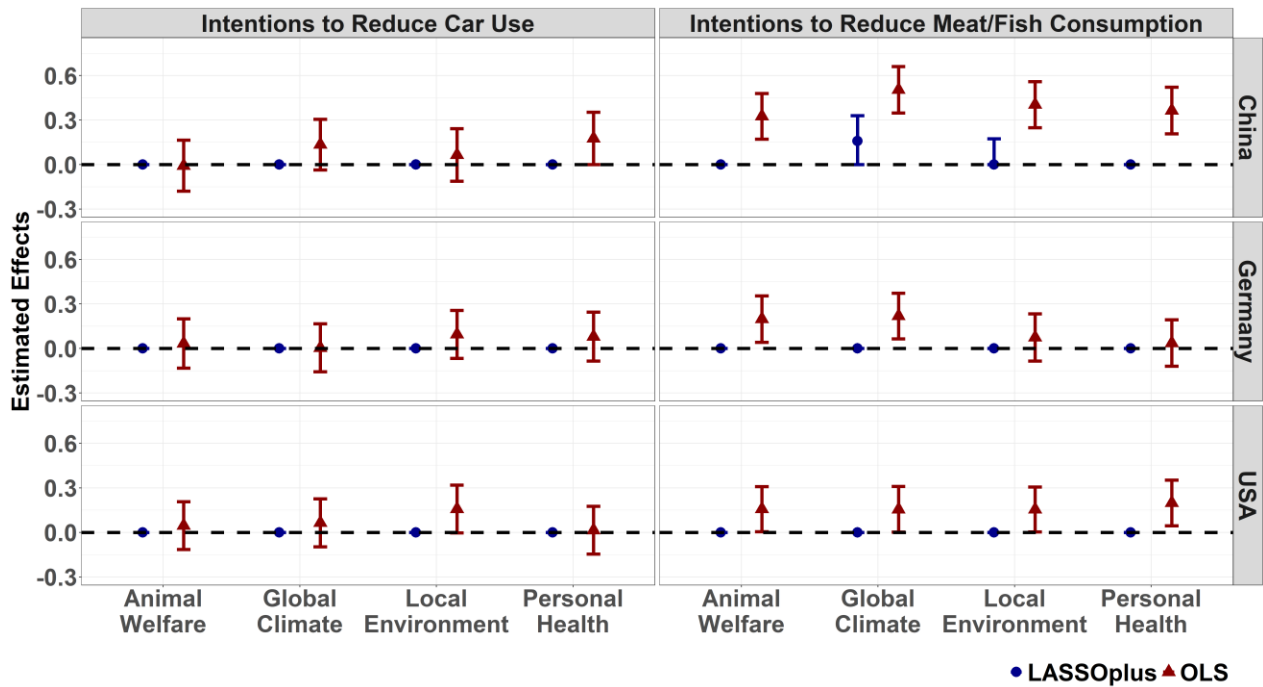
499 We also do not find any positive and robust interaction effects between any of the frames and  
500 individual-level factors like individual ideological predispositions (e.g., left-right position),  
501 personal values (e.g., self-transcendent and self-centered values), prior consumption habits (e.g.,  
502 amount of meat consumed per week) and criteria (e.g., convenience or price criterion), or  
503 sociodemographics (e.g., age, gender, or education). In essence, for all these treatment-covariate  
504 interactions the posterior median is zero (see detailed regression output in Tables SI-3b). In other  
505 words, our findings do not support prior research that suggests that tailoring messages to an  
506 audience increases the effectiveness of frames in changing individuals' environmental attitudes  
507 (Bain et al., 2012; Bolderdijk et al., 2013a; Druckman and McGrath, 2019; Graham and Abrahamse,  
508 2017).

509 Figures 4 and 5 show a very similar pattern to Figure 3. While OLS regressions suggest that some  
510 of the framing conditions increase individual willingness to pay more for meat/fish products (but  
511 less so for motor fuels) in the form of an additional tax, differences between framing conditions are  
512 not significant and weak. Moreover, the posterior median in LASSOplus regressions drops to zero  
513 and indicates a high probability of false positive or small effects (see Figure 4). Figure 5 shows  
514 framing effects on individuals' intentions to reduce personal car use and meat/fish consumption.  
515 Here, the posterior median of almost all framing conditions is zero – only the global climate frame  
516 in China increases the intention of respondents to reduce meat/fish consumption substantially and  
517 robustly in both OLS (0.50 standard deviations greater than for the control group) and LASSOplus  
518 regression models (0.16 standard deviations). Again we do not find any relevant interaction effects  
519 between the frames and various individual-level variables (e.g., personal consumption habits,  
520 income, education, ideological predispositions and personal values) in respect to the willingness to  
521 pay and behavioral intention outcomes (see posterior median is zero for all treatment interactions  
522 in Tables SI-4b and SI5b). In sum, the consistent finding of our experiment across the two  
523 consumption areas and three countries is that via classical OLS regressions we can identify some  
524 framing effects compared to the control group, but most effect differences between treatment  
525 conditions are not significant. Finally, the more conservative LASSOplus models suggest that most  
526 of the identified framing effects from OLS regressions are likely to be false positives or of  
527 negligible size.



