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ABSTRACT

Climate Change and Diet*

Though many in the general public are concerned about climate change, most are unaware that agriculture and food production accounts for about one quarter of aggregate green house emissions and therefore, diet change is one of the most effective ways that individuals can reduce their climate impact. To investigate how best to communicate this, we present the results of a pre-registered randomised control trial, involving 1220 subjects, exploring six different information interventions. Our findings indicate that the most influential interventions are based on scientific knowledge and efficacy salience. These effects are mediated by prior beliefs and individual characteristics. Providing information on the health impact of a plant-based diet was most effective for individuals with pre-existing health concerns. The greatest resistance to this information was associated with motivated reasoning around meat consumption: the more meat a participant consumed the less they reported knowing about the relationship between diet and climate before the study, the more resistant they were to new information demonstrating that relationship, the lower their efficacy beliefs around climate change, and the more likely they were to take moral offence at being informed. Our results suggest that while many people are open to dietary change and are responsive to scientific evidence, the largest potential for impact between diet and climate may be in overcoming pre-existing biases associated with sacred values around meat consumption.

JEL Classification: Q54, D91, I12, C90

Keywords: climate change, diet, vegetarian, vegan, agriculture, environment, interventions, nudge, decit model of science communication, self efficacy, motivated reasoning, cognitive dissonance, strategic ignorance, social norms

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1 Introduction

Globally, agriculture and food production account for more than 25% of aggregate greenhouse gas emissions, where as all types of transportation, such as automobiles, airplanes, trains, trucks, and ships, are responsible for only 14% of such emissions (Tilman and Clark (2015)). A global shift towards a diet with lower meat content (based on dietary recommendations by the Harvard Medical School for Public Health) is estimated to reduce the costs of climate change mitigation by up to 50% in 2050, compared to a reference case where there are no changes to diet or climate policy (Stehfest et al. (2009)). In the UK, it was estimated that by eliminating meat from diet one can reduce their food related greenhouse gas emissions by 35%, compared to the average diet (Hoolohan et al. (2013)). Despite scientific consensus regarding the high carbon footprint of the livestock sector, food related climate change mitigation actions rank low in their perceived effectiveness compared to recycling, reduced levels of driving and energy saving (Vanhonacker et al. (2013); de Boer et al. (2016); Truelove and Parks (2012)).

Interventions aiming to enhance awareness about the ecological impact of a dietary shift and increase intention to reduce meat content in individual diets have been scattered and inconclusive. Harguess et al. (2020) offers a systematic review of experimental studies aiming to reduce meat consumption. These studies largely focussed on proving information about the health effects of meat consumption (Bertolotti et al. (2016); Fehrenbach (2015)) or the environmental impact of meat production (Graham and Abrahamse (2017)) or both (Vainio et al. (2018); Verain et al. (2017); Cordts et al. (2014)). A branch of literature has also used animal welfare arguments, in order to invoke empathy, to persuade individuals to reduce their meat intake (Zickfeld et al. (2018); Kunst and Palacios Haugestad (2018); Tian et al. (2016)). However, what remains absent in the literature is a comprehensive and comparative evaluation of different information interventions aiming to reduce the consumption of meat.

In order to devise communication campaigns to promote a dietary shift away from meat-based foods, it is crucial to identify potential barriers to reducing meat consumption to combat climate change. Ockwell et al. (2009) identify a number of barriers related to enhancing knowledge and concern and promoting actions to mitigate climate change. These barriers include lack of knowledge, scepticism towards scientific information, inefficacy of action, perceived inaction by others, social norms and lack of personally relevant information. Additionally, the largely habitual nature of meat consumption (Rees et al. (2018); Schösler et al. (2014)), makes it harder to persuade people to reduce their meat intake.

There is generally quite low awareness of the impact of red meat consumption on the environment among the general population (Macdiarmid et al. (2016); de Boer et al. (2016, 2013); Vanhonacker et al. (2013)). In accordance with the *deficit model of science communication* (Bauer et al. (2007)), one way to reduce this knowledge barrier is to provide people with additional scientific information. The deficit model, a widely used approach to communicate scientific issues, promotes the enhancement of public knowledge levels about complex issues like climate change through scientific facts. With regards to meat consumption, there is a dearth of knowledge regarding not only the environmental impacts of meat but also the general health ramifications of a meat-rich diet (Verbeke et al. (2010)). Emphasizing the personal health impact of eating meat has an added benefit of making communication interventions more personally relevant to those who may feel climate change is an otherwise quite distant threat (Monroe et al. (2019); Wibeck (2014); Ockwell et al. (2009)). However, despite the strengths of the deficit model, there are several barriers which can mitigate its potency such as scepticism, perceived inefficacy and social norms. Furthermore, acceptance of scientific facts about climate change is dependent on perceived scientific (Lewandowsky et al. (2013)) and social consensus (Lewandowsky et al. (2019)). Additionally, it has been observed that individuals have a tendency to reject scientific information about climate change which contradicts their pre-existing beliefs (Druckman and McGrath (2019); Hart and Nisbet (2012)). Such *directional motivated reasoning* (Kunda (1990)) or *strategic ignorance* (Carrillo and Mariotti (2000)) could further blunt the effectiveness of the deficit model.

Lorenzoni et al. (2007) argue that simply being more informed about climate change is not sufficient for public engagement, it is vital to care, to be motivated and to believe that one is capable of action. The extended Parallel Process Model (EPPM) (Witte (1992)) posits that persuasive messages highlighting potential threats - for example from Climate Change - should also include efficacy information to promote attitude and behaviour change which can combat the threat. Efficacy describes an individual's perception that an issue is addressable and the individual is capable of taking the action necessary to tackle the issue (Balch (1974)). Self efficacy theory (Bandura (1977)) is built on two concepts - efficacy expectation and outcome expectancy. While efficacy expectation (or self efficacy) is the belief that one is capable of performing a certain behaviour, outcome expectancy (or response efficacy) is an individual's estimate that the behaviour will lead to specific outcomes. Prior literature has found that messages with high efficacy content (Salomon et al. (2017); Jugert et al. (2016); Xue et al. (2016)) have a positive impact on encouraging action to combat climate change.

Many meat-eaters enjoy eating meat but dislike the notion that their diet might necessitate the killing or harming of animals. This state of inconsistent beliefs is termed the "meat paradox" (Loughnan et al. (2010)). Meat-eaters can resolve this form of *cognitive dissonance*, where beliefs and behaviour are inconsistent (Festinger (1957)), by not associating meat-eating with living and sentient animals or by withdrawing moral status from animals (Loughnan et al. (2010)). Inducing higher cognitive dissonance through statements and images which connect meat with living animals has been shown to have a positive impact in reducing willingness to eat meat (Tian et al. (2016); Kunst and Hohle (2016)) and provides another possible intervention. However, this may be reduced, consistent with previous research, by *hedonic motivations* like pleasure derived from meat consumption(Feinberg et al. (2019)).

Doherty and Webler (2016) posit that descriptive social norms (information about others' behaviour) are an important predictor of public engagement in climate actions. In particular, eating meat is a well-reinforced norm as meat is often served in social gatherings and restaurants (Sparkman and Walton (2017)). Information about social norms have shown a positive effect on energy conservation (Allcott (2011); Nolan et al. (2008)), littering (Cialdini et al. (1990)), recycling (Schultz (1999)) and towel reuse in hotels (Goldstein et al. (2008)). Sparkman and Walton (2017) found that dynamic descriptive social norms (which involve considering how the behaviour of others is changing over time) are more effective than static social norms (which considers the current behaviour of other people) in encouraging lower levels of meat consumption.

The information intervention design used in this paper addresses all these major barriers to reducing meat intake - the scientific knowledge gap, perceived inefficacy of action, personal relevance, cognitive dissonance and social norms. A prominent drawback of prior information interventions promoting reduced meat intake is the reliance on a "no information" control group for estimating effect sizes of the interventions, potentially leading to overestimation or bias since it is hard to know participants' prior knowledge. This study avoids this issue by using a control group which was offered a baseline amount of scientific information about the greenhouse gas emissions caused by farm animals. This control group is compared with 6 treatment conditions each of which is provided an additional statement pertaining to the barriers discussed, along with the control group information. The treatment conditions provide an additional statement concerning: 1. The effect of carbon dioxide emissions (More scientific information); 2. The CO_2 equivalent of eating less meat expressed in terms of miles driven in a car (Efficacy salience); 3. The health impact of meat (Health information); 4. Potential animal lives saved through reduced meat consumption (Animal welfare); 5. The proportion of the public that is actively eating more plant-based foods (Social norms) and 6. The social effect of less meat intake (Social efficacy). A list of the treatment conditions used in this study are presented in table 1.

The study also elicited the subject's baseline ecological concern and efficacy beliefs to see how pre-existing beliefs could moderate the effect of new information. Prior research (Lorenzoni et al. (2007); Graham and Abrahamse (2017); Bostrom et al. (2013); Klöckner and Ofstad (2017)) has highlighted the need for targeting and tailoring information to specific subject groups to encourage public engagement in climatic actions. Accordingly, the paper collects information regarding baseline beliefs and practices to help formulate strategies for targetted messaging. Furthermore, this study measures moral offence taken by subjects on being told the consequences of meat consumption. This is done because moral convictions related to meat intake can have an impact on behaviour (Feinberg et al. (2019)). Finally, the paper adds a directly-incentivised element by allowing participants

Table 1: Information interventions to encourage reduced meat consumption to combat climate change

Treatment	**Intervention**	**Supporting Theory**	**Relevant Papers**
Treatment 1	More scientific information	Deficit model of science communication	Graham and Abrahamse (2017)
Treatment 2	Efficacy salience	Self efficacy theory	Salomon et al. (2017); Jugert et al. (2016); Xue et al. (2016)
Treatment 3	Health information	Personal relevance	Bertolotti et al. (2016); Vainio et al. (2018)
Treatment 4	Animal welfare	Cognitive Dissonance	Tian et al. (2016); Kunst and Hohle (2016); Feinberg et al. (2019)
Treatment 5	Social norms	Social norms approach	Sparkman and Walton (2017)
Treatment 6	Social Efficacy	Self efficacy theory	Salomon et al. (2017); Jugert et al. (2016); Xue et al. (2016)

to donate funds given to them in the experiment to a climate change charity, and tests the impact of each treatment on the amount they are willing to donate.

The rest of the paper is structured as follows: Section 2 presents a detailed description of the experimental setup used in the study. Section 3 presents the results from the study and discusses the potential implications. Section 4 concludes.

