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Thinking through norms can make them more effective. Experimental evidence on reflective climate policies in the UK

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ABSTRACT

Adopting low-carbon diets is important to meet our climate goals. Prior experimental evidence suggests green nudges help people adopt such diets, more so when encouraged to think through them. In this paper, we re-evaluate this role of reflection in a "social norm" nudge to promote intentions for climate-friendly diets in the United Kingdom. Using 5,555 English respondents, we find that the social norm nudge increases meal order intentions for low-carbon diets versus the control condition. Asking people to reveal their personal dietary norms after exposing them to these social norms ("lower-order nudge+") does not produce any measurable change compared to the nudge. However, when people are subsequently encouraged to think and pledge to climate-friendly diets ("higher-order nudge+"), the effectiveness of the social norm nudge increases by 90% or more.

1. Introduction

Carbon-intensive diets, such as meat and dairy, contribute substantially to greenhouse gas emissions.[1] Adopting low-carbon diets has one of the highest mitigation potential (Shukla et al., 2022), and therefore switching people towards climate-friendly diets is key to meeting our climate goals. However, diets are complex human behaviours. Shaped by environmental constraints and social norms, they remain difficult to change (Brulotte & Di Giovine, 2016; Caplan, 2013; Rozin, 1996; Stoll-Kleemann & Schmidt, 2017). Here, regulatory and economic policies – like meat taxes or bans – limit people's choices and have low public acceptability (Hagman, Andersson, Västfjäll, & Tinghög, 2015; Reynolds et al., 2019). This can hamper their potential to induce demand-led changes in dietary behaviours (Milford, Le Mouël, Bodirsky, & Rolinski, 2019). On the other hand, recent literature suggests that liberty-preserving interventions, like nudges (Thaler & Sunstein, 2008), can be quite effective in promoting climate-friendly diets (Gravert & Kurz, 2021; Kurz, 2018; Lohmann, Gsottbauer, Doherty, & Kontoleon, 2022). Recently, Banerjee, Galizzi, John, and Mourato (2022b) added to this literature by showing that when people are encouraged to think

before being defaulted to climate-friendly diets, their intentions for greener dietary options increase significantly compared to the standalone nudge. Coupling reflection with a nudge in this way, referred to as a nudge+ (Banerjee & John, 2021), therefore, can increase the nudge's effectiveness. But do these effects of reflection hold across other nudges as well? In this paper, we re-evaluate the role of reflection in a "social norm" nudge to promote intentions for low-carbon diets among 5555 English individuals.

We choose a social norm nudge to replicate this effect of reflection for two reasons. First, while social norm messaging has been used extensively in many domains of behaviour change,[2] their use in sustainable dietary transformations is sparse (Byerly et al., 2018), with mixed evidence on their effectiveness (Brachem, Krüdewagen, & Hagmayer, 2019; Çoker et al., 2022; Sparkman & Walton, 2017). We add robustness to prior findings by re-evaluating the effectiveness of social norms in fostering climate-friendly diets. Second, we also investigate whether people's likelihood to pledge and conform to social norms is driven by an alignment of their personal norms with the said social norms. This is important as failures of social norm nudges[3] have been attributed to a lack of *norm internalisation* — a phenomenon

[1] For an assessment of the impact on the climate of diverting away from meat and dairy, see Audsley and Wilkinson (2014), Hedenus, Wirsenius, and Johansson (2014) and Stehfest et al. (2009). To estimate the carbon footprint of food products at the global scale, see Poore and Nemecek (2018). Scarborough et al. (2014) performs a similar exercise for the United Kingdom.

[2] See Bergquist, Nilsson, and Schultz (2019) for a recent meta-analysis on social norm nudges.

[3] See Dur, Fleming, van Garderen, and van Lent (2021), Gravert and Collentine (2021), Kantorowicz-Reznichenko and Kantorowicz (2021) and Mol, Botzen, Blasch, Kranzler, and Kunreuther (2021) for studies on social norm nudges that failed.

whereby individual preferences are either non-aligned to social norms or unaffected by them (Bicchieri & Dimant, 2019; Entwistle, 2021; Hall, 2021; Hauser, Gino, & Norton, 2018; Mols, Haslam, Jetten, & Steffens, 2015; Sunstein, 2017). We also explore underlying heterogeneity in the effect of commitment pledges, and elicit social-demographic profiles on which they are more effective.

Social norm nudges are posited to work by signalling normative social identities to people (Cialdini, 2007; Reno, Cialdini, & Kallgren, 1993). In re-testing Banerjee et al. (2022b), we incrementally increase the degree of reflection added to a social norm nudge: first, by asking people to reflect on their personal norms with respect to the social norm ("lower-order nudge+"); second, by asking them to think about conforming to the social norm by taking a pledge ("higher-order nudge+"). Pledges have been shown to increase compliance with norms and foster honest behaviours (Ariely & Jones, 2012; Cotterill, 2014; Cotterill, John, & Richardson, 2013; Jacquemet, James, Luchini, & Shogren, 2017; Jacquemet, Joule, Luchini, & Shogren, 2013; Jacquemet, Luchini, Malézieux, & Shogren, 2020; Shu, Mazar, Gino, Ariely, & Bazerman, 2012). Consequently, we present findings from a parallel–subjects design, where participants were randomly assigned to 1 in 4 conditions: a control condition, the social norm nudge condition, a lower-order nudge+ condition, and a higher-order nudge+ condition. Nudge+ modifies the nudge by adding an element of reflection in it. While many nudges might already have some passive reflective component, the nudge+ upgrades the nudge by making this "thinking" element more active (Banerjee & John, 2021).