528 *Figure 4: Comparison of framing treatment effects on willingness to pay more for motor fuels and*  
 529 *meat/fish products (by adding a tax on those products) from classical linear regressions (marked in red)*  
 530 *and Bayesian LASSOplus sparse regressions (marked in blue).*

531 *Note: Red triangles and error bars represent treatment effects and 95 percent confidence intervals obtained from OLS*  
 532 *regressions with robust standard errors. Blue circles and error bars represent the posterior median and 95 percent*  
 533 *credible intervals obtained from Bayesian LASSOplus regressions. The dashed line represents the control group.*



534 *Figure 5: Comparison of framing treatment effects on intentions to reduce the use of cars that run on*  
 535 *fossil fuels and meat/fish products from classical linear regressions (marked in red) and Bayesian*  
 536 *LASSOplus sparse regressions (marked in blue).*

537 *Note: Red triangles and error bars represent treatment effects and 95 percent confidence intervals obtained from OLS*  
 538 *regressions with robust standard errors. Blue circles and error bars represent the posterior median and 95 percent*  
 539 *credible intervals obtained from Bayesian LASSOplus regressions. The dashed line represents the control group.*

## 540 Discussion

541 Overall, our results point to the limits of strategic issue framing techniques used in isolation, rather  
542 than integrated into a holistic behavioral change campaign, with regard to increasing public support  
543 for measures to reduce meat/fish consumption and the use of cars running on fossil fuels. In essence,  
544 we find that only the personal health frame robustly increases individuals' concern about the impact  
545 of meat/fish consumption across all three countries. The finding of a robust effect of the personal  
546 health frame is in line with prior research that suggests appealing to egoistic motives is the most  
547 successful strategy for motivating a reduction in meat consumption (Cordts et al., 2014; Wellesley  
548 et al., 2015). It is, however, very questionable if these increased levels of concern translate into real  
549 behavioral changes and support for ambitious demand-side policies. In fact, across countries and  
550 consumption areas we do not find any robust evidence that increased levels of concern translate  
551 into changes in behavioral intentions, willingness to pay, or policy support. In other words, even in  
552 a stated-preference context that does not require individuals to reveal actual behavioral change, we  
553 do not find any robust and substantially meaningful framing effects. This underscores existing  
554 skepticism about the effectiveness of using strategic issue framing on its own in respect to demand-  
555 side measures with visible cost-implications for citizens' everyday lives.

556 Moreover, our findings show that strategic issue framing alone is ineffective in motivating a  
557 reduction in the use of cars that run on fossil fuels. None of the issue frames (not even the personal  
558 health frame) had any robust effects on the outcome variables in the car-related case across all three  
559 countries. Our comparative study also does not find any evidence that any of the issue frames  
560 typically used to motivate demand-side measures affect individuals to a substantially different  
561 degree from each other or differently depending on the country context or individual-level  
562 parameters. This finding contrasts with prior research that has highlighted the importance of  
563 tailoring political messages in order to increase their effectiveness in changing public opinion (Bain  
564 et al., 2012; Baumer et al., 2017; Bolderdijk et al., 2013b, 2013a; Druckman and McGrath, 2019;  
565 Graham and Abrahamse, 2017; Wolsko et al., 2016).

566 Our results suggest that strategic issue framing alone is not sufficient to increase support for  
567 ambitious environmental policies that involve clearly visible cost implications in citizens' everyday  
568 lives. The findings also suggest that we need to be more cautious when interpreting framing effects  
569 from survey-embedded experiments, especially at the subgroup level. The nil finding of strategic  
570 issue framing effects across the three countries, two consumption areas and across different  
571 subgroups could suggest that directional motivated reasoning (Druckman and McGrath, 2019) plays  
572 a less important role when evaluating the strategic issue frames presented in this study. Cognitive  
573 dissonance theory (Festinger, 1962) and directional-motivated reasoning models (Druckman and  
574 McGrath, 2019; Kunda, 1990) imply that individuals actively focus on information that corresponds  
575 to their prior attitudes and values, while discarding information that contrasts existing beliefs. Yet,  
576 we do not find that individuals react more positively or negatively to any of the issue frames if those

577 align or not align with their prior attitudes or values. In contrast to most of the existing literature  
578 that has investigated support for environmental policies in general, our study makes the costs and  
579 everyday implications of demand-side environmental policies easily perceptible to respondents.

580 There are several interpretations of this finding. First, it could be that the tested frames in this study  
581 were not strong enough to lead to substantial motivated reasoning, and that stronger frames would  
582 lead to significant interactions in line with individuals' priors. The second interpretation could be  
583 that in respect to more salient issues, people generally engage in more conscious decision-making  
584 routes and actively weigh different arguments against each other. In other words, in such more  
585 conscious situations individuals employ their priors less often as heuristics to evaluate framing  
586 treatments. As outlined above according to the elaboration likelihood model of persuasion (Petty  
587 and Cacioppo, 1986), in such salient settings, it is more likely that individuals have stable prior  
588 attitudes that are not easily affected through a simple issue frame (Bechtel et al., 2015; Ciuk and  
589 Yost, 2016; Druckman and Leeper, 2012; Slothuus, 2010). Potentially, strategic issue framing could  
590 have larger effects on attitudes in areas in which costs are less visible. However, it is questionable  
591 to what extent the cost implications of ambitious environmental policy measures can and should be  
592 obscured from citizens.