2 Experiment Design

The experiment began with a series of questions designed to assess baseline ecological concerns. For this the 7 item questionnaire proposed by Stedman (2004) was used. This questionnaire is based on the "New Environmental Paradigm" (NEP), developed by Dunlap and Van Liere (1978). Each item on the questionnaire could be answered on a scale of 1 to 5, with ecological concerning rising from 1 to 5. The average of the answer to these 7 questions was calculated as a measure of prior ecological concern for each subject. Related to this, subjects were also asked how concerned were they about climate change and how concerned their friends thought they were about climate change on a 5-point scale where 1 was not at all concerned and 5 extremely concerned. This was followed by asking subjects what they believe are effective ways of combating climate change, for which they were allowed to write any answers that came to mind. This provided us with a knowledge base from which to compare the effectiveness of our various interventions.

Next, subjects were asked their baseline efficacy beliefs. Efficacy beliefs were calculated by taking the average value of the answers to two questions. They were asked the degree to which they agreed with the following statements on a scale of 1 to 5 where 1 is Strongly Disagree and 5 is Strongly Agree: (1) Individuals can influence climate change and (2)

Collectively humans have little influence on climate change (*reverse coded*). Subjects were then asked about the number of days they consume meat in a week to measure baseline or pre-intervention frequency of meat consumption. This was followed by asking participants the degree to which they agree with the statement that "there is a relationship between climate change and people's food choices" which provides a baseline level of issue importance and follows Hart and Feldman (2016).

Participants were then randomly allocated into either the control group or one of 6 treatment conditions. Depending on the condition they were assigned to, they faced a different information intervention related to meat consumption and climate change. The exact information provided to the subjects in the different conditions is presented in Appendix B. Following the intervention, subjects were asked the degree to which they now agree with the statement that there is a relationship between climate change and people's food choices. When compared to baseline issue importance, this provided a basic measure of the effectiveness of each intervention in shifting perceptions about the importance of diet on climate change.

Post intervention subjects were asked the same efficacy belief questions as they were asked pre-intervention. We then asked participants the number of days in a week they planned to consume meat. This was subtracted from the baseline answer from before the intervention to produce a measure in days of the effect of each intervention (referred to as "Δ Days" throughout the rest of the paper) and provides us with the key dependent variable for the study. Participants were also again asked what likely actions they could undertake to reduce climate change together with the information that they could recall from the experiment, providing us with measures of salience and also a set of text data for each participant. To measure the degree of moral offence taken by subjects at being informed about the consequences of meat intake, they were asked if it was morally wrong to show people the consequences of their own behaviour. The subjects were further asked certain demographic questions like age, gender, educational qualification, political beliefs and perceived social network (the number of people who might notice if they changed their diet). Subjects were also asked if any close family member had ever suffered from any heart disease, stroke, cancer, diabetes, high blood pressure or high cholesterol. This question was asked to ascertain if the subject had any genetic history of diseases.

The experiment concluded by asking participants if they would like to keep or donate to a climate change related charity a bonus amount offered to them. This provided us with an incentivised measure of the external validity of the various information interventions. A detailed experimental script for the entire experiment is provided in Appendix C.

The experiment was designed using oTree (Chen et al. (2016)) and it was conducted online on Amazon Mechanical Turk (MTurk). The subject pool were registered MTurk workers in the US. The experiment took approximately 10 minutes. There were 1458 observations collected in total, after removing those who had technical issues owing to browser/device compatibility. In order to remove noise, originating from insincere responses, bots and autofill, the final dataset only included those subjects that spent more than 10 seconds on the intervention page and wrote more than 3 words when asked to recall the evidence presented during the study. The final dataset comprised of 1220 subjects: 177 in the Control condition, 175 in Treatment 1 (More scientific information), 179 in Treatment 2 (Efficacy salience), 174 in Treatment 3 (Health information), 177 in Treatment 4 (Animal welfare), 164 in Treatment 5 (Social norms) and 174 in Treatment 6 (Social efficacy).[1]

All subjects received a participation fee of $1.50 and a bonus of $0.50 (which they could either keep for themselves or donate to a climate change charity in the final part of the experiment). The average earnings from the experiment was $1.85 as 372 out of the 1220 subjects chose to donate their bonus earnings.

3 Results

The results sections is divided into 3 main parts: a description of baseline beliefs and practice, an analysis of the effectiveness of the information interventions on intention to reduce weekly meat consumption (Δ Days) and an analysis of the effect of the interventions on donations to charity. In the final part of the results section we also provide a brief discussion of the text used by participants when they are asked to recall the scientific information they were shown, and a discussion of moral convictions.

3.1 Baseline beliefs and practices

Only 111 out of 1220 participants mentioned a dietary change from meat-based to plant-based foods as an effective personal action to combat climate change at the start of the experiment. This highlights the low awareness among individuals about the impact of meat consumption on climate change, consistent with prior studies (Macdiarmid et al. (2016); Vanhonacker et al. (2013); de Boer et al. (2016, 2013); Truelove and Parks (2012)), despite the United Nation's Intergovernmental Panel on Climate Change releasing new evidence to this effect in 2019 (Schiermeier (2019)). The number of subjects mentioning eating less meat as an effective personal action went up to 633 post intervention when subjects were

[1] Data for the control and treatment groups 1, 3 and 6 were collected in December 2019 whereas data for treatment groups 2, 4 and 5 were collected in March 2020. This raises a potential issue: what if the salience of COVID19 or any other event which occurred between the two data-gathering exercises rendered our two sets of data incomparable? In order to exclude this possibility we collected an additional 88 control condition observations in March 2020 (and we used this data only as part of the following comparability exercise since it was not part of our pre-registered plan). We then compared the two sets of control group observations from December and March, failing to reject the null of equal means (using t-tests) and equal distributions (using Kolmogorov-Smirnov tests) for Δ meat, donation to charity, prior ecological concerns, efficacy beliefs (pre and post intervention) and baseline and post-intervention meat consumption of the two groups at the 5 and 10% significance levels, which suggests that there was no change in behaviour *related to our experiment* between December 2019 and March 2020.

asked again to list actions they could personally take to combat climate change. A word-cloud representing subjects' baseline and post intervention answers to "actions you could take personally to reduce climate change" is shown in Figure A.1 and provides a visual indication of the change.

We also examined if the information interventions were successful in increasing the subjects' beliefs about the importance of diet to climate change and the efficacy of any action they might undertake. Paired t-tests conducted to examine the within-group effect of the information interventions showed that interventions significantly enhanced beliefs about issue importance for the control and all 6 treatment conditions (p-value < 0.01). To examine the within-group effect of the information interventions on efficacy beliefs, paired t-tests were conducted for all 7 groups. For the control group and all treatment groups except for social norms and social efficacy, the efficacy beliefs were significantly higher post intervention. The null that the post-intervention beliefs were not significantly different from the pre-intervention beliefs was rejected for the control, health information and efficacy salience groups with p-value < 0.05 and for more scientific information and animal welfare groups with p-value < 0.10. Furthermore, paired t-tests also revealed that for the control and all 6 treatment groups the null of no significant difference between baseline and post-intervention frequency of meat eating was rejected with p-value < 0.01. The average baseline and post-intervention beliefs and practices are presented in figure 1.

Next, we considered the relationship between baseline weekly meat consumption and baseline beliefs in the importance of diet to climate change. We found a negative relationship between pre-intervention number of days of meat consumption and the degree to which subjects agree with the statement "There is a relationship between climate change and people's food choices" on a scale of 1 to 5 where 1 is Strongly Disagree and 5 is Strongly Agree. The two variables are inversely related with Pearson correlation coefficient -0.2848 with p-value < 0.01. The relationship is depicted in figure 2. The percentage of subjects who strongly agree with the sentence is highest among those who eat meat 0-1 days a week. On the other hand, the percentage of subjects who strongly disagree with the sentence is highest among those who eat meat 6-7 days a week. Hence, when subjects eat meat more frequently they are less inclined to acknowledge the relationship between climate change and diet. This is consistent with Tobler et al. (2011) who find that frequent meat eaters perceive the environmental benefits of reducing meat intake as small. The relation between baseline weekly meat consumption and post-intervention beliefs in the importance of diet to climate change remains negative (Pearson correlation coefficient -0.1846 with p-value $<$ 0.01), although the coefficient is smaller. Further, we also observed a significant negative correlation (Pearson correlation coefficient -0.1107 with p-value < 0.01) between baseline frequency of weekly meat consumption and baseline efficacy beliefs. This is consistent with the idea of directional motivated reasoning (Kunda (1990)) or strategic ignorance (Carrillo and Mariotti (2000)) where people are wiling to modify their own beliefs to the extent allowed by self-justification. Ignoring the relationship between climate change and food choices acts as a cognitive dissonance reduction tactic.

In summary, we found that participants recorded low baseline awareness about the climatic impact of meat consumption. Frequent meat eaters were also less inclined to acknowledge the relationship between climate change and diet, at baseline and also after providing them with evidence.

3.2 Effect of the information interventions on Δ Days

In this section we look at the effect of the information interventions on participants' intention to reduce meat consumption. Table 3 reports the results from an OLS regression. The dependent variable is the change in number of days of weekly meat consumption (Δ Days). All regressions in the paper were run with standardised explanatory variables and the tables report robust standard errors. Column 1 examines the impact of being a member of one of the different treatment (intervention) groups on Δ Days relative to the control group. Columns 2 and 3 show that the results of column 1 are robust to the inclusion of control variables such as prior ecological concern, pre-intervention weekly meat consumption, baseline efficacy beliefs and the demographic variables age, female, democrat and education (a dummy which equals 1 if the subject reported that the highest degree obtained by them is greater than a high school degree and 0 otherwise). Column 3 shows that more scientific information reduces meat consumption by 0.22 days (p-value < 0.05) and efficacy salience by 0.21 days (p-value < 0.05) more compared to the control group. To get a better grasp of the effect size of the treatments we convert the estimates to CO_2 emissions. In terms of CO_2 emissions, by shifting away from meat 1 day per week, an individual can reduce their CO_2 emissions by 161.11 kg CO_2 per year (calculation based on estimates provided by Weber and Matthews (2008); see Appendix D). Thus exposure to more scientific information and efficacy salience conditions can reduce CO_2 emissions by 35.4 kg/year and 33.8 kg/year, respectively. The effect sizes of the treatments are presented in figure 3.

These results support the deficit model and self efficacy theory. More scientific information and information enhancing salience of response efficacy can successfully encourage public engagement in environmental actions. The success of the deficit model highlights a pre-existing knowledge gap about the relationship between climate change and diet which can be addressed with more scientific information (Bauer et al. (2007)). Also, consistent with Bandura's self efficacy theory (Bandura (1977)), we see that it is not enough that individuals know that they can engage in a behaviour (i.e. consume less meat), but it is also necessary that they know that consuming less meat will have the desired environmental impact, i.e. their own actions can make a difference.