We test our propositions using a preregistered, quasi-consequential[4] online experiment in which individuals had to place an order for online meal delivery. The social norm nudge significantly lowered intended meal orders for carbon-intensive items like meat and dairy. On average, individuals exposed to the social norm message chose menu items with 18% lower carbon emissions than the control condition. In the lower-order nudge+ condition, asking people to elicit their norms had no measurable change in their intentions for climate-friendly diets compared to the social norms condition. However, in the higher-order nudge+ condition, when individuals were encouraged to think about these norms and pledge to consume climate-friendly diets, they chose greener options, almost doubling the effectiveness of the social norm nudge. Our findings align with Banerjee et al. (2022b), who find similar effects of combining the pledge with a green default nudge. Unlike Banerjee et al. (2022b), we cannot test the effect of standalone reflection versus the control condition due to sampling and budgetary constraints. Further, the effect of reflection was stronger for those who were already motivated, like those who had reported they were currently trying or might change their diets in the future. Contrarily, there was a backlash from those that reported no intentions to make their diets less carbon-intensive. These findings are robust across multiple specifications, which include spatial fixed effects at the individual's zip-code level, conditions for the individual's compliance with treatments, and control for lasso-selected covariates. Our experimental insights add validity to prior evidence that suggests adding reflection to a nudge, such as with a nudge+ strategy (see Banerjee and John 2021), can improve the effectiveness of the standalone nudge in promoting climate citizenship.

Our findings have important implications for practitioners in the food industry, particularly in online settings, who can use citizen-oriented policies such as reflective prompts to boost pro-environmental choices among their customers. We discuss the policy implications of

our findings more broadly in the remainder of the paper. Next, we outline our experimental design. Then, we discuss our methodological approach before presenting the experimental findings. We conclude by discussing how to upscale reflective behavioural policies to engage citizens in environmentally sustainable lifestyles.

2. Experimental design

We administered a preregistered[5], quasi-consequential online experiment to a gender-balanced pool of 5555 English individuals recruited via prolific between 1st March 2022 and 15th April 2022. All respondents were paid at standard prolific reward rates. The survey was written in English and designed using Qualtrics. The survey experiment and a detailed survey design plan are available in the Online Appendix. The decision-making task in the experiment was set up in four stages, as outlined below.

Stage 1: Individuals were checked for their attention using a preregistered attention screener.[6] If they failed the attention check, they were reminded to pay attention to the survey.

Stage 2: Then, individuals were randomly assigned to one in four experimental conditions, where each condition mimicked a particular behavioural public policy such as a nudge or nudge+ condition. Following this, all individuals were presented with specific sets of restaurant menus from which they could choose a food item.

Stage 3: Next, individuals were taken to a check-out screen to place their intended order for the online meal delivery.

Stage 4: Finally, individuals were assessed on their compliance with the experimental conditions, using a preregistered manipulation check where they were asked to recall an aspect of their randomly assigned treatment vignette.[7]

Randomisation described in stage 2 was delivered to vary the level of reflection individuals had on the social norm nudge. It worked as follows. First, in the "control" condition, individuals were given a baseline set of menus without any nudge or reflective prompt. Second, in the "social norm" nudge condition, individuals were shown a dynamic and descriptive social norm message. Third, in the "social norm + personal norms" condition, individuals were shown the said social norm message. Then they were asked to reveal their personal norms. In particular, we asked them if they were trying to change their diets to become climate-friendly. This corresponds to the first (lower-order) nudge+ condition in which we assessed if making people reflect on their personal norms concerning the social norm message could increase its effectiveness. Fourth, in the "social norm + personal norms + pledge" condition, individuals were exposed to the social norm message, asked to report their personal norms, and then offered to pledge to climate-friendly diets.[8] This corresponds to the second

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[4] Participants were told that they could win 1 in 60 vouchers to help them order the same dishes. However, due to privacy laws and confidentiality, authors could not track participant orders, making the food choices in the experiment partly consequential. Similar approaches have been taken in the experimental literature to elicit food choices (see Shreedhar and Galizzi (2021, p7)).

[5] The experiment was preregistered on Open Science Foundation (OSF) platform, and the pre-analysis documents are available here.

[6] They were asked the following question: *Most modern theories of decision making recognise that decisions do not take place in a vacuum. Individual preferences and knowledge, along with situational variables can greatly impact the decision process. To demonstrate that you've read this much, just go ahead and select both red and green among the alternatives below. Based on the text you read above, what colour have you been asked to select?* Options include: "White", "Black", "Red", "Pink", "Green", "Blue".

[7] We asked the following question: *Before being shown the restaurant menu, you were shown a message. What was the message about?* Options include: "People changing diets to become climate-friendly", "People changing their diets to lose weight", "People changing their diets to respect animals' well-being", "I was not shown any specific message", "I do not remember any specific message displayed".

[8] If individuals were unsure or chose not to pledge, we asked them to write down their thoughts on what prevents them from committing to a commitment using an open-text box.

Table 1

Text displayed to respondents in each experimental vignette.