593 While we have good confidence in the robustness of our results, there are clearly some limitations.  
594 Even though the findings are based on large samples in different countries and consumption  
595 contexts, conservative Bayesian sparse regressions, and both quantitative and qualitative pretests,  
596 we acknowledge the following shortcomings. To start with, we did not use the full spectrum of  
597 available frames to motivate support and behavioral change. In this study, we only focus on one  
598 particular – while widespread – type of emphasis framing: strategic issue framing. Future research  
599 should extend the generalizability of our results to other types of frames, for instance social norm  
600 (Bouman and Steg, 2019; Mildemberger and Tingley, 2017), source-cue (Dür, 2019) or  
601 psychological distance frames (Brügger et al., 2015). For example, social norm- or second-order  
602 belief frames that emphasize a broad consensus about the importance of protecting the environment  
603 and changes in personal lifestyles (Bouman and Steg, 2019; Mildemberger and Tingley, 2017) could  
604 be more effective in altering environmental attitudes and behaviors than the arguments typically  
605 used to communicate the benefits of ambitious environmental policy. Future research should also  
606 test the degree to which active information processing mediates different types of framing effects.

607 Moreover, research has also shown that affective campaign messages, for example with respect to  
608 health issues, are more effective in changing attitudes and behaviors when paired with a specific  
609 call to action (Noar, 2006). Hence, further research should assess whether strategic issue framing  
610 is more likely to create substantially meaningful effects when embedded into broader behavioral  
611 change campaigns that effectively follow established principles of campaign design (e.g., audience  
612 segmentation, message design, and channel selection) and provide individuals with clear, tangible  
613 action guidance and nudges for changing their attitudes and behaviors.

614 In addition, the information context is key to understanding the effectiveness of frames in altering  
615 attitudes and behaviors (Chong and Druckman, 2007; Jacobs, 2011). Not only is the availability,  
616 accessibility, and applicability of potential counterframes relevant in real political debates (Aklin  
617 and Urpelainen, 2013; Druckman, 2013), but also the salience of particular arguments. The salience  
618 of arguments is likely to depend heavily on political context and the existence of focal events  
619 (Jacobs, 2011). Recent extreme weather events or food scandals can offer policymakers windows  
620 of opportunity to employ framing strategies and effectively shift public opinion, potentially even in  
621 relation to ambitious demand-side environmental policies. Future research should also conduct  
622 similar experiments across different EU countries and emerging economies with growing  
623 population and consumption demands to test the generalizability of our findings.

624 Finally, and more fundamentally, one can question the suitability of the widespread methodological  
625 approach taken by survey-embedded framing experiments. While only a few studies have  
626 scrutinized this standard empirical approach to conducting framing experiments (Barabas and Jerit,  
627 2010; Bechtel et al., 2015; Kahan and Carpenter, 2017; Kinder, 2007; Leeper and Slothuus, 2018;  
628 Levine and Kline, 2017), our study suggests that the existing literature might have over-reported  
629 significant framing effects. In light of well-known biases against the reporting of zero effects  
630 (Fanelli, 2010) and weak pre-registration standards, many insignificant and weak framing effects  
631 may well not be published or enter the review process in the first place. It could also be that the  
632 established method of embedding information-based framing experiments into surveys simply  
633 lacks sufficient ecological validity and results would substantially change when testing frames in  
634 more field-experimental settings (Barabas and Jerit, 2010). In particular, we note three general  
635 concerns about the current standard of conducting survey-experimental research to understand  
636 public opinion about environmental or sustainability issues – including the study at hand.

637 First, most studies have employed survey-embedded experiments at one point in time and in one  
638 specific country, often the US. This is particularly problematic, as in reality changes in the framing  
639 of a political issue such as climate change may only have effects over time and may strongly depend  
640 on the information context (e.g., the presence of focal events). Second, confronting individuals with  
641 simple information treatments in a single survey-experiment runs the risk of involving them in  
642 unrealistic settings of low ecological validity. In reality, political entrepreneurs use multiple  
643 combined rational and emotional cues, building on voice, imagery, and written text to alter citizens'  
644 climate attitudes and action (Kinder, 2007). Also, counter-framing and argumentative competition  
645 take place in reality, but seldom in survey-embedded experiments. Framing effects are likely to be  
646 substantially weaker if arguments in favor of and against climate mitigation cancel each other out  
647 (Aklin and Urpelainen, 2013; Druckman, 2013). Accordingly, field experiments may be a better  
648 approach than online survey experiments to investigate to what extent strategic framing changes  
649 behavioral intentions, support for the uptake of policy incentives to change behavior, or the  
650 behavior itself. The third concern is that most studies do not make use of advanced methods, such  
651 as Bayesian sparse regressions, to reduce the risk of the inefficient and noisy estimation of effects.

652 This failure to use more conservative estimations approaches to control for valid covariates and  
653 interactions can lead to false-positive results and underpowered analyses, even in perfectly  
654 randomized experiments (Grimmer et al., 2017; Ratkovic and Tingley, 2017).