Furthermore, the higher the prior ecological concerns and baseline efficacy beliefs of the participant, the greater the intended change in diet. A 1 standard deviation increase in prior ecological concern and baseline efficacy beliefs reduces weekly meat consumption by 0.10 and 0.15 days (p-value < 0.01) respectively. Also, there is a significant (p-value < 0.01) positive impact of pre-intervention diet on the dependant variable. Among the demographic variables, being female (p-value < 0.05) has a positive significant effect on intention to reduce meat consumption. Indeed, females in our study consumed less meat than men prior to the study (4.04 days/week versus 4.37 days/week, difference significant with p-value < 0.01 and t-statistic 2.7538). The change in meat consumption is consistent with two separate empirical observations in the literature. Firstly, females have been observed to display greater concern and knowledge about climate change than males (McCright (2010)). Secondly, males tend to implicitly associate meat with healthiness more strongly than females (Love and Sulikowski (2018)) and hence might be less inclined to reduce their weekly meat intake. Table 3 is replicated with the dependent variable as proportional reduction in weekly meat intake i.e $\frac{\Delta Days}{Pre-intervention Diet}$ and the results are presented in table A.2. Exposure to the efficacy salience treatment group has the biggest effect in terms of proportionate reduction in weekly meat consumption and the effect remains significant after controlling for baseline characteristics and demographic variables.

Next the paper evaluates a more targetted messaging approach. This is done to find the most effective targetted messages depending on the participant's baseline beliefs and practices. For this we examine if the information interventions had a differential impact on participants depending upon their prior health concerns, baseline efficacy beliefs and baseline weekly frequency of meat consumption.

We first look at the effect of any prior family history of diseases, interacted with the health information condition, on intended reduction in meat consumption. Table 4 reports the results. Here, disease is a dummy variable which equals 1 if the subject indicated that they had a history of diseases in the immediate family and 0 otherwise. The positive and significant (p-value < 0.01) interaction term between health information and history of diseases indicates that the health information condition has a significantly bigger effect on Δ Days if the subject has a history of family disease, compared to when they do not. This interaction effect is depicted in figure A.3. When the subject has prior health concerns the health information condition is significantly more effective than the control group, where as when the subject has no prior health concerns the control group information is more effective as shown in table A.3. Table A.3 shows that when the subject has a history of family diseases, along with more scientific information and efficacy salience, the health information condition also has a significantly larger effect on Δ Days relative to the control group. Health information increases Δ Days by 0.34 days more than the control group (p-value < 0.05) i.e a reduction in CO_2 emissions by 54.78 kg/year. This is consistent with the notion that health information serves as a form of intrinsic motivation and is therefore more likely to be effective when the subject already has prior health concerns. This may also be consistent with motivated reasoning since behavioural change in this instance may well be in a participant's own best interest if prior health concerns are a valid predictor of future poor health.

Table 5 reports the results from an OLS regression to examine the differential treatment effects based on baseline efficacy beliefs by interacting the treatment groups with the variable "high efficacy beliefs". High efficacy beliefs is a dummy variable which equals 1 if the subject's baseline efficacy beliefs is greater than the median value and 0 otherwise. The interaction terms are positive and significant for more scientific information (p-value < 0.10), efficacy salience (p-value < 0.01), animal welfare (p-value < 0.10) and social norms (p-value < 0.05). This implies that the impact of these treatments on Δ Days is significantly higher for subjects with high baseline efficacy beliefs compared to those with low baseline efficacy beliefs. Interaction terms are depicted in figure A.4. Table A.4 describes the effect of the treatment groups on Δ Days, relative to the control group, for different values of baseline efficacy beliefs. When the subject has high baseline efficacy beliefs, along with more scientific information and efficacy salience, social norms has a significantly larger effect on Δ Days, relative to the control group. When the subject has high baseline efficacy beliefs, more scientific information and efficacy salience increase Δ Days by 0.40 days (p-value < 0.01) and 0.51 days (p-value < 0.01) more than the control group, respectively, where as social norms increases Δ Days by 0.20 days (p-value < 0.10) more.

Table 6 reports the results from an OLS regression to examine the differential treatment effects based on the frequency of baseline meat consumption, by interacting the treatment groups with the variable "frequent meat eater". Frequent meat eater is a dummy variable which equals 1 if subjects report that their baseline number of days of weekly meat consumption is greater than the median value (4 days) and 0 otherwise. Column 3 shows that the interaction terms are positive and significant for animal welfare and social norms, both with p-value < 0.10. This implies that the impact of these treatments on Δ Days is significantly higher for frequent meat eaters compared to those who eat meat less frequently (interaction terms depicted in Figure A.5). T-tests revealed that for subjects in animal welfare and social norms conditions, the mean Δ Days for frequent meat eaters was significantly higher than infrequent meat eaters, with p-value < 0.01 for both (as show in figure A.6). Table A.5 shows that for frequent meat eaters, more scientific information and efficacy salience are the only treatment conditions which have a significantly larger effect on Δ Days, relative to the control group.

In summary, more scientific information about the environmental effects of meat consumption and information enhancing the salience of response efficacy or the outcome expectancy of reduced meat consumption were found to be most effective in encouraging reduced meat consumption. Additionally, it was observed that a targetted messaging approach can prove effective for specific subject groups. For instance, along with more scientific information and efficacy salience, health information was also found to be effective

Table 2: Targetted messaging approach to encourage reduced meat consumption. The effectiveness of different information interventions for different subject groups, relative to the control group.

	More scientific information	Efficacy salience	Health information	Animal welfare	Social norms	Social efficacy
All	✓	✓				
Prior health concerns	✓	✓	✓			
High efficacy	✓	✓			✓	
Frequent meat eaters	✓	✓				

in reducing meat intake for subjects with prior health concerns. A summary of our results and how they work for different population groups is provided in table 2.

3.3 Donation behaviour, Morality and Evidence recall

At the end of the study, all subjects were offered the opportunity to either donate a bonus sum of \$ 0.50 to a climate change charity or to keep it for themselves. Here, we evaluate the effect of the information interventions, as well as baseline beliefs and practices, on subjects' donation decisions. Table A.6 reports the marginal effects from a probit model. The dependant variable is the binary variable donate which equals 1 if the subject donated their bonus earnings to the climate change charity and 0 otherwise. We find that after the inclusion of sensible control variables, no treatment had a significant effect on donation behaviour. Prior ecological concern is a strong positive determinant of decision to donate. We also consider the donation decision of those with low (below median) prior ecological concern and high (above median) prior ecological concern. For those with low priors, more scientific information and social norms conditions are the most effective messages to encourage donation, increasing the probability of donation by 14 (p-value < 0.05) and 15 (p-value < 0.05) percentage points more than the control group, respectively. The average donation levels across the 7 groups are depicted in figure 5. Overall, prior ecological concerns were a key determinant of donation decision. For subjects with low prior ecological concern, more scientific information and social norms conditions were the most effective in encouraging donation to a climate change charity.

Moral convictions, especially those about meat consumption, can have a prominent impact on human behaviour (Feinberg et al. (2019)). To draw out the moral values associated with meat intake, we elicited the moral offence taken by subjects on being told the consequences of meat consumption. This was done to investigate whether or not meat might be seen as a sacred value, one that is morally licensed irrespective of its cost. This would make moral value of meat consumption resistant to trade-offs with climate or animal suffering (Hanselmann and Tanner (2008)). Accordingly, after the treatment, we included the question "Is it morally wrong to show people the consequences of their own behaviour?" which was answered on a scale of 1 to 5 where 1 is very morally wrong and 5 is very morally right. We found a significant positive correlation between the answer to the morality question and Δ Days, with Pearson's correlation coefficient .0998 and p-value < 0.01 (Figure A.7). This implies that subjects who have committed to a greater behavioural change are less inclined to take any moral offence from being shown the consequences of own behaviour. On the other hand, people who had a higher baseline meat intake were more inclined to report moral offence at being shown the consequences of their own behaviour (with Pearson correlation coefficient -0.0655 and p-value < 0.05). These results are consistent with holding meat as a sacred value.

Lastly, the paper evaluates the text reported by the subjects when they were asked to recall the evidence presented to them during the course of the study. Word-clouds representing what the subjects reported are presented in figure A.8. For each participant we calculated a cosine similarity score between the words they reported and the evidence they were shown which varied by treatment. Cosine similarity was calculated by converting the reported evidence (R) and actual evidence (A) to vector representations (after removing punctuation and stop-words from both) and then by measuring the cosine of the angle between these two vectors. A cosine similarity of 1 would mean that the reported and actual evidence are perfectly similar.

$$Similarity(R, A) = cos\theta = \frac{R \cdot A}{||R||||A||} \tag{1}$$

The average cosine similarity scores across the groups are presented in Fig 4. The group which received efficacy salience information had the highest mean cosine similarity score of 0.36. However, the difference compared to the control group score (0.33) was not significant. This provides some evidence that within the confines of the experiment all of the information interventions were approximately equally memorable between the point of the intervention taking place and the request for participants to recall the evidence presented to them. This does not of course allow us to say anything about how memorable interventions might be in the longer run.

4 Conclusion

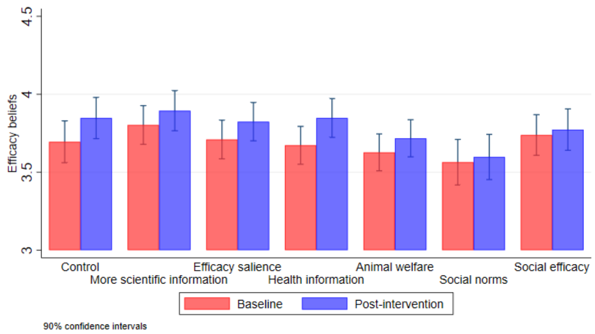
There is a broad scientific consensus that reduced meat consumption would have significant positive effects upon the current climate change crisis. Despite this consensus there is a lack of awareness of the link between diet and climate change among the general population. This creates an opening for information provision to provide positive benefits. However, there are many alternative approaches to providing additional information and there is no existing consensus on the best approach. We provide a first attempt to compare and contrast the leading approaches.

Our results show that compared to a control group, which was provided baseline scientific information about the environmental impact of meat intake, an additional statement about more similar scientific facts or a statement highlighting response efficacy of action can reduce an individual's CO_2 emissions by more than 30 kg/year. Extrapolating our results to a population the size of the U.S., our interventions could reduce the production of CO_2-equivalents by approximately 10 million tonnes per year. The effectiveness of these two statements prove the dearth of knowledge about both the environmental effects of meat and response efficacy or outcome expectancy of reducing one's meat intake, respectively. Our results also support a targeted messaging approach, dependent upon prior beliefs and individual characteristics, to alter behaviour. For instance, for subjects with pre-existing health concerns, providing information on the health benefits of a plant-based diet was effective in encouraging reduced meat intake. Additionally, the paper finds evidence that using messages with more scientific information or social norms frames can encourage donation to climate change charities among those who report low baseline ecological concerns.