Treatment	Vignette description
Control	Imagine you are in a restaurant. You will be presented with a menu to place an order for a meal. Please choose an item that you would like to eat for real. By completing this task, you will get a chance to win a food voucher worth £20 that you can use after this survey to place an actual order.
Nudge (Social norms)	A study published in The Lancet Planetary Health found that the share of British people who stopped eating meat has increased by more than 50% from 2008 to 2019. More and more people are choosing plant-based dishes that are kinder to the planet and in turn are becoming climate-friendly.
	Imagine you are in a restaurant. You will be presented with a menu to place an order for a meal. Please choose an item that you would like to eat for real. By completing this task, you will get a chance to win a food voucher worth £20 that you can use after this survey to place an actual order.
Low-order nudge+ (Social norms + Personal norms)	A study published in The Lancet Planetary Health found that the share of British people who stopped eating meat has increased by more than 50% from 2008 to 2019. More and more people are choosing plant-based dishes that are kinder to the planet and in turn are becoming climate-friendly.
	Are you trying to change your diet to become more climate-friendly as well? (Options: (a) No, I am not trying now, and I do not intend to try in future (b) No, I am not trying now, but I might consider changing my diet to be more-climate-friendly in future (c) Yes, I am trying to change my diet now to become more climate-friendly (d) Yes, I have already changed my diet to be more climate-friendly)
	Imagine you are in a restaurant. You will be presented with a menu to place an order for a meal. Please choose an item that you would like to eat for real. By completing this task, you will get a chance to win a food voucher worth £20 that you can use after this survey to place an actual order.
High-order nudge+ (Social norms + Personal norms + Pledge)	A study published in The Lancet Planetary Health found that the share of British people who stopped eating meat has increased by more than 50% from 2008 to 2019. More and more people are choosing plant-based dishes that are kinder to the planet and in turn are becoming climate-friendly.
	Are you trying to change your diet to become more climate-friendly as well? (Options: (a) No, I am not trying now, and I do not intend to try in future (b) No, I am not trying now, but I might consider changing my diet to be more-climate-friendly in future (c) Yes, I am trying to change my diet now to become more climate-friendly (d) Yes, I have already changed my diet to be more climate-friendly)
	You can make a commitment to yourself to try to adopt climate-friendly diets. Are you willing to make this self-commitment? (Options: (a) Yes I am willing to commit to myself to try and adopt a climate-friendly diet (b) No I am not willing to commit to myself to try and adopt a climate-friendly diet (c) I am not sure)
	Imagine you are in a restaurant. You will be presented with a menu to place an order for a meal. Please choose an item that you would like to eat for real. By completing this task, you will get a chance to win a food voucher worth £20 that you can use after this survey to place an actual order.

(higher-order) nudge+ condition, where we tested whether making people think about the social norm message (through explicitly stating their personal norm) and about their preferences (via the pledge) improved the effectiveness of the social norm nudge. The exact wordings of these preregistered treatment conditions are outlined in Table 1.

In each condition, individuals were first automatically defaulted to a shorter menu, presented as the chef's selection. Individuals could choose an item from this menu or opt out to see the standard *à la carte* menu with all the options. Individuals were effectively presented with a take-it-or-leave-it offer in each experimental condition, where they could either take the default option or leave it and go to the larger menu. We used this design to ensure our treatment effects were not an artefact of a specific choice environment. Consequently, we varied two important dimensions on these menus:

(1) The degree of saturation of carbon-intensive items on the menu. Parkin and Attwood (2022) show that menu saturation in plant-based items can affect people's food choices. As such, we randomly assigned participants to menus, so they were loaded with one-third or two-thirds of carbon-intensive items.
(2) The level of familiarity with the food items; items were either named colloquially (for example, *fish and chips*) or not (alternatively called *fillet of cod*). This was done following the literature in "foolish familiarity" which suggests people make irrational decisions when faced with familiar choices Litt, Reich, Maymin, and Shiv (2011).

We randomised the order of the items on the full menus to prevent any ordering effects on individuals' final food choices. Using this experimental design, we generated 2 (carbon-intensity) × 2 (familiarity) different sets of menus that were further randomised among participants, assigned to each experimental condition listed in Table 1. A detailed description of our factorial design experiment is available in the preregistration document here.

Using this experimental design, we test the hypotheses that the "social norm" (H1), "social norm + personal norms" (H2), and "social norm + personal norms + pledge" (H3) experimental conditions will significantly increase the uptake of low-carbon meals versus the control condition. We further test the hypotheses that increasing the degree of reflection in the nudge will also lead to measurable changes in the uptake of low-carbon meals, with significantly positive differences between the social norms intervention and that combined either with personal norms (H4) and/or the pledge (H5). We expect the higher-order nudge+ to be better than the lower-order nudge+ (H6). These hypotheses follow Banerjee and John (2021), who theorise that reflection in a nudge improves effectiveness. The exact wording of these preregistered hypotheses is detailed in the Online Appendix.

3. Empirical analysis

3.1. Variables

We use *Greenhouse gas emissions (GHGe)* as a preregistered proxy for the environmental impact of individuals' dietary choices in the experimental task (see Table 4 in the Online Appendix). This outcome measure corresponds to the life cycle emissions of the main ingredients of each food item, based on Scarborough et al. (2014). Our main explanatory variables are binary, indicating the experimental conditions to which individuals were randomly assigned. The variables $Reflection_i$ correspond to each of the three treatment interventions in our design, where:

$$Reflection_i = \begin{cases} 1, & \text{if participant is in } i\text{th reflective condition} \\ 0, & \text{otherwise} \end{cases}$$

$\forall i = \{\text{Nudge, Low-order nudge+, High-order nudge+}\}$

We also use a dummy variable, called $Compliance_i$, to measure individuals' compliance with the reflective treatment that they were randomly assigned to, such that:

$$Compliance_i = \begin{cases} 1, & \text{if } Reflection_i = 1 \text{ and answers the manipulation} \\ & \text{check correctly} \\ 0, & \text{otherwise} \end{cases}$$

Finally, we measure individuals' attention levels, prior to the first experimental task, with a dummy variable, called $Attention_i$, such that:

$$Attention_i = \begin{cases} 1, & \text{if participant answers the attention check correctly} \\ 0, & \text{otherwise} \end{cases}$$

We construct other preregistered covariates to use as controls in regressions and to check for the balance of means in assessing randomisation.