## 655 **Conclusion**

656 In this paper, we present the results of a comparative framing experiment with 9,750 survey  
657 respondents in China, Germany, and the US that studied strategic issue framing effects in two areas  
658 known to be key to increasing the sustainability of consumption: meat/fish consumption, and fossil-  
659 fuel car use. Employing both classical linear regressions and advanced Bayesian sparse estimations,  
660 we show that strategic issue framing alone is unlikely to alter concern, willingness to pay,  
661 behavioral intentions, and policy support for demand-side action. We do not find robust and  
662 substantially relevant differences between the effects of different popular strategic issue frames  
663 across the two studied consumption areas and three countries. Our findings question the  
664 effectiveness of strategic issue framing used in isolation, rather than embedded into holistic  
665 behavioral change campaigns, in influencing public support for ambitious environmental policy  
666 that makes the cost of mitigation visible in citizens' everyday lives. Moreover, we call for a  
667 systematic review of existing framing studies that extends the generalizability of the present study,  
668 that checks the robustness of existing research on different framing types to alter environmental  
669 attitudes and behaviors, and that empirically validates the assumption that the literature might have  
670 over-reported significant framing effects and false positives. Our results also encourage researchers  
671 to rethink established methods of conducting framing experiments, an activity that we consider to  
672 be crucial to advance knowledge about effective communication and understanding its limits in  
673 relation to building public support for effective environmental actions and policies.

674 For political actors interested in adopting ambitious environmental policies, it is key to better  
675 understanding how strategic framing and the substantive features of policies interact and can be  
676 designed in ways to increase public support. One promising strategy for increasing public support  
677 is packaging policies with visible demand-side mitigation costs together with policies that  
678 compensate citizens by including clear benefits for the latter, or that redistribute costs to producers  
679 (Beiser-McGrath and Bernauer, 2019; Carattini et al., 2018; Fesenfeld et al., 2020; Fesenfeld, 2018;  
680 Klenert et al., 2018; Wicki et al., 2019a, Wicki et al, 2019b). Policy packaging accounts for the  
681 prevailing beliefs and preferences of citizens rather than trying to change them through strategic  
682 framing. In particular, in the context of policy packaging it is essential for political entrepreneurs  
683 to highlight those policy design features that benefit citizens and effectively mitigate sustainability  
684 problems, rather than to re-frame the contextual issue and focus of the overarching debate (e.g.,  
685 trying to emphasize animal welfare rather than climate change impacts of meat consumption).

686 In summary, future studies should embrace the full spectrum of available methods, account for the  
687 potential interactions between strategic policy framing and design, and thereby actively identify  
688 feasible and effective environmental policies.

689 **List of References**

- 690 Amsalem, E., Zoizner, A., 2020. Real, but Limited: A Meta-Analytic Assessment of Framing  
691 Effects in the Political Domain. *Br. J. Polit. Sci.*, 1–17.
- 692 Aklin, M., Urpelainen, J., 2013. Debating clean energy: Frames, counter frames, and audiences.  
693 *Glob. Environ. Chang.* 23, 1225–1232. <https://doi.org/10.1016/j.gloenvcha.2013.03.007>
- 694 Bain, P.G., Hornsey, M.J., Bongiorno, R., Jeffries, C., 2012. Promoting pro-environmental action  
695 in climate change deniers. *Nat. Clim. Chang.* 2, 603–603.
- 696 Bain, P.G., Milfont, T.L., Kashima, Y., Bilewicz, M., Doron, G., Garðarsdóttir, R.B., Gouveia, V.  
697 V., Guan, Y., Johansson, L.-O., Pasquali, C., Corral-Verdugo, V., Aragonés, J.I., Utsugi, A.,  
698 Demarque, C., Otto, S., Park, J., Soland, M., Steg, L., González, R., Lebedeva, N., Madsen,  
699 O.J., Wagner, C., Akotia, C.S., Kurz, T., Saiz, J.L., Schultz, P.W., Einarsdóttir, G.,  
700 Saviolidis, N.M., 2016. Co-benefits of addressing climate change can motivate action around  
701 the world. *Nat. Clim. Chang.* 6, 1–6.
- 702 Barabas, J., Jerit, J., 2010. Are survey experiments externally valid? *Am. Polit. Sci. Rev.* 104,  
703 226–242. <https://doi.org/10.1017/S0003055410000092>
- 704 Baumer, E.P.S., Polletta, F., Pierski, N., Gay, G.K., 2017. A simple intervention to reduce  
705 framing effects in perceptions of global climate change. *Environ. Commun.* 11, 289–310.
- 706 Bechtel, M.M., Hainmueller, J., Hangartner, D., Helbling, M., 2015. Reality Bites: The Limits of  
707 Framing Effects for Salient and Contested Policy Issues. *Polit. Sci. Res. Methods* 3, 683–  
708 695. <https://doi.org/10.1017/psrm.2014.39>
- 709 Beiser-McGrath, Liam F., Bernauer, T., 2019. Commitment failures are unlikely to undermine  
710 public support for the Paris agreement. *Nat. Clim. Chang.* 9, 248–252.  
711 <https://doi.org/10.1038/s41558-019-0414-z>
- 712 Beiser-McGrath, Liam F., Bernauer, T., 2019. Could revenue recycling make effective carbon  
713 taxation politically feasible? *Sci. Adv.* 5, eaax3323.
- 714 Beiser-McGrath, L.F., Huber, R.A., 2018. Assessing the relative importance of psychological and  
715 demographic factors for predicting climate and environmental attitudes. *Clim. Change* 1–13.
- 716 Bernauer, Gampfer, R., 2015. How robust is public support for unilateral climate policy? *Environ.*  
717 *Sci. Policy* 54, 316–330.
- 718 Bernauer, T., 2013. Climate change politics. *Annu. Rev. Polit. Sci.* 16, 421–448.
- 719 Bernauer, T., McGrath, L.F., 2016. Simple reframing unlikely to boost public support for climate  
720 policy. *Nat. Clim. Chang.* 6, 680–683.
- 721 Bolderdijk, J., Gorsira, M., Keizer, K., Steg, L., 2013a. Values Determine the ( In ) Effectiveness  
722 of Informational Interventions in Promoting Pro-Environmental Behavior. *PLoS One* 8, 1–7.  
723 <https://doi.org/10.1371/journal.pone.0083911>
- 724 Bolderdijk, J., Steg, L., Geller, E.S., Lehman, P.K., Postmes, T., 2013b. Comparing the  
725 effectiveness of monetary versus moral motives in environmental campaigning. *Nat. Clim.*  
726 *Chang.* 3, 413–416. <https://doi.org/10.1038/nclimate1767>
- 727 Boomsma, C., Steg, L., 2014. The effect of information and values on acceptability of reduced  
728 street lighting. *J. Environ. Psychol.* 39, 22–31.
- 729 Borgstede, C. Von, Andersson, M., Hansla, A., Borgstede, C. Von, Andersson, M., 2014. Value-