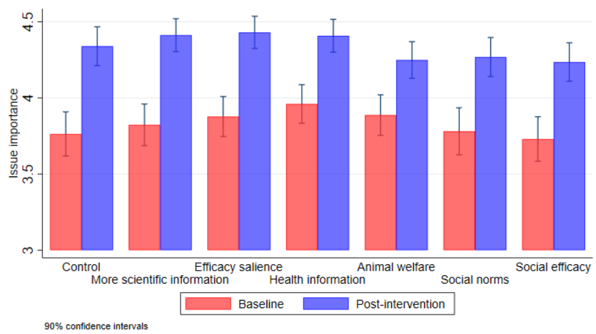
Furthermore, our results indicate that the more meat a person consumed, the less they acknowledged the relationship between climate and diet, the more resistant they were to new information, the lower their efficacy beliefs and the more likely they were to take moral offence at being told the consequences of their behaviour. Critically, the frequent meat eaters in this study have the most to offer reduction in climate impact, and one may consider those who do respond to the evidence as "meat pragmatists". Persuading some meat eaters to reduce their meat consumption poses a challenge due to the trade-off faced by them between the sacred values associated with meat intake and the benefits of environmental, personal, and animal wellbeing.

Overall, our findings provide a general taxonomy that should guide those in a position to disseminate information and enable them to achieve the maximum possible impact which is summarised in table 2.

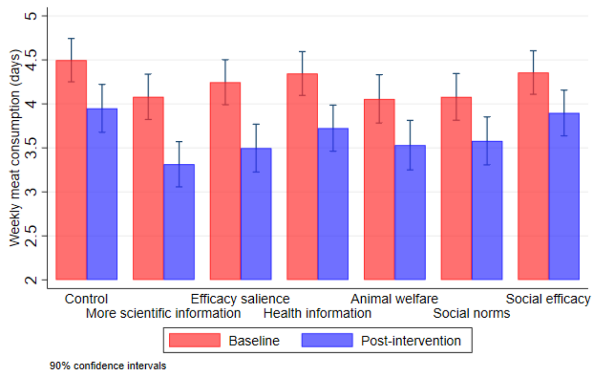
Tables and Figures



(a) Efficacy beliefs

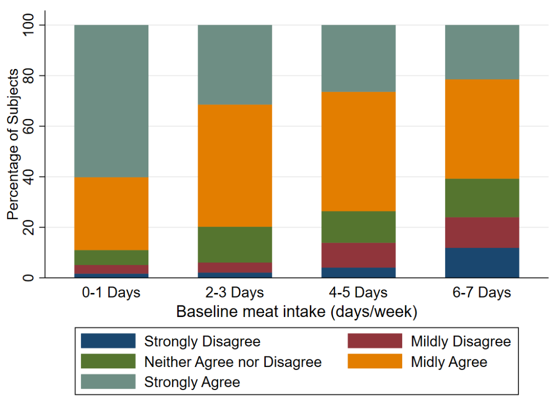


(b) Issue importance

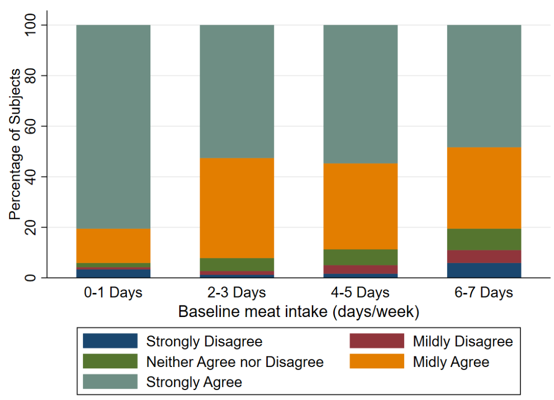


(c) Weekly meat consumption (days)

Figure 1: (a) Efficacy Beliefs, (b) issue importance and (c) weekly meat consumption (days) before and after intervention across different conditions.

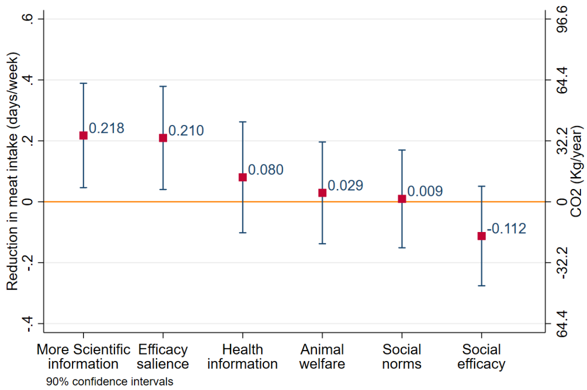


(a) Baseline

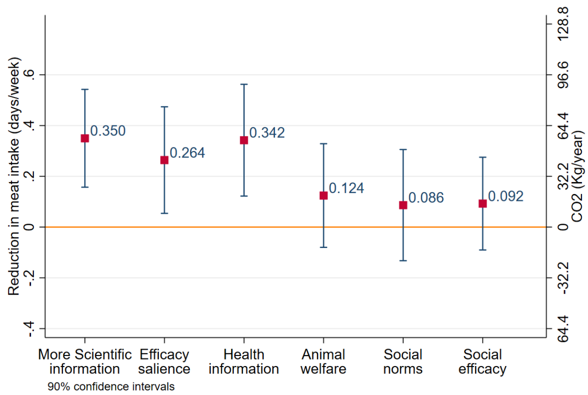


(b) Post intervention

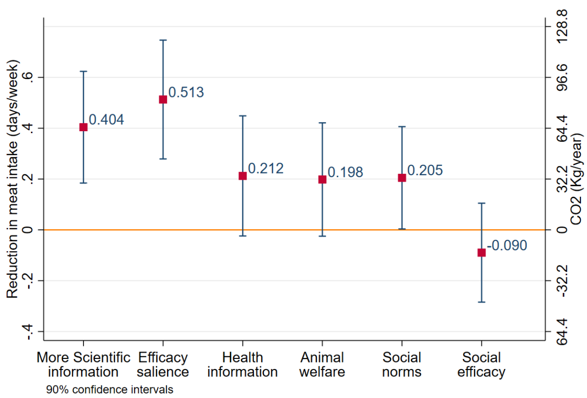
Figure 2: Relationship between baseline number of days of meat consumption per week and the (a) pre-intervention and (b) post-intervention degree to which subjects agree that there is a relationship between climate change and people's food choices.



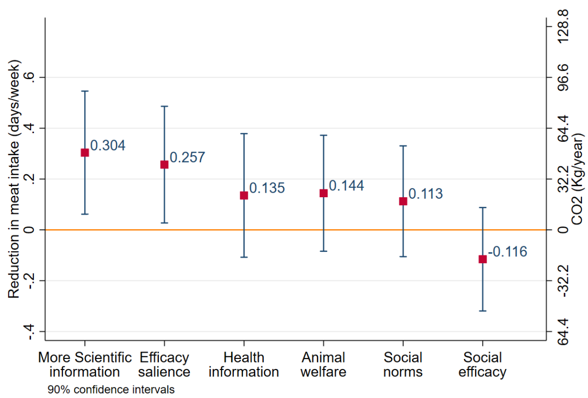
(a) All subjects



(b) Subjects with health concerns



(c) Subjects with high baseline efficacy beliefs



(d) Frequent meat eaters

Figure 3: Regression coefficients showing the effect size of the information interventions on reduction in number of days of meat consumption per week across different targeted groups. The right hand axis plots the equivalent of reduced meat consumption (days per week) in terms of reduced CO_2 emissions per year. The regression coefficients plotted show the effect size after controlling for baseline beliefs and practices, and demographic characteristics.

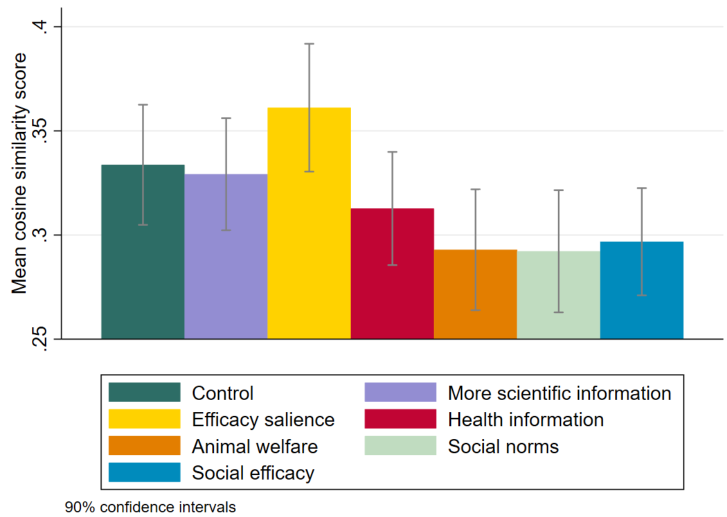
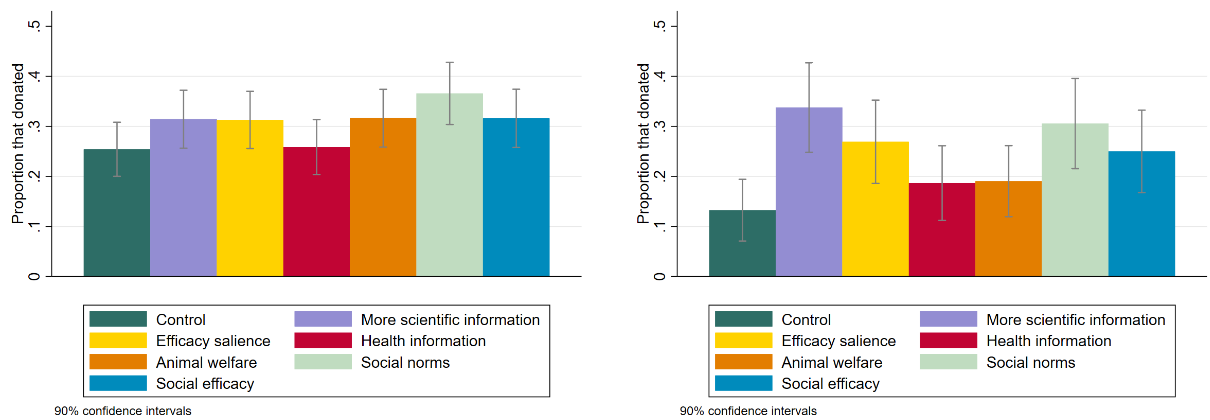


Figure 4: Cosine similarity score between the evidence the subjects could recall and the actual evidence given to them across the different groups



(a) All

(b) Low Priors

Figure 5: Donation to charity across groups. (a) presents the proportion that donated to charity in all groups. (b) presents the proportion that donated to charity when the subject had low prior ecological concern across the different groups. A oneway ANOVA test rejected the null of no significant difference in means between the groups for those with low priors with F-statistic 2.33 and p-value 0.0316.