3.2. Empirical strategy

We test hypotheses H1-H3 by measuring the average treatment effects of being assigned to a treatment condition versus the control condition. We do this in two different ways. First, we calculate the intent-to-treat effect (ITT) of *reflection* on *GHGe* using linear regressions. In doing robustness checks, we control for any j covariates selected using a lasso-based regression technique,[9] l menu-types, and for k individuals' residential fixed effects (at the zip-code level) as outlined by specification (1) below.

$$\text{GHGe} = \alpha + \sum_i \beta_i \text{Reflection}_i + \sum_j \gamma_j \text{Covariates}_j + \sum_k \delta_k \text{Zip}_k \\ + \sum_l \rho_l \text{MenuType}_l + \epsilon \quad (1)$$

Second, as preregistered, we also calculate complier average causal effects (CACE) effects of *reflection* on *GHGe* using a two-stage least-squares based regression approach (for details, see Angrist, Imbens, and Rubin 1996). In the first stage, we use the initial random assignment to a reflective treatment to instrument for individuals' levels of treatment compliance, $Compliance_i$. We use these instrumented compliance levels in the second stage to predict its causal effect on emissions. In robustness checks, we control for covariates, menu types and zip fixed-effects. This second stage regression is outlined by specification (2) below.

$$\text{GHGe} = \alpha + \sum_i \beta_i^{TSLS} \widehat{\text{Compliance}}_i + \sum_j \gamma_j \text{Covariates}_j + \sum_k \delta_k \text{Zip}_k \\ + \sum_l \rho_l \text{MenuType}_l + \epsilon \quad (2)$$

Further, to understand what explains individuals' levels of compliance with assigned experimental treatments, we follow Marbach and Hangartner (2020) in profiling compliers and non-compliers in this analysis by pre-treatment individual characteristics. Next, to test hypotheses H4-H6, which compares either the different nudge+ treatments to the nudge ("social norm + personal norms" or "social norm + personal norms + pledge" versus "social norm"), or compares an increasing degree of reflection ("social norm + personal norms + pledge" versus "social norm + personal norms"), we re-use specification (1) and (2) by setting "social norm + personal norms + pledge" as our reference category of comparison.

We follow Young (2019) to rule out leverage as a potential driver of statistical significance. All analysis has been performed using a combination of Stata 17 and R packages.[10]

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[9] We use a Stata package *lasso* and select covariates using information criteria, such as AIC and BIC.

[10] Specifically, we use Rstudio to clean the data set and conduct the socio-demographic profiling, see tables 8–10. The packages we used are *dplyr*, *ggplot2*, *gridExtra*, *xtable* and *readr*.

4. Results and discussion

4.1. Summary statistics

Individuals were randomised into four experimental conditions (see Figure 5 in Online Appendix). As preregistered, we do not find any significant differences between experimental conditions by age, gender, and education using a t- (parametric) and kruskal-wallis (non-parametric) test (for details, see tables 5–8 in Online Appendix). We also fail to reject a joint hypothesis that coefficients of age, gender, and education are not significantly different from zero in a linear regression of treatment assignment on these covariates (F = 1.02, $p = 0.3833$). We meet our sampling criteria (N = 5552) by recruiting a total of 5,555 individuals, after excluding people who do not meet our preregistered inclusion criteria[11] (for power analysis, see section A.1.2 in Online Appendix).

Our final sample is gender-balanced, with 49% female representation. The modal age of individuals is between 25 and 34 years, and $\approx$29% of the sample is over 45 years old. More than half the sample has a university degree or more, with 14% of individuals in full or part-time education. 5% of the sample is unemployed. Our sample is predominantly white in ethnic origin ($\approx$89%). Over half the individuals ($\approx$55%) have left-leaning political views. These sample characteristics across the four experimental conditions are summarised in Table 2.

The average emission from all intended meal orders is 16.78 kilos of carbon-equivalent (CO_2e). Fig. 1 below plots the average GHG emissions over intended meal orders across the four experimental conditions. The modal food type consumed by individuals is white fish and poultry. This is consistent across all experimental conditions, including the control condition. Nonetheless, when exposed to the nudge or nudge+ conditions, we observe a further shift[12] towards low-carbon items (see Figure 6 in Online Appendix). In the next section, we explore these shifts in detail by estimating the average treatment effects of being randomly assigned to these experimental conditions.

4.2. Average treatment effects

Table 3 summarises our intent-to-treat (column 1) and complier average causal effects without controls. These findings are robust across multiple specifications, such as when controlling for different menu types,[13] for covariates selected by a lasso-based regression (columns 2 & 3), for individuals' level of compliance with the treatment (see column 3 of Table 3), and location fixed effects at individuals' zip-code level (columns 2 & 3). Our three main experimental findings are discussed below.

Result 1: All behavioural climate policies (nudge and nudge+) lower intended orders of carbon-intensive food items.

Our first finding tells us that all behavioural climate policies, namely the social norm nudge and its nudge+ variants reduce emissions over intended meal orders versus the control condition. Individuals who were assigned randomly to the social norm condition chose meals with $\approx$2.7 less carbon-equivalent units versus the control condition. Similarly, when individuals were made to reflect on their personal

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[11] If individuals do not consent to participate in the survey or they fail the starting attention screener (they were asked, People are very busy these days, and many do not have time to follow what goes on in the government. We are testing whether people read questions. To show that you've read this much, answer both "extremely interested" and "very interested", with options ranging on a 5-point Likert scale from *Not at all interested* to *Extremely interested*).