- 730 Congruent Information Processing : The Role of Issue Involvement and Argument Strength  
731 Value-Congruent Information Processing : The Role of Issue Involvement and Argument  
732 Strength 3533. <https://doi.org/10.1080/01973533.2014.958226>
- 733 Bouman, T., Steg, L., 2019. Motivating Society-wide Pro-environmental Change. *One Earth* 1,  
734 27–30. <https://doi.org/10.1016/j.oneear.2019.08.002>
- 735 Bouman, T., Steg, L., Kiers, H.A.L., 2018. Measuring values in environmental research: A test of  
736 an environmental Portrait Value Questionnaire. *Front. Psychol.* 9, 1–15.  
737 <https://doi.org/10.3389/fpsyg.2018.00564>
- 738 Brügger, A., Dessai, S., Devine-Wright, P., Morton, T. A., & Pidgeon, N. F. 2015. Psychological  
739 responses to the proximity of climate change. *Nat. Clim. Chang.* 5(12), 1031-1037.
- 740 Carattini, S., Carvalho, M., Fankhauser, S., 2018. Overcoming public resistance to carbon taxes.  
741 *Wiley Interdiscip. Rev. Clim. Chang.* 9, e531.
- 742 Chong, D., Druckman, J., 2007. Framing Theory. *Annu. Rev. Polit. Sci.* 10, 103–126.  
743 <https://doi.org/10.1146/annurev.polisci.10.072805.103054>
- 744 Ciuk, D.J., Yost, B.A., 2016. The Effects of Issue Salience, Elite Influence, and Policy Content on  
745 Public Opinion. *Polit. Commun.* 33, 328–345.  
746 <https://doi.org/10.1080/10584609.2015.1017629>
- 747 Cordts, A., Nitzko, S., Spiller, A., 2014. Consumer Response to Negative Information on Meat  
748 Consumption in Germany. *Int. Food Agribus. Manag. Rev.* 17.
- 749 Creutzig, F., Fernandez, B., Haberl, H., Khosla, R., Mulugetta, Y., Seto, K.C., 2016. Beyond  
750 Technology: Demand-Side Solutions for Climate Change Mitigation. *Annu. Rev. Environ.  
751 Resour.* 41, 173–98. <https://doi.org/10.1146/annurev-environ-110615-085428>
- 752 Creutzig, F., Jochem, P., Edelenbosch, O.Y., Mattauch, L., van Vuuren, D.P., McCollum, D.,  
753 Minx, J., 2015. Transport: A roadblock to climate change mitigation? *Science* (80-. ). 350,  
754 911–912.
- 755 Creutzig, F., Roy, J., Lamb, W.F., Azevedo, I.M.L., Bruin, W.B. De, Dalkmann, H., Edelenbosch,  
756 O.Y., Geels, F.W., Grubler, A., Hepburn, C., Hertwich, E.G., Khosla, R., Mattauch, L.,  
757 Minx, J.C., Ramakrishnan, A., Rao, N.D., Steinberger, J.K., Tavoni, M., Weber, E.U., 2018.  
758 Towards demand-side solutions for mitigating climate change. *Nat. Clim. Chang.* 8, 260–  
759 271.
- 760 Diekmann, A., Preisendörfer, P., 2003. Green and greenback the behavioral effects of  
761 environmental attitudes in low-cost and high-cost situations. *Ration. Soc.* 15, 441–472.
- 762 Drews, S., van den Bergh, J.C.J.M., 2016. What explains public support for climate policies? A  
763 review of empirical and experimental studies. *Clim. Policy* 16, 855–876.
- 764 Druckman, J., 2013. Public opinion: Stunted policy support. *Nat. Clim. Chang.* 3, 617–617.  
765 <https://doi.org/10.1038/nclimate1939>
- 766 Druckman, J., 2001. The Implications of Framing Effects Implications for Citizen Competence.  
767 *Polit. Behav.* 23, 225–256. <https://doi.org/10.1023/A:1015006907312>
- 768 Druckman, J.N., Leeper, T.J., 2012. Learning more from political communication experiments:  
769 Pretreatment and its effects. *Am. J. Pol. Sci.* 56, 875–896.
- 770 Druckman, J.N., McGrath, M.C., 2019. The evidence for motivated reasoning in climate change  
771 preference formation. *Nat. Clim. Chang.* <https://doi.org/10.1038/s41558-018-0360-1>