Table 3: Impact of information interventions on reduction in number of days of meat consumption per week

	Dependent Variable: Δ Days		
	(1)	(2)	(3)
More scientific information	0.2177**	0.2339**	0.2176**
	(0.1060)	(0.1039)	(0.1041)
Efficacy salience	0.2006*	0.2118**	0.2095**
	(0.1040)	(0.1027)	(0.1028)
Health information	0.0727	0.0828	0.0803
	(0.1127)	(0.1113)	(0.1106)
Animal welfare	-0.0226	0.0295	0.0293
	(0.1020)	(0.1013)	(0.1015)
Social norms	-0.0480	0.0130	0.0093
	(0.0984)	(0.0979)	(0.0975)
Social efficacy	-0.0883	-0.0963	-0.1124
	(0.0973)	(0.0983)	(0.0992)
Prior Ecological Concern		0.1007***	0.0975***
		(0.0298)	(0.0304)
Pre-intervention Diet		0.2115***	0.2193***
		(0.0286)	(0.0287)
Baseline Efficacy Beliefs		0.1559***	0.1541***
		(0.0320)	(0.0327)
Age			0.0008
			(0.0272)
Female			0.1344**
			(0.0636)
Democrat			0.0227
			(0.0626)
Education			0.0788
			(0.0663)
N	1220	1220	1220

Standard errors in parentheses. Statistical significance indicated as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Impact of health information intervention on reduction in number of days of meat consumption per week depending on history of diseases in the family

	Dependent Variable: Δ Days		
	(1)	(2)	(3)
Health information × Disease	0.6685***	0.6786***	0.6913***
	(0.2387)	(0.2356)	(0.2359)
Health information	-0.3511*	-0.3522*	-0.3622*
	(0.1958)	(0.1931)	(0.1923)
Disease	-0.3144**	-0.3371**	-0.3510**
	(0.1457)	(0.1458)	(0.1486)
Prior Ecological Concern		0.0842	0.0617
		(0.0575)	(0.0599)
Pre-intervention Diet		0.1510***	0.1571***
		(0.0560)	(0.0564)
Baseline Efficacy Beliefs		0.1086*	0.0874
		(0.0600)	(0.0583)
Age			-0.0094
			(0.0501)
Female			0.2195*
			(0.1280)
Democrat			0.2017*
			(0.1152)
Education			0.0436
			(0.1285)
N	351	351	351

Standard errors in parentheses. Statistical significance indicated as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Impact of information interventions on reduction in number of days of meat consumption per week depending on baseline efficacy beliefs

	Dependent Variable: Δ Days		
	(1)	(2)	(3)
More scientific information × High efficacy beliefs	0.4410**	0.3883*	0.3936*
	(0.2122)	(0.2084)	(0.2089)
Efficacy salience × High efficacy beliefs	0.6858***	0.6268***	0.6309***
	(0.2036)	(0.2027)	(0.2031)
Health information × High efficacy beliefs	0.3549	0.2841	0.2821
	(0.2263)	(0.2236)	(0.2240)
Animal welfare × High efficacy beliefs	0.3920*	0.3559*	0.3475*
	(0.2041)	(0.2024)	(0.2027)
Social norms × High efficacy beliefs	0.4500**	0.4148**	0.3959**
	(0.1956)	(0.1934)	(0.1936)
Social efficacy × High efficacy beliefs	0.1265	0.0359	0.0381
	(0.2005)	(0.1999)	(0.2004)
More scientific information	-0.0329	0.0238	0.0035
	(0.1626)	(0.1611)	(0.1626)
Efficacy salience	-0.1525	-0.1149	-0.1204
	(0.1458)	(0.1467)	(0.1473)
Health information	-0.1150	-0.0691	-0.0702
	(0.1703)	(0.1697)	(0.1711)
Animal welfare	-0.2146	-0.1568	-0.1537
	(0.1557)	(0.1540)	(0.1534)
Social norms	-0.2639*	-0.2017	-0.1974
	(0.1517)	(0.1516)	(0.1520)
Social efficacy	-0.1584	-0.1083	-0.1256
	(0.1634)	(0.1633)	(0.1646)
High Efficacy Beliefs	-0.0344	-0.2456	-0.2535
	(0.1299)	(0.1680)	(0.1684)
Prior Ecological Concern		0.1042***	0.1010***
		(0.0304)	(0.0309)
Pre-intervention Diet		0.2091***	0.2170***
		(0.0285)	(0.0287)
Baseline Efficacy Beliefs		0.1307**	0.1344**
		(0.0583)	(0.0582)
Age			0.0033
			(0.0273)
Female			0.1308**
			(0.0643)
Democrat			0.0170
			(0.0626)
Education			0.0824
			(0.0663)
N	1220	1220	1220

Standard errors in parentheses. Statistical significance indicated as follows:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Impact of information interventions on reduction in number of days of meat consumption per week depending on baseline frequency of meat consumption

	Dependent Variable: Δ Days		
	(1)	(2)	(3)
More scientific information × Frequent meat eater	0.3458*	0.3180	0.3050
	(0.2002)	(0.1964)	(0.1966)
Efficacy salience × Frequent meat eater	0.2563	0.1968	0.1842
	(0.1940)	(0.1896)	(0.1903)
Health information × Frequent meat eater	0.3057	0.2172	0.2080
	(0.2138)	(0.2107)	(0.2130)
Animal welfare × Frequent meat eater	0.3955**	0.3567*	0.3545*
	(0.1951)	(0.1952)	(0.1967)
Social norms × Frequent meat eater	0.3199*	0.3232*	0.3135*
	(0.1887)	(0.1875)	(0.1873)
Social efficacy × Frequent meat eater	0.1463	0.0574	0.0752
	(0.1977)	(0.1981)	(0.1990)
More scientific information	0.0233	0.0250	0.0173
	(0.1315)	(0.1300)	(0.1299)
Efficacy salience	0.0407	0.0730	0.0793
	(0.1322)	(0.1302)	(0.1295)
Health information	-0.1239	-0.0685	-0.0649
	(0.1521)	(0.1496)	(0.1507)
Animal welfare	-0.2511*	-0.2052	-0.2034
	(0.1375)	(0.1374)	(0.1377)
Social norms	-0.2259*	-0.1989	-0.1961
	(0.1313)	(0.1307)	(0.1312)
Social efficacy	-0.1791	-0.1432	-0.1699
	(0.1551)	(0.1553)	(0.1571)
Frequent meat eater	0.0820	-0.1349	-0.1441
	(0.1253)	(0.1611)	(0.1610)
Prior Ecological Concern		0.1048***	0.1013***
		(0.0301)	(0.0306)
Pre-intervention Diet		0.1789***	0.1919***
		(0.0536)	(0.0542)
Baseline Efficacy Beliefs		0.1526***	0.1510***
		(0.0324)	(0.0331)
Age			-0.0004
			(0.0275)
Female			0.1276**
			(0.0648)
Democrat			0.0256
			(0.0628)
Education			0.0780
			(0.0668)
N	1220	1220	1220

Standard errors in parentheses. Statistical significance indicated as follows:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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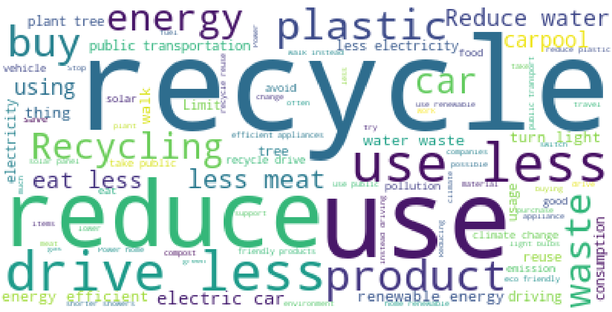
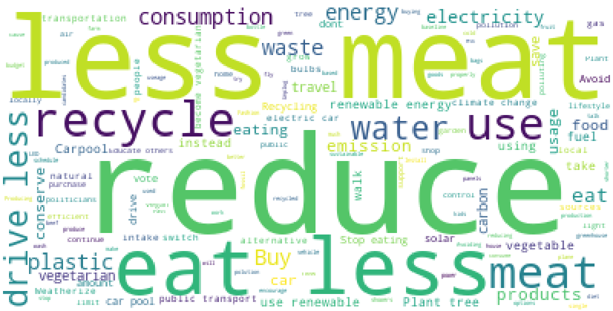
Appendix

A Additional Figures and Tables



(a) Baseline



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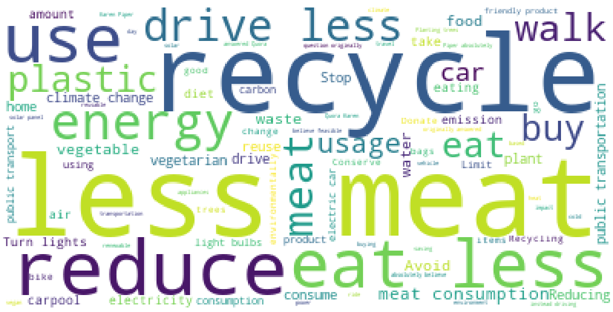
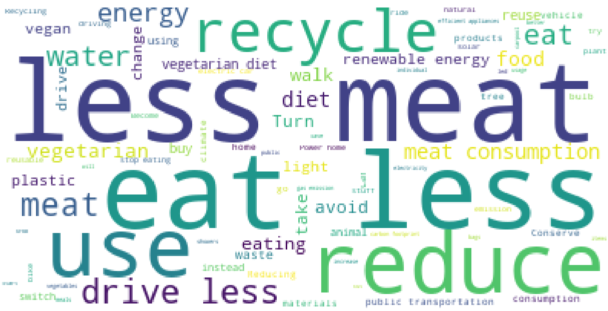
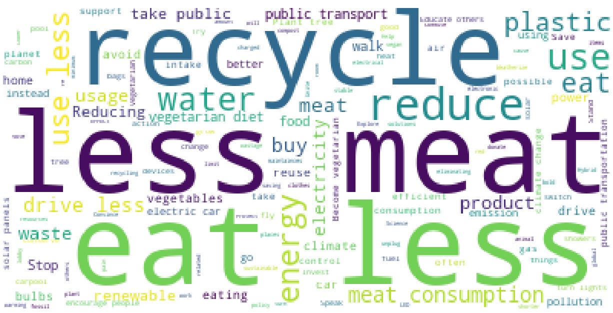


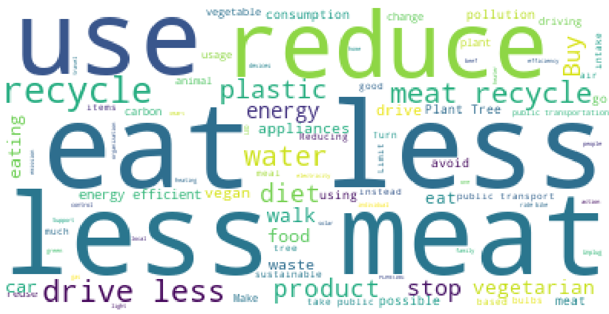
(c) More scientific information



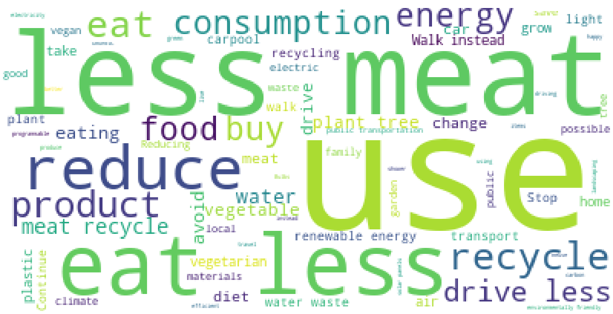
(d) Efficacy salience



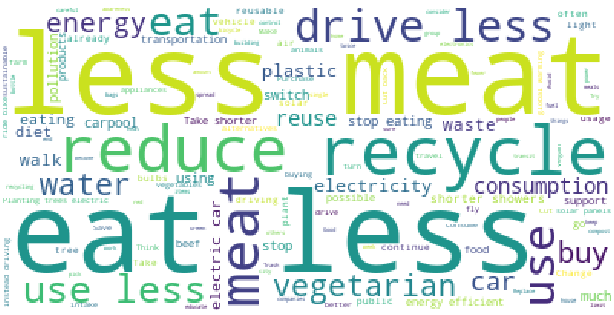
(e) Health information



(f) Animal welfare



(g) Social norms



(h) Social efficacy

Figure A.1: Actions to combat climate change listed at baseline and post-intervention. (a) Wordcloud representing baseline answers to actions you can take personally to combat climate change. (b) to (h) Wordclouds representing post interventions answers to actions you can take personally to combat climate change across the different groups.