[12] A two-way tabulation test of the type of food consumed and treatments returns a $\chi^2 = 109.71$ at p < 0.00001.

[13] Tables 9 and 10 summarise findings from an exploratory within menu-type ITT and CACE analysis only.

Table 2
Descriptive statistics across experimental conditions.

	Control	Social norms	Social norms + Personal norms	Social norms + Personal norms + Pledge	All
Outcomes					
GHG emissions (μ)	19.4	16.6	16.5	14.7	16.8
GHG emissions (σ)	25.56	24.02	24.00	22.68	24.14
Demographics					
Male	51.6%	48.7%	48.8%	50.4%	48.9%
First degree or more	53.3%	53.3%	53.1%	50.1%	52.5%
Employed	73.8%	74.7%	72.5%	74.4%	73.9%
Student	14.4%	12.9%	13.7%	16.1%	14.3%
White-UK	89.5%	88.8%	88.4%	89.2%	88.9%
Right-Leaning	45.2%	44.3%	44.8%	44/3%	44.7%
Survey performance					
Attention	99.8%	99.7%	99.9%	99.9%	99.8%
Compliance	81.8%	81.5%	83.9%	72.4%	79.9%
Completion time	7.66	7.9	8.5	9.1	8.3
Observations	1384	1390	1398	1383	5555

GHG emissions measured in carbon-equivalent units. First degree refers to completion of a college/university degree. Completion time in minutes.
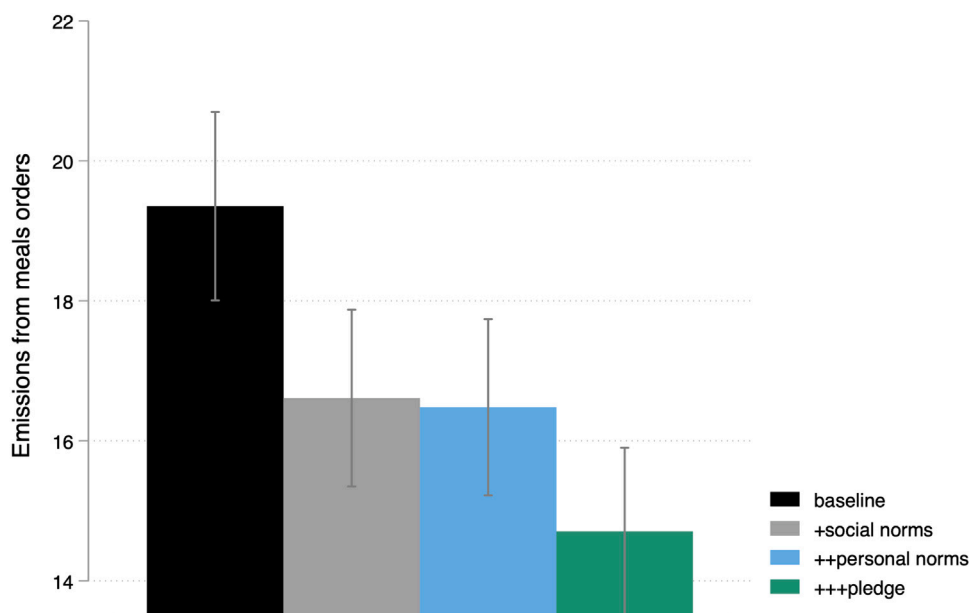

Fig. 1. Emissions over meal orders across experimental conditions.

norms after exposure to the social norm, they equally reduced their orders of carbon-intensive meals versus the control condition by ≈2.8 carbon-equivalent units. Finally, for individuals encouraged to reflect on their personal norms with an offer to pledge to climate-friendly diets, the reduction in orders of carbon-intensive foods was the largest compared to the control condition. In this "social norm + personal norms + pledge" condition, on average, emissions were ≈5.17 carbon-equivalent units lower than in the control condition. All these treatment effects become stronger when we control for individuals' compliance with the experimental conditions. These findings validate hypotheses H1-H3, namely that nudge and nudge+ policies promote intentions for climate-friendly diets. The effects of the pledge combined with the social and personal norms condition align with Banerjee et al. (2022b), who showed a similar increase in effect sizes of green defaults when combined with a pledge.

Result 2: Adding reflection to a nudge via a pledge increases its effectiveness

Next, we evaluate the effect of increasing the degree of reflection in the social norm nudge. These pairwise differences are also highlighted

in Table 3. We find that when individuals are made to reveal their personal norms and then offered to pledge to climate-friendly diets to conform to social norms, the corresponding increase in the effectiveness of the nudge is the largest. This effect also holds when people in this higher-order nudge+ condition are compared to respondents in the lower-order nudge+ condition, namely the "social norm + personal norms" condition. On average, being assigned to the "social norm + personal norms + pledge" condition significantly reduced intended orders for carbon-intensive foods by ≈2.5 (or 2.3) carbon-equivalent units, versus the "social norm" (or "social norm + personal norms") condition. To put this difference into perspective, combining a pledge to the social norm nudge increases the effectiveness of the standalone social norm nudge by ≈94%. We observe a similar increase in effectiveness compared to the lower-order nudge+ condition. Thus, encouraging individuals to conform to social norms using commitment pledges almost doubled the effectiveness of the social norm nudge. This validates hypotheses H5 and H6. Nonetheless, when comparing individuals in the lower order nudge+ condition with the standalone social norm nudge condition, we do not find any measurable differences in intended meal orders for climate-friendly items. As such, we are unable to validate

Table 3

Average treatment effects.