- 772 Dür, A., 2019. How interest groups influence public opinion: Arguments matter more than the  
773 sources. *European journal of political research* 58(2), pp.514-535.
- 774 Eagly, A.H., Chaiken, S., 1993. *The psychology of attitudes*. Harcourt Brace Jovanovich College  
775 Publishers.
- 776 Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of*  
777 *communication*, 43(4), 51-58.
- 778 Fanelli, D., 2010. “Positive” results increase down the hierarchy of the sciences. *PLoS One* 5,  
779 e10068.
- 780 Fesenfeld, L. P. The Political Feasibility of Transformative Climate Policy–Public Opinion about  
781 Transforming Food and Transport Systems. ETH Research Collection.  
782 <https://doi.org/10.3929/ethz-b-000425564>
- 783 Fesenfeld, L. P., Wicki, M., Sun, Y., & Bernauer, T. 2020. Policy packaging can make food  
784 system transformation feasible. *Nature Food*, 1(3), 173-182.
- 785 Fesenfeld, L. P. 2018. The Effects of Policy Packaging on Public Support for Transformative  
786 Policies. ETH Research Collection.
- 787 Fesenfeld, L.P., Schmidt, T.S., Schrode, A., 2018. Climate policy for short- and long-lived  
788 pollutants. *Nat. Clim. Chang.* 8, 933–936.
- 789 Festinger, L., 1962. *A theory of cognitive dissonance*. Stanford university press.
- 790 Franzen, A., Vogl, D., 2013. Two decades of measuring environmental attitudes: A comparative  
791 analysis of 33 countries. *Glob. Environ. Chang.* 1001–1008.
- 792 Framework Institute, Communications Jobs of 12 Frame Elements, 2018, (available at  
793 [https://www.frameworksinstitute.org/assets/files/PDF/comms\\_jobs.pdf](https://www.frameworksinstitute.org/assets/files/PDF/comms_jobs.pdf)).
- 794 Fuglestedt, J., Berntsen, T., Myhre, G., Rypdal, K., Skeie, R.B., 2008. Climate forcing from the  
795 transport sectors. *Proc. Natl. Acad. Sci.* 105, 454–458.
- 796 Global Footprint Network, 2018. Global Footprint Network [WWW Document]. URL  
797 <https://data.footprintnetwork.org/#/>
- 798 Godfray, J., Aveyard, P., Garnett, T., Hall, J.W., Key, T.J., Lorimer, J., Pierrehumbert, R.T.,  
799 Scarborough, P., Springmann, M., Jebb, S.A., 2018a. Meat consumption, health, and the  
800 environment. *Science*. 361. <https://doi.org/10.1126/science.aam5324>
- 801 Godfray, J., Aveyard, P., Garnett, T., Hall, J.W., Key, T.J., Lorimer, J., Pierrehumbert, R.T.,  
802 Scarborough, P., Springmann, M., Jebb, S.A., 2018b. Meat consumption, health, and the  
803 environment. *Science*. 361.
- 804 Graham, T., Abrahamse, W., 2017. Communicating the climate impacts of meat consumption:  
805 The effect of values and message framing. *Glob. Environ.* 44, 98–108.  
806 <https://doi.org/10.1016/j.gloenvcha.2017.03.004>
- 807 Grimmer, J., Messing, S., Westwood, S.J., 2017. Estimating heterogeneous treatment effects and  
808 the effects of heterogeneous treatments with ensemble methods. *Polit. Anal.* 25, 413–434.
- 809 Hardisty, D., Johnson, E., Weber, E., 2010. A dirty word or a dirty world? Attribute framing,  
810 political affiliation, and query theory. *Psychol. Sci.*
- 811 Hart, P.S., Nisbet, E.C., 2012. Boomerang effects in science communication: How motivated  
812 reasoning and identity cues amplify opinion polarization about climate mitigation policies.