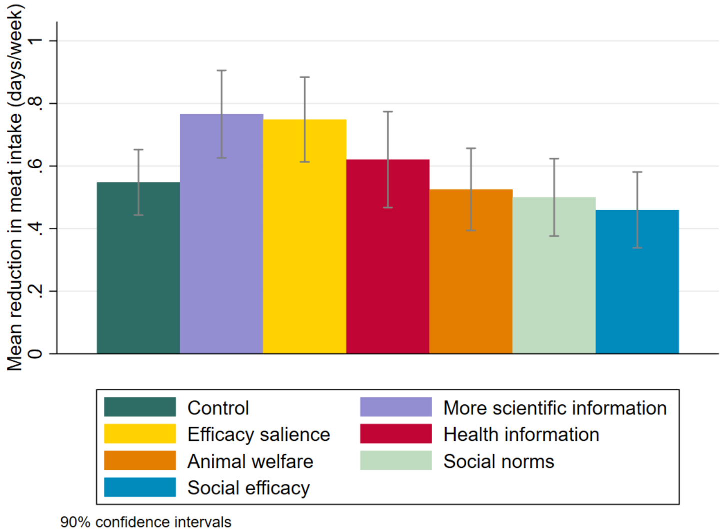
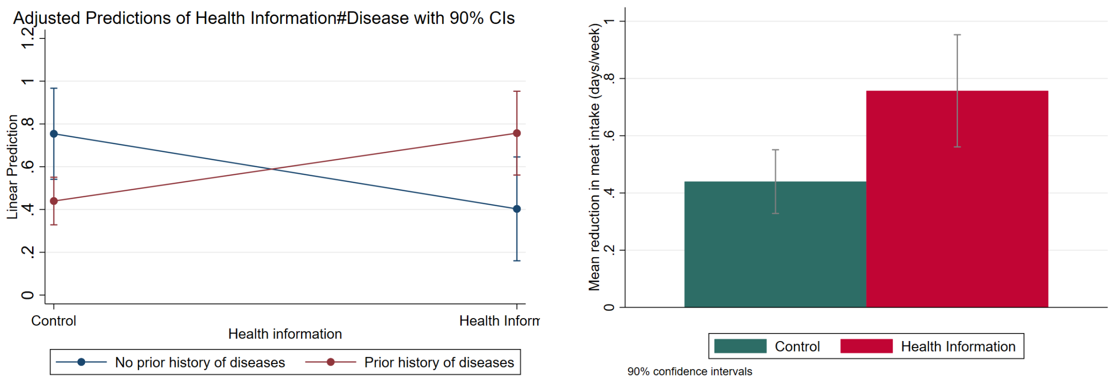


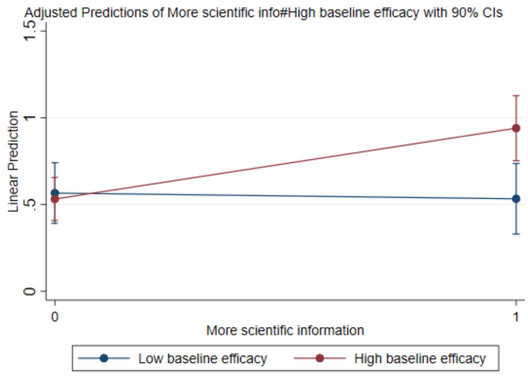
Figure A.2: (a) Average reduction in number of days of meat consumption per week across groups. A oneway ANOVA test rejected the null of no significant difference in means between the groups with F-statistic 2.32 and p-value 0.0309.



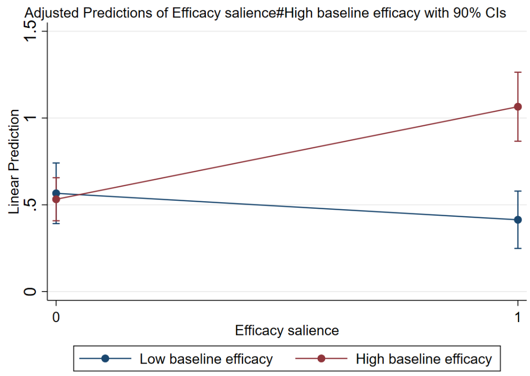
(a) Interaction plot

(b) For subjects with prior health concerns

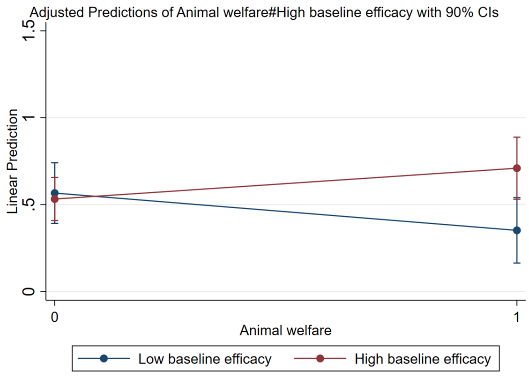
Figure A.3: The differential effect of the health information intervention on change in weekly meat consumption depending on whether the subject has a prior health concern. (a) shows that health information is more effective than the Control when the individual has prior health concerns (disease=1). (b) plots the mean change in weekly meat consumption for control and health information groups, only when subjects have prior health concern. The null of equal means was rejected by a t-test with t-statistic -2.3716 and p-value 0.0186.



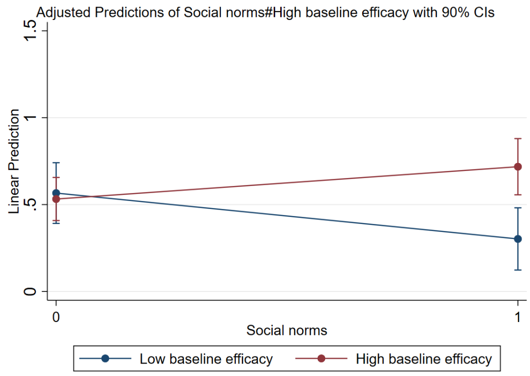
(a) More scientific information



(b) Efficacy salience

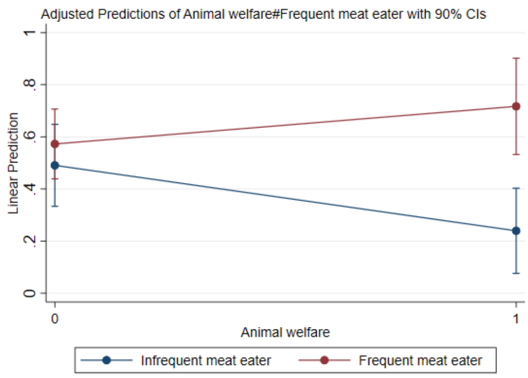


(c) Animal welfare

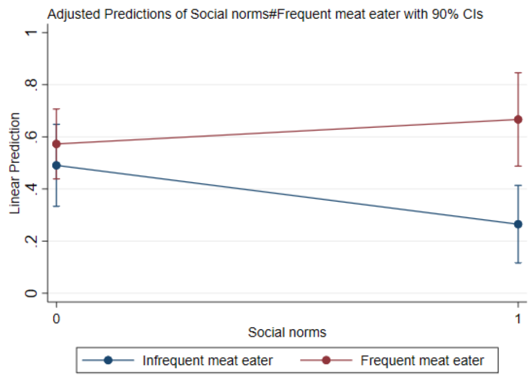


(d) Social norms

Figure A.4: Interaction plots showing effects of (a) More scientific information, (b) Efficacy salience, (c) Animal welfare and (d) Social norms on reduction in number of days of meat consumption per week, for different baseline efficacy beliefs values.

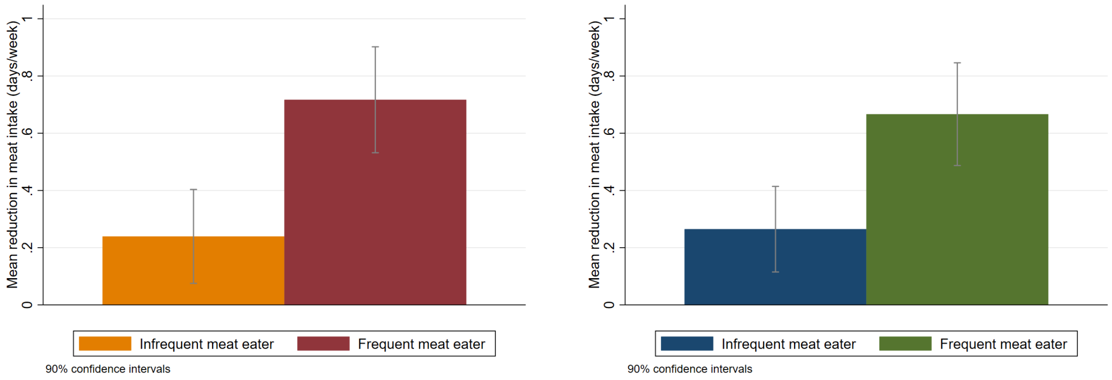


(a) Animal welfare



(b) Social norms

Figure A.5: Interaction plot showing effects of (a) Animal welfare and (b) Social norms conditions on reduction in number of days of meat consumption per week, for different frequencies of pre-intervention meat consumption.