GHG emissions	ITT(1)	ITT(2)	CACE
Social norms	−2.74***	−2.68**	−3.32***
	(0.941)	(1.107)	(1.067)
	[0.004]	[0.006]	[0.001]
Social norms + personal norms	−2.87***	−3.36***	−3.98
	(0.940)	(1.023)	(1.036)
	[0.002]	[0.004]	[0.001]
Social norms + personal norms + pledge	−4.65***	−5.45***	−7.609***
	(0.919)	(1.004)	(1.229)
	[0.001]	[0.001]	[0.001]
$Treat_{(social\ norms\ +\ personal\ norms\ +\ pledge)\ -\ (social\ norms)}$	−1.90*	−2.77**	−4.29***
	(0.887)	(0.976)	(1.153)
	[0.032]	[0.007]	[0.001]
$Treat_{(social\ norms\ +\ personal\ norms\ +\ pledge)\ -\ (social\ norms\ +\ personal\ norms)}$	−1.77*	−2.09*	−3.63***
	(0.886)	(0.975)	(1.145)
	[0.045]	[0.014]	[0.001]
$Treat_{(social\ norms\ +\ personal\ norms\ )\ -\ (social\ norms)}$	−0.13	−0.677	−0.65
	(0.909)	(0.993)	(1.049)
	[0.886]	[0.855]	[0.981]
Controls	×	✓	✓
Fixed effects	×	✓	✓
Instrumented	×	×	✓
N	5555	5133	5133
R-squared	0.0047	0.3050	0.3030
First-Stage F	–	–	1246.34

Simple OLS estimates in column 1. OLS estimates of specification (1) are in columns 2. TSLS estimates of specification (2) in column 3. Standard errors in parentheses, *p*-values in box brackets; *** p < 0.005, ** p < 0.01, * p < 0.05 Young (2019) randomised-t *p*-values. In columns 2 & 3, controls selected by adaptive lasso–regression include: education, whether person has other commitment after the experiment (hurry), political ideology (left–right scale), whether they prefer British food, whether they think cultural diets should be meat-based, scepticism towards climate change, moral duty in acting against climate change, palatability towards the menu, whether they faced a trade-off (liking versus pro-climate) in choosing their meal orders, and whether they felt they helped the environment. In columns 2 & 3, we have 422 missing observations due to missing values for political ideology (left–right scale), education, and zip code.

hypothesis H4. Fig. 2 plots these differences in emissions over intended meal orders across the different experimental conditions, along with a 95% confidence interval.

These results are also in line with Banerjee et al. (2022b), who find that a combination of weak reflection[14] with green defaults is ineffective in boosting the effectiveness of the (default or traffic lighting) nudge. Taken together, these findings suggest that a certain degree of reflection might be necessary to increase the effectiveness of a nudge. While Banerjee et al. (2022b) show such effectiveness gains from reflection are unrelated to the time spent by individuals in these experimental conditions, we find the opposite. Specifically, individuals in the "social norm + personal norms + pledge" condition take almost a minute longer [$p = 0.006$] to complete the food choice task versus the "social norm" condition. Further, individuals in the "social norm" condition take ≈20 s longer to complete the food task versus the control condition [$p = 0.094$]. The increase in time speaks to the higher cognitive burden that reflective treatments impose on people when trying to effectuate new behaviours. There are possible trade-offs between effectiveness and cognitive engagement levels from using such reflective behavioural policies, as noted previously (see John et al. 2013). Future research should robustly assess whether the time spent in the experimental condition mediates the benefits of reflection.

Further, to understand what explains compliance with these conditions, we follow Marbach and Hangartner (2020) in an exploratory profiling of compliers and non-compliers across the nudge and nudge+ conditions. We do not find any measurable differences between compliers and non-compliers of these treatments by individual's age, gender, political ideology, level of hurry, level of hunger, dietary preferences, or climate change beliefs. However, the less educated are found to be less compliant with the higher order nudge+ ("social norm + personal

norms + pledge") condition [$p = 0.0347$] (see Figure 7 in Online Appendix).

Result 3: The already motivated respond more positively to the pledge offer than the rest.

Reflective behavioural policies are posited to be more effective for those who are already motivated to undertake certain behaviours as targeted by the behavioural policy (for a discussion, see conditions for effectiveness by Banerjee & John, 2021; Hertwig & Grüne-Yanoff, 2017). To test this claim, we compare individuals who were offered to pledge with those who were not, conditioning on individuals' personal norms towards climate-friendly diets (see Table 11 in Online Appendix). In doing so, we restrict the analysis to respondents allocated to the "social norm + personal norms" and "social norm + personal norms + pledge" treatment arms.

We find individuals who had reported no intentions to adopt climate-friendly diets significantly increased their orders for carbon-intensive food items when offered the pledge [$p = 0.087$]. This backlash effect was missing in the other groups. Any further increase in self-reported motivations was positively correlated (at a 5% level of significance) with a decrease in intended orders for carbon-intensive foods when the pledge was offered. These benefits of reflection for the motivated, however, disappear when we test this claim using actual decisions, to accept or reject the pledge, of those who were offered the pledge in the higher order nudge+ condition. Table 11 presents these results in the Online Appendix. The emissions over intended meal orders (with 95% confidence intervals) by individuals' self-reported personal norms, conditional on an offer of the pledge, are shown in Fig. 3.