- 813 Communic. Res. 39, 701–723.
- 814 He, P., Baiocchi, G., Hubacek, K., Feng, K., Yu, Y., 2018. The environmental impacts of rapidly  
815 changing diets and their nutritional quality in China. *Nat. Sustain.* 1, 122–127.
- 816 Hornsey, M.J., Harris, E.A., Bain, P.G., Fielding, K.S., 2016. Meta-analyses of the determinants  
817 and outcomes of belief in climate change. *Nat. Clim. Chang.* 6, 622.
- 818 Howey, D.A., 2012. Policy: A challenging future for cars. *Nat. Clim. Chang.* 2, 28.
- 819 Inglehart, R., 1995. Public Support for Environmental Protection: Objective Problems and  
820 Subjective Values in 43 Societies. *PS Polit. Sci. Polit.* 28, 57. <https://doi.org/10.2307/420583>
- 821 Jacobs, A.M., 2011. *Governing for the long term: democracy and the politics of investment.*  
822 Cambridge University Press.
- 823 Kahan, D.M., Carpenter, K., 2017. Out of the lab and into the field. *Nat. Clim. Chang.* 7, 309.
- 824 Kahneman, D., 2011. *Thinking, fast and slow.* Macmillan.
- 825 Kane, J. V., Barabas, J., 2018. No Harm in Checking: Using Factual Manipulation Checks to  
826 Assess Attentiveness in Experiments. *Am. J. Pol. Sci.* 00, 1–16.  
827 <https://doi.org/10.1111/ajps.12396>
- 828 Kinder, D.R., 2007. Curmudgeonly advice. *J. Commun.* 57, 155–162.  
829 <https://doi.org/10.1111/j.1460-2466.2006.00335.x>
- 830 Klenert, D., Mattauch, L., Combet, E., Edenhofer, O., Hepburn, C., Rafaty, R., Stern, N., 2018.  
831 Making carbon pricing work for citizens. *Nat. Clim. Chang.* 8, 669–677.
- 832 Kunda, Z., 1990. The case for motivated reasoning. *Psychol. Bull.* 108, 480.
- 833 Lakoff, G., 2010, Why it matters how we frame the environment. *Environ. Commun.* 4, 70–81.
- 834 Leeper, T., Slothuus, R., 2018. Can Citizens Be Framed? How Persuasive Information More than  
835 Emphasis Framing Changes Political Opinions.
- 836 Lelieveld, J., Evans, J.S., Fnais, M., Giannadaki, D., Pozzer, A., 2015. The contribution of  
837 outdoor air pollution sources to premature mortality on a global scale. *Nature* 525, 367.
- 838 Levine, A.S., Kline, R., 2017. A new approach for evaluating climate change communication.  
839 *Clim. Change* 142, 301–309.
- 840 Liberman, N., Trope, Y., 2008. The Psychology of Transcending the Here and Now. *Science.*  
841 322.
- 842 Mace, G. M. 2014. Whose conservation?. *Science* 345(6204), 1558-1560.
- 843 McCollum, D.L., Wilson, C., Bevione, M., Carrara, S., Edelenbosch, O.Y., Emmerling, J.,  
844 Guivarch, C., Karkatsoulis, P., Keppo, I., Krey, V., Lin, Z., Broin, E., Paroussos, L., Pettifor,  
845 H., Ramea, K., Riahi, K., Sano, F., Rodriguez, B.S., van Vuuren, D.P., 2018. Interaction of  
846 consumer preferences and climate policies in the global transition to low-carbon vehicles.  
847 *Nat. Energy* 3, 1–10. <https://doi.org/10.1038/s41560-018-0195-z>
- 848 Mildemberger, M., Tingley, D., 2017. Beliefs about Climate Beliefs: The Importance of Second-  
849 Order Opinions for Climate Politics. *Br. J. Polit. Sci.* 1–29.  
850 <https://doi.org/10.1017/S0007123417000321>
- 851 Mills, N.L., Donaldson, K., Hadoke, P.W., Boon, N.A., MacNee, W., Cassee, F.R., Sandström,  
852 T., Blomberg, A., Newby, D.E., 2009. Adverse cardiovascular effects of air pollution. *Nat.*

853 Rev. Cardiol. 6, 36.

854 Nelson, T., Oxley, Z.M., Clawson, R.A., 1997. Toward a psychology of framing effects. *Polit.*  
855 *Behav.* 19, 221–246.

856 Nilsson, A., Hansla, A., Heiling, J.M., Bergstad, C.J., Martinsson, J., 2016. Public acceptability  
857 towards environmental policy measures: Value-matching appeals. *Environ. Sci. Policy* 61,  
858 176–184. <https://doi.org/10.1016/j.envsci.2016.04.013>

859 Nisbet, M.C., Mooney, C., 2007. Science and society: Framing science. *Science.* 316, 56.  
860 <https://doi.org/10.1126/science.1142030>

861 Noar, S.M., 2006. A 10-year retrospective of research in health mass media campaigns: Where do  
862 we go from here? *J. Health Commun.* 11, 21–42.

863 O’Keefe, D. J., 2017. Misunderstandings of effect sizes in message effects research.  
864 *Communication Methods and Measures*, 11(3), 210-219.

865 Petty, R.E., Cacioppo, J.T., 1986. The elaboration likelihood model of persuasion, in:  
866 *Communication and Persuasion*. Springer, New York, pp. 1–24.

867 Poore, J., Nemecek, T., 2018. Reducing food ’ s environmental impacts through producers and  
868 consumers 992, 987–992.

869 Ratkovic, M., Tingley, D., 2017. Sparse estimation and uncertainty with application to subgroup  
870 analysis. *Polit. Anal.* 25, 1–40.

871 Rickard, L.N., Yang, Z.J., Schuldt, J.P., 2016. Here and now, there and then: How “departure  
872 dates” influence climate change engagement. *Glob. Environ. Chang.* 38, 97–107.

873 Scheufele, D., Iyengar, S., 2014. The State of Framing Research: A Call for New Directions, in:  
874 *The Oxford Handbook of Political Communication*. Oxford University Press, New York, pp.  
875 1–26. <https://doi.org/10.1093/oxfordhb/9780199793471.013.47>

876 Schleifer, P., Sun, Y., 2018. Emerging markets and private governance: the political economy of  
877 sustainable palm oil in China and India. *Rev. Int. Polit. Econ.* 25, 190–214.

878 Schultz, P.W., Zelezny, L., 2003. Reframing Environmental Messages to be Congruent with  
879 American Values. *Hum. Ecol. Rev.* 10, 126–136.