(a) Animal welfare

(b) Social norms

Figure A.6: Average change in weekly meat consumption for different frequencies of baseline meat eating for subjects in (a) Animal welfare and (b) Social norms conditions. The null of no significant differences in means between frequent and less frequent meat eaters is rejected for both animal welfare (with t-statistic -3.0008 and p-value 0.031) and social norms (with t-statistic -2.6846 and p-value 0.0080).

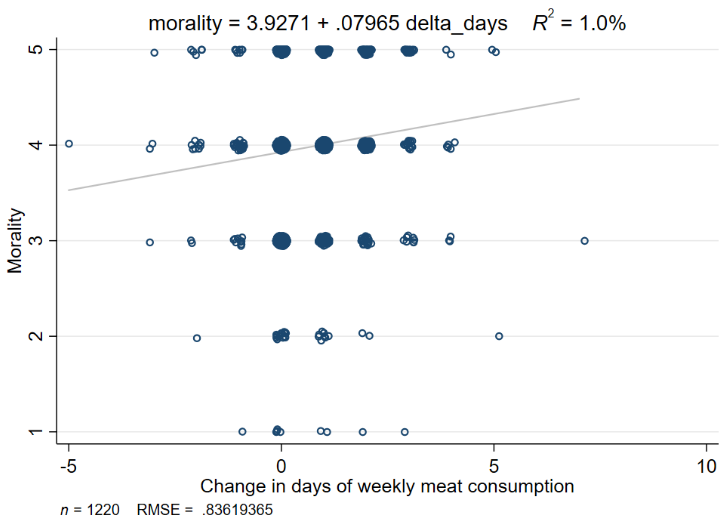
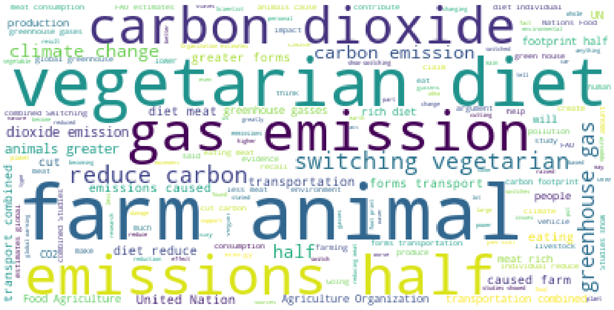
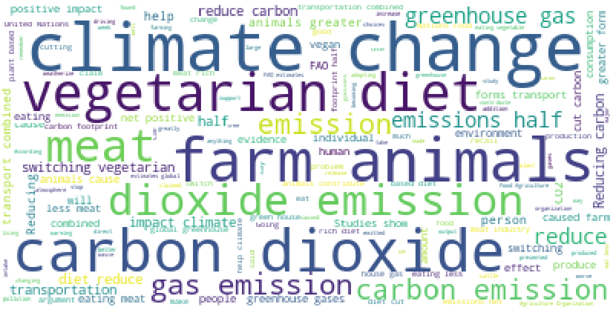


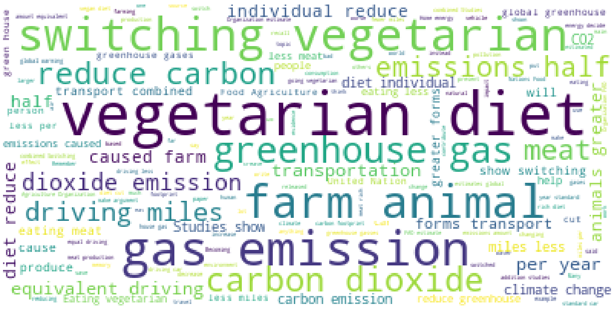
Figure A.7: Relationship between Δ Days and answer to “Is it morally wrong to show people the consequences of their own behaviour?” on a scale of 1 to 5 where 1 is very morally wrong and 5 is very morally right.



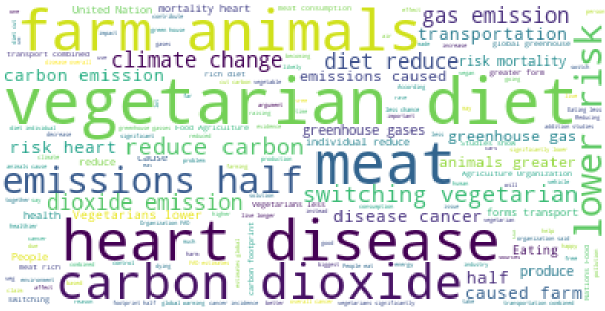
(a) Control



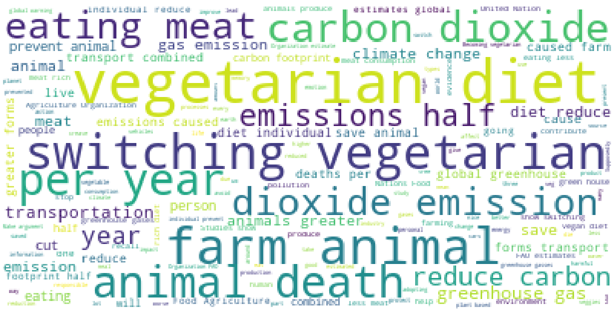
(b) More scientific information



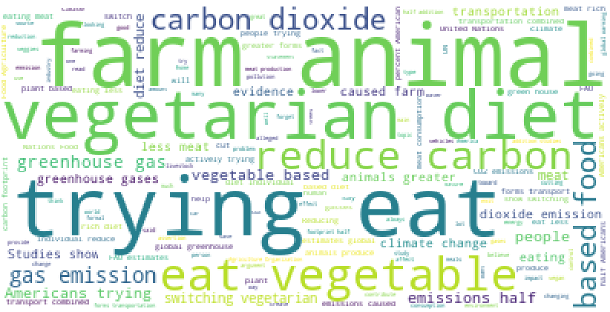
(c) Efficacy salience



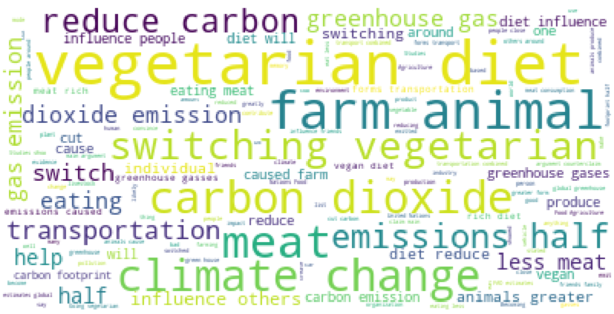
(d) Health information



(e) Animal welfare



(f) Social norms



(g) Social efficacy

Figure A.8: Evidence recall from different treatment conditions

Table A.1: Summary Statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Δ Days	0.597	1.052	-5	7	1220
Donation to charity	0.305	0.461	0	1	1220
Prior Ecological Concern	4.025	0.734	1	5	1220
Pre-intervention diet	4.239	2.05	0	7	1220
Post-intervention diet	3.642	2.147	0	7	1220
Baseline Efficacy Beliefs	3.688	1.024	1	5	1220
Post-intervention Efficacy Beliefs	3.788	1.033	1	5	1220
Disease (history of family diseases)	0.594	0.491	0	1	1220
Age	36.329	10.394	19	78	1220
Female	0.388	0.487	0	1	1220
Democrat	0.555	0.497	0	1	1220
Education	0.774	0.419	0	1	1220

Table A.2: Impact of information interventions on reduction in number of days of meat consumption per week

	Dependent Variable: $\frac{\Delta Days}{Pre-intervention Diet}$		
	(1)	(2)	(3)
More scientific information	0.0544*	0.0460	0.0411
	(0.0283)	(0.0281)	(0.0283)
Efficacy salience	0.0655**	0.0612**	0.0587**
	(0.0282)	(0.0274)	(0.0274)
Health information	0.0044	0.0028	0.0021
	(0.0295)	(0.0291)	(0.0289)
Animal welfare	-0.0169	-0.0173	-0.0177
	(0.0306)	(0.0300)	(0.0302)
Social norms	-0.0073	-0.0048	-0.0067
	(0.0282)	(0.0276)	(0.0276)
Social efficacy	-0.0365	-0.0419	-0.0446
	(0.0279)	(0.0280)	(0.0286)
Prior Ecological Concern		0.0187**	0.0177**
		(0.0074)	(0.0078)
Pre-intervention Diet		-0.0111	-0.0088
		(0.0093)	(0.0092)
Baseline Efficacy Beliefs		0.0403***	0.0424***
		(0.0087)	(0.0089)
Age			-0.0020
			(0.0080)
Female			0.0229
			(0.0182)
Democrat			0.0004
			(0.0188)
Education			0.0395**
			(0.0154)
N	1220	1220	1220

Standard errors in parentheses. Statistical significance indicated as follows:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Impact of information interventions on reduction in number of days of meat consumption per week depending on history of diseases in the family

	Dependent Variable: Δ Days			
	Prior history		No history	
More scientific information	0.3061**	0.3498***	0.0529	-0.0048
	(0.1195)	(0.1170)	(0.2079)	(0.2020)
Efficacy salience	0.2446*	0.2639**	0.0673	0.0382
	(0.1300)	(0.1275)	(0.1781)	(0.1724)
Health information	0.3174**	0.3423**	-0.3511*	-0.3666*
	(0.1365)	(0.1337)	(0.1960)	(0.1938)
Animal welfare	0.0653	0.1242	-0.2015	-0.1793
	(0.1255)	(0.1240)	(0.1778)	(0.1741)
Social norms	-0.0093	0.0865	-0.1894	-0.1889
	(0.1306)	(0.1330)	(0.1642)	(0.1576)
Social efficacy	0.1108	0.0925	-0.4464**	-0.4825**
	(0.1061)	(0.1109)	(0.1907)	(0.1907)
Prior Ecological Concern		0.0613		0.1294***
		(0.0384)		(0.0486)
Pre-intervention Diet		0.2362***		0.1944***
		(0.0349)		(0.0489)
Baseline Efficacy Beliefs		0.1608***		0.1468***
		(0.0418)		(0.0528)
Age		-0.0064		0.0107
		(0.0317)		(0.0528)
Female		0.0931		0.1790
		(0.0777)		(0.1099)
Democrat		0.1486*		-0.1234
		(0.0783)		(0.1013)
Education		-0.0170		0.2273*
		(0.0797)		(0.1180)
N	725	725	495	495

Standard errors in parentheses. Statistical significance indicated as follows:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.4: Impact of information interventions on reduction in number of days of meat consumption per week for those with high and low baseline efficacy beliefs