These findings suggest that some individuals respond more positively to reflective behavioural policies versus others. There could also arise backlash from reflection for those whose intentions do not match the nudge. In our survey, however, this does not lead to opt-outs. For example, we find that people allocated to the "social norm + personal norm condition" (lower-order nudge+) and those assigned to the "social norm + personal norm + pledge" (higher-order nudge+)

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[14] The authors try to encourage reflection on the nudge by disclosing the design of the nudge to individuals, a form of reflective transparency.
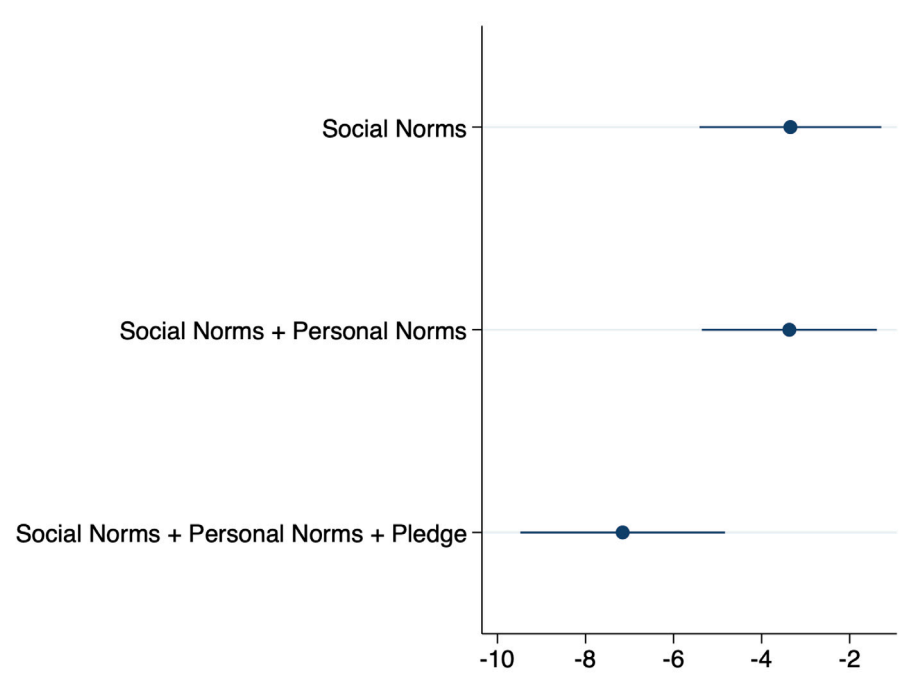
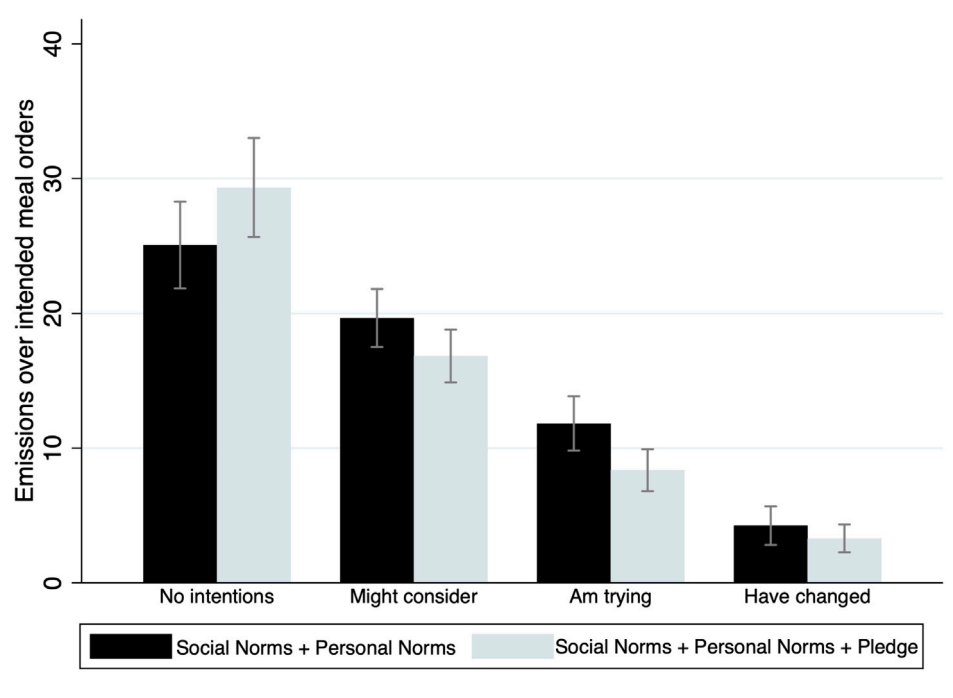**Fig. 2.** Complier average causal effects across reflective treatments.

Fig. 3. Heterogeneity in treatment effects of pledge by personal norms towards climate-friendly diets.

condition are less likely to opt out of the experiment (respectively −0.81 pp, $p < 0.001$, and −0.6 pp, $p < 0.02$) compared to the control and those allocated to the social norm condition only. Further, exploratory socio-demographic profiling shows individuals who are more liberal, educated, mobile[15] and female are more likely to respond positively to reflective behavioural policies (see table 12 and figures 8, 9, and 10 in the Online Appendix for more details). These individual profiles and their responsiveness to reflective behavioural policies should be evaluated in future research to improve the tailoring of behavioural policies.

4.3. Robustness checks

We run a series of robustness checks to test the validity of our findings. These results are presented in Table 13 in the appendix.

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[15] We define mobile by the likelihood that one's area of birth is different from one's area of residence.