880 Schwartz, S.H., Melech, G., Lehmann, A., Burgess, S., Harris, M., Owens, V., 2001. Extending  
881 the cross-cultural validity of the theory of basic human values with a different method of  
882 measurement. *J. Cross. Cult. Psychol.* 32, 519–542.

883 Singh, S.P., Swanson, M., 2017. How issue frames shape beliefs about the importance of climate  
884 change policy across ideological and partisan groups. *PLoS One* 12, e0181401.

885 Slothuus, R., 2010. When can political parties lead public opinion? Evidence from a natural  
886 experiment. *Polit. Commun.* 27, 158–177. <https://doi.org/10.1080/10584601003709381>

887 Slothuus, R., & De Vreese, C. H. 2010. Political parties, motivated reasoning, and issue framing  
888 effects. *The Journal of Politics* 72(3), 630-645.

889 Spilker, G., Koubi, V., Bernauer, T., 2017. International political economy and the environment,  
890 in: *Oxford Research Encyclopedia of Politics*.

891 Springmann, M., Clark, M., Mason-D’Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., de  
892 Vries, W., Vermeulen, S.J., Herrero, M., Carlson, K.M., 2018. Options for keeping the food  
893 system within environmental limits. *Nature* 562, 1.

- 894 Springmann, M., Mason-D’Croz, D., Robinson, S., Wiebe, K., Godfray, H.C.J., Rayner, M.,  
895 Scarborough, P., 2017. Mitigation potential and global health impacts from emissions pricing  
896 of food commodities. *Nat. Clim. Chang.* 7, 69–74.
- 897 Steg, L., 2018. Limiting climate change requires research on climate action. *Nat. Clim. Chang.* 8,  
898 759–761.
- 899 Steg, L., Bolderdijk, J.W., Keizer, K., Perlaviciute, G., 2014a. An Integrated Framework for  
900 Encouraging Pro-environmental Behaviour: The role of values, situational factors and goals.  
901 *J. Environ. Psychol.* 38, 104–115. <https://doi.org/10.1016/j.jenvp.2014.01.002>
- 902 Steg, L., Bolderdijk, J.W., Keizer, K., Perlaviciute, G., 2014b. An Integrated Framework for  
903 Encouraging Pro-environmental Behaviour : The role of values , situational factors and  
904 goals. *J. Environ. Psychol.* 38, 104–115. <https://doi.org/10.1016/j.jenvp.2014.01.002>
- 905 Thaler, R. H., & Sunstein, C. R. 2009. *Nudge: Improving decisions about health, wealth, and*  
906 *happiness.* Penguin
- 907 Wellesley, L., Happer, C., Froggatt, A., 2015. *Changing Climate, Changing Diets Pathways to*  
908 *Lower Meat Consumption.* Chatham House Rep.
- 909 Whitmarsh, L., Xenias, D., Jones, C.R., 2019. Framing effects on public support for carbon  
910 capture and storage. *Palgrave Commun.* 5, 17. <https://doi.org/10.1057/s41599-019-0217-x>
- 911 Wicki, M., Fesenfeld, L., Bernauer, T., 2019a. In Search of Politically Feasible Policy-Packages  
912 for Sustainable Transport: Insights from Choice Experiments in China, Germany, and the  
913 USA. *Environ. Res. Lett.* 14.
- 914 Wicki, M., Huber, R., Bernauer, T. 2019b. Can Policy-Packaging Increase Public Support for  
915 Costly Policies? Insights from a Choice Experiment on Policies against Vehicle Emissions.  
916 *J. Public Policy.*
- 917 Wiedenhofer, D., Guan, D., Liu, Z., Meng, J., Zhang, N., Wei, Y.-M., 2017. Unequal household  
918 carbon footprints in China. *Nat. Clim. Chang.* 7, 75.
- 919 Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T.,  
920 Tilman, D., Declerck, F., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S.,  
921 Cornell, S.E., Reddy, K.S., Narain, S., Nishtar, S., Murray, C.J.L., Wood, A., Jonell, M.,  
922 Clark, M., Gordon, L.J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., De Vries, W.,  
923 Majele Sibanda, L., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F.,  
924 Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell,  
925 S.E., Srinath Reddy, K., Narain, S., Nishtar, S., Murray, C.J.L., 2019. Food in the  
926 Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems.  
927 *Lancet (London, England)* 393, 447–492. [https://doi.org/10.1016/S0140-6736\(18\)31788-4](https://doi.org/10.1016/S0140-6736(18)31788-4)
- 928 Wilk, R. 2002. Consumption, human needs, and global environmental change. *Global*  
929 *Environmental Change*, 12(1), 5-13.
- 930 Wolsko, C., Ariceaga, H., Seiden, J., 2016. Red, white, and blue enough to be green: Effects of  
931 moral framing on climate change attitudes and conservation behaviors. *J. Exp. Soc. Psychol.*  
932 65, 7–19.
- 933 Zhang, B., Van Der Linden, S., Mildenerger, M., Marlon, J.R., Howe, P.D., Leiserowitz, A.,  
934 2018. Experimental effects of climate messages vary geographically. *Nat. Clim. Chang.* 8.  
935 <https://doi.org/10.1038/s41558-018-0122-0>
- 936 Zhang, L., Xu, Y., Oosterveer, P., Mol, A.P.J., 2016. Consumer trust in different food