	Dependent Variable: Δ Days			
	High efficacy		Low efficacy	
More scientific information	0.4081***	0.4039***	-0.0329	-0.0117
	(0.1362)	(0.1334)	(0.1627)	(0.1663)
Efficacy salience	0.5333***	0.5128***	-0.1525	-0.1401
	(0.1421)	(0.1419)	(0.1458)	(0.1484)
Health information	0.2398	0.2123	-0.1150	-0.0850
	(0.1489)	(0.1435)	(0.1704)	(0.1738)
Animal welfare	0.1774	0.1981	-0.2146	-0.1764
	(0.1318)	(0.1354)	(0.1558)	(0.1552)
Social norms	0.1860	0.2048*	-0.2639*	-0.2200
	(0.1235)	(0.1223)	(0.1517)	(0.1531)
Social efficacy	-0.0319	-0.0898	-0.1584	-0.1381
	(0.1162)	(0.1182)	(0.1634)	(0.1669)
Prior Ecological Concern		0.0765		0.1099***
		(0.0491)		(0.0401)
Pre-intervention Diet		0.2532***		0.1695***
		(0.0367)		(0.0467)
Baseline Efficacy Beliefs		0.2169**		0.0937
		(0.1054)		(0.0704)
Age		-0.0006		0.0105
		(0.0373)		(0.0416)
Female		0.1596*		0.0987
		(0.0834)		(0.1000)
Democrat		0.0299		0.0020
		(0.0841)		(0.0935)
Education		0.0491		0.1216
		(0.0858)		(0.1042)
N	640	640	580	580

Standard errors in parentheses. Statistical significance indicated as follows:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: Impact of information interventions on reduction in number of days of meat consumption per week for frequent and infrequent meat eaters

	Dependent Variable: Δ Days			
	Frequent		Infrequent	
More scientific information	0.3692**	0.3038**	0.0233	0.0293
	(0.1507)	(0.1471)	(0.1317)	(0.1240)
Efficacy salience	0.2970**	0.2567*	0.0407	0.0779
	(0.1418)	(0.1393)	(0.1325)	(0.1261)
Health information	0.1818	0.1355	-0.1239	-0.0775
	(0.1500)	(0.1477)	(0.1524)	(0.1450)
Animal welfare	0.1444	0.1440	-0.2511*	-0.1736
	(0.1383)	(0.1385)	(0.1378)	(0.1358)
Social norms	0.0941	0.1125	-0.2259*	-0.1935
	(0.1354)	(0.1324)	(0.1316)	(0.1276)
Social efficacy	-0.0328	-0.1157	-0.1791	-0.1566
	(0.1223)	(0.1236)	(0.1555)	(0.1552)
Prior Ecological Concern		0.1093***		0.0602
		(0.0384)		(0.0456)
Pre-intervention Diet		0.0789		0.4054***
		(0.0719)		(0.0523)
Baseline Efficacy Beliefs		0.1721***		0.1310***
		(0.0465)		(0.0399)
Age		0.0332		-0.0240
		(0.0422)		(0.0300)
Female		0.2206**		-0.0019
		(0.0889)		(0.0822)
Democrat		0.0186		0.0443
		(0.0890)		(0.0813)
Education		0.0254		0.1407**
		(0.0905)		(0.0700)
N	771	771	449	449

Standard errors in parentheses. Statistical significance indicated as follows:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.6: Impact of information interventions on decision to donate bonus earnings

	Dependent Variable: Prob(donate=1)			
	(1) All	(2) All	(3) Low Priors	(4) High Priors
More scientific information	0.0600	0.0335	0.1415**	-0.0471
	(0.0480)	(0.0455)	(0.0594)	(0.0652)
Efficacy salience	0.0586	0.0221	0.0727	-0.0227
	(0.0477)	(0.0446)	(0.0553)	(0.0643)
Health information	0.0044	-0.0149	0.0313	-0.0360
	(0.0466)	(0.0438)	(0.0548)	(0.0637)
Animal welfare	0.0621	0.0203	0.0456	0.0190
	(0.0479)	(0.0444)	(0.0562)	(0.0659)
Social norms	0.1116**	0.0708	0.1489**	0.0179
	(0.0499)	(0.0467)	(0.0632)	(0.0655)
Social efficacy	0.0619	0.0589	0.1101*	0.0362
	(0.0481)	(0.0466)	(0.0626)	(0.0648)
Prior Ecological Concern		0.1166***	0.1363***	-0.0338
		(0.0142)	(0.0276)	(0.0482)
Pre-intervention Diet		-0.0809***	-0.0857***	-0.0651***
		(0.0121)	(0.0164)	(0.0170)
Δ Days		0.0250*	0.0216	0.0225
		(0.0129)	(0.0178)	(0.0173)
Baseline Efficacy Beliefs		-0.1078***	-0.0541***	-0.1433***
		(0.0132)	(0.0178)	(0.0183)
Age		-0.0030	-0.0123	0.0311*
		(0.0128)	(0.0174)	(0.0184)
Female		-0.0554**	-0.0342	-0.0670*
		(0.0257)	(0.0344)	(0.0355)
Democrat		-0.0439*	-0.0018	-0.0773**
		(0.0264)	(0.0341)	(0.0358)
Education		0.1236***	0.1700***	0.0692
		(0.0313)	(0.0447)	(0.0450)
N	1220	1220	545	675

Standard errors in parentheses. Statistical significance indicated as follows:
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B Information Interventions

The following are the messages which were used in the interventions. Sources of the information mentioned below were not included as part of the information interventions.

Control

The United Nations Food and Agriculture Organization (FAO) estimates global greenhouse gas emissions caused by farm animals is greater than all forms of transport combined.

Studies show that by switching to a vegetarian diet from a meat rich diet, an individual could reduce their carbon dioxide emissions by half.

Source: FAO (2006) and Scarborough et al. (2014)

More scientific information

Control

+

In addition, studies show that reducing carbon dioxide emissions can have a net positive impact on climate change.

Source: NASA (2020)

Efficacy salience

Control

+

In addition, studies show that by switching to a vegetarian diet an individual can reduce their greenhouse gas emissions by an amount that is equivalent to driving about 3000 miles less per year in a standard car.

Source: Weber and Matthews (2008).

Health information

Control

+

In addition, studies show that vegetarians have a significantly lower risk of mortality from heart disease and overall cancer incidence.

Source: Huang et al. (2012)

Animal welfare

Control

+

In addition, studies show that by switching to a vegetarian diet an individual can prevent more than 100 animal deaths per year.

Source: PETA (2013)

Social norms

Control

+

In addition, studies show that 39% of Americans are actively trying to eat more vegetable-based foods.

Source: Shoup (2018)

Social efficacy

Control

+

In addition, studies show that if you switch to a vegetarian diet from a meat rich diet you could influence people close to you to do the same.

Source: Higgs and Thomas (2016)

C Experiment Script

1. Rate the degree to which you agree with the following statements:

   Answer on a 5-point likert scale where 1 is strongly disagree and 5 is strongly agree.

   (a) The balance of nature is very delicate and easily upset by human activities.

   (b) Ecological, rather than economic, factors must guide our use of natural resources.

   (c) We attach too much importance to economic measures of the well-being of our society.

   (d) We are approaching the limit of the number of people the earth can support.

   (e) When humans interfere with nature, it often produces disastrous consequences.

   (f) Humans must live in harmony with nature in order to survive.

   (g) There are limits to growth beyond which our industrialized society cannot expand.

2. How concerned about climate change are you?

   Answer on a 5-point likert scale where 1 is Not at all concerned and 5 is Extremely concerned.

3. How concerned about climate change do your friends think you are

   Answer on a 5-point likert scale where 1 is Not at all concerned and 5 is Extremely concerned.

4. What actions could you take personally to reduce climate change? Please mention 3 actions. Leave empty if you cannot think of any.

5. Rate the degree to which you agree with the following statements:

   Answer on a 5-point likert scale where 1 is Strongly disagree and 5 is strongly agree.

   (a) Individuals can influence climate change.

   (b) Collectively humans have little influence on climate change.

6. How many days in a week do you eat meat? Please indicate a number between 0 to 7 days.

7. Rate the degree to which you agree with the following statement.

   There is a relationship between climate change and people's food choice.

   Answer on a 5-point likert scale where 1 is Strongly disagree and 5 is strongly agree.

Information Intervention

8. Rate the degree to which you agree with the following statement.

   The information I read made me feel that there is a relationship between climate change and people's food choices.

   Answer on a 5-point likert scale where 1 is Strongly disagree and 5 is strongly agree.

9. Rate the degree to which you agree with the following statements.

   Answer on a 5-point likert scale where 1 is Strongly disagree and 5 is strongly agree.

   (a) Individuals can influence climate change.

   (b) Collectively humans have little influence on climate change.

10. After reading the information provided, how many days in a week will you eat meat? Please indicate a number between 0 to 7 days.

11. What actions could you take personally to reduce climate change? Please mention 3 actions. Leave empty if you cannot think of any.

12. Please write down everything you can recall from the evidence presented to you.

13. Is it morally wrong to show people the consequences of their own behaviour?

    Options - very morally wrong, morally wrong, neither morally wrong nor right, morally right, very morally right

14. What is your age?

15. What is your gender?

    Options - Male, Female, Other, Prefer not to say

16. Please indicate the highest academic degree you have completed.

    Options - None, High/Secondary School, Vocational Training, Bachelor, Master, PhD

17. In which part of the US are you currently located?

18. Which party would you prefer to win the next election?

    Democrat, Republican, Other, Prefer not to say.

19. How many people would notice if you changed your diet?

20. How many of these people do you think might be influenced to change their diets as well?

21. Have you or any member of your immediate family (father, mother, siblings, and grandparents) had or suffered from heart disease, stroke, cancer, diabetes, high blood pressure or high cholesterol?

You have now reached the end of the study.

For your participation today, you will be receiving $1.50.

Additionally, for your effort, we would like to offer you a **bonus of $.50**.

You can keep the bonus earnings for yourself or you can give it to the experimenters who will **donate on your behalf to the** Adaptation Fund.

The Adaptation Fund was set up under the Kyoto protocol of **United Nations Framework Convention on Climate Change**.The fund finances projects and programmes which help vulnerable communities in developing countries adapt to climate change.

Do you want to donate your bonus earnings to The Adaptation Fund?

Thank you for participating in the study. We appreciate your help with our research.

Your earnings today is $x.

In case of donation to The Adaptation Fund;

Also, we want to thank you for your donation to The Adaptation Fund.

D Carbon dioxide emissions

Weber and Matthews (2008) estimate that by switching to a plant-based diet just 1 day per week from red meat and dairy a household can reduce their greenhouse gas (GHG) emissions equivalent to driving 1160 miles less per year. The authors normalise the data to the unit of a household using US census data in 1997 which included around 267 million residents in 101 million households. Hence, the size of each household is around $\frac{267}{101}$ i.e 2.64. Thus, by switching to a plant-based diet 1 day per week an individual can reduce their GHG emission equivalent to driving $\frac{1160}{2.64}$ or 439.39 miles per year less. Further, the authors estimates that driving 12,000 miles in a standard automobile (25 miles/gallon) produces around 4.4 t CO_2 per year. Which means, that by switching to a plant-based diet 1 day per week an individual can reduce their CO_2 emissions by $\frac{4400}{12000} \times 439.39$ or 161.11 kg CO_2 per year.