First, as food choices in the experiment were quasi-consequential, we had measured participants' confidence in their food choices and verified the truthfulness of their elicited preferences. We did this using a post-treatment survey question[16] that provided participants with an opportunity to change their food choices if we were to place their meal order immediately with the restaurant. We find that less than ≈2% participants in our sample modified their prior food choices, with no measurable differences in this modification rate between the treatment conditions. We note that while we do not find respondents reporting false preferences, there is a possibility of experimenter demand effects, albeit low. Previous findings from the literature have shown that such experimenter-demand effects are limited when researchers design their interventions honestly (see De Quidt, Haushofer, & Roth, 2018; Mummolo & Peterson, 2019; Zizzo, 2010).

Second, we assessed the social desirability bias of participants in our sample. To this extent, we asked participants[17] if they were willing to participate in an online dashboard where their food choices would be made publicly visible. Here again, we find no measurable differences between the treatment conditions when comparing them with the control and one another.

5. Discussion & conclusion

In this paper, we present experimental findings from an online survey experiment in England that validates the role of reflection in improving the effectiveness of nudges promoting climate-friendly diets. Banerjee and John (2021) theorise how combining reflective strategies with nudges, referred to as nudge+, can improve their uptake. We show that when people are randomly encouraged to think through the social norm, first by revealing their personal norms and then by reflecting on their will to conform and pledge to the norm, intentions for greener diets almost double versus the nudge-only condition. Through this experiment, we contribute to emerging literature testing reflective policies to promote welfare-improving behaviours.[18] Our experimental analysis specifically replicates Banerjee et al. (2022b), albeit with a different nudge. Banerjee et al. (2022b) show that intentions for green dietary options improve significantly when people are encouraged to think before being defaulted to climate-friendly diets. We replicate these findings using a similar experimental protocol and respondent profiles, and a significantly larger sample size.[19] Further, our research also contributes to more tests of social norm nudges in encouraging environmentally sustainable consumption.

Our findings have important policy implications for a steadily expanding food delivery market that can use these reflective prompts in nudges to encourage climate-friendly food orders among customers. Such honesty pledges and prompts are now being trialled and scaled up by many private companies; for example, Honest Pledge is a Swiss firm that designs behavioural solutions using pledges. Further, we also find backlash against the nudge when participants are made to pledge for it — this backfire is prominent for those who do not already have

intentions to change their diets. Our findings here speak to a growing literature in behavioural sciences that shows nudging people, especially when individual goals are not aligned with the nudge, can lead to reactance or rebound effects (Banerjee, Galizzi, John, & Mourato, 2023; Bicchieri & Dimant, 2019; Boenke, Panning, Thurow, Hörisch, & Loschelder, 2022; Bolton, Dimant, & Schmidt, 2020; Hummel & Maedche, 2019). Further, ethical concerns can arise when nudges covertly steer people into meat-free diets (Lades & Nova, 2022). Adding reflective policies to nudges can generate effective signals to policymakers, thereby developing a more mature policy dialogue between the state and the government (Banerjee, Hunter et al., 2022). Further, eliciting backfires can help policymakers personalise nudge-type behavioural interventions to deliver more effective behaviour change (Mills, 2022).

We note some important caveats that must be carefully assessed while interpreting our findings. First, reflective policies are more effective for some individuals than others, with potential backlash effects from those who do not intend to adopt greener diets. This should be tested in future research to target better populations that can be nudged in this way.[20] Second, we also find that reflection in nudges is significantly correlated with longer task completion times, which could make such interventions cognitively burdensome to recipients.[21] The cost-effectiveness of these interventions must be weighed out to inform nudge+ design better. Third, nudge+ interventions have only been tested using self-reported intentions. These findings must be tested with fully consequential decisions in the field and/or with other nudges. Future research should also test the welfare implications and persistence of such policies. Fourth, while Banerjee et al. (2022b) also show that their nudge+ intervention performs significantly better compared to standalone reflection, we were unable to do so in our experiment. Therefore, it is possible that the reflective element completely drives the effects of the nudge+. This should be tested more extensively in future research. Fifth, we can only test one-shot intentions in our experiment. Future research should also consider long-term behaviour change more generally with repeated citizen interactions.

Despite these limitations, our results suggest that combining reflective elements with nudge-style interventions can effectively promote socially desirable behaviours. We are hopeful that more tests of nudge+ policies will evaluate their merits robustly in promoting good behaviours among citizens.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

We have attached the dataset and the do files as attachments. At time of publications, we will share links to the data stored in a public repository.

Ethics approval

This study was in line with research ethics guidelines at the author's institution.

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[16] Participants were asked "If we contact the restaurant now to place this order for you, will you be happy for us to proceed?". Participants were allowed to select one of the two options: "Yes, please place this order for me" and "No, I would like to change my choice".

[17] Participants were asked: "Imagine we create a dashboard at the end of this survey. This dashboard will be publicly visible to all respondents participating in this survey. It will have the following information: (a) respondents' names (b) respondents' food choices and their climate impact". They could choose one of the two options: "Yes" or "No".

[18] Keppeler, Sievert, and Jilke (2022) show a nudge+ like mechanism using psychological ownership improves vaccination behaviours in Germany. Mühlböck, Kalleitner, Steiber, and Kittel (2022) show a nudge+ strategy combining reflection with an information nudge improves job search outcomes in Austria.

[19] Banerjee et al. (2022b) use N = 3074, whereas we use N = 5555

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[20] For a discussion on personalised nudging, see Mills (2022).

[21] Purely reflective policies have been found to be hard to scale up because of their cognitive costs in prior experimental analysis, for a discussion see John et al. (2013). Nudge+ suggests we can minimise these burdens (John & Stoker, 2019), but these claims are yet to be tested.

Informed consent

All participants participated in the study with their informed consent.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.socec.2023.102024.

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