# Communicating dynamic norm information

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We have no known conflict of interest to disclose. All study materials and data will be hosted on the Open Science Framework (<https://osf.io/vb2s8/>).

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# Abstract

While decreasing meat consumption is one of the most impactful behaviours an individual may do to reduce their carbon emissions, it is still a minority behaviour in many parts of the world. Research suggests that communicating information about changing ‘dynamic’ norms may be a useful tool to change attitudes and behaviours in the direction of those currently held by the minority. This study utilizes a 2x2 mixed design (type of norm [dynamic/visual] x visual cue [present/absent], and a no-task control) to investigate the effect of making dynamic norms salient on various meat consumption outcomes: attitudes toward meat consumption, interest in reducing own meat consumptions, intentions to reduce own meat consumption, and self-reported meat consumption. We expect that: a) dynamic norms will positively influence meat consumption outcomes, b) using a visual cue will enhance the effect of dynamic norms, and c) any effects of dynamic norms will endure over a period of one week.

*Keywords*: dynamic norms, sustainability, norms, communication, visual, meat

# Communicating dynamic norm information

Meat production is a major contributor to greenhouse gas emissions and environmental degradation, and decreasing consumption of meat is considered a high-impact action for reducing carbon emissions (Machovina et al., 2015). A review of educational textbooks and government resources for civilians from the EU, USA, Canada, and Australia found that there is a focus on behaviours with low impact on the environment, rather than effective emission reduction strategies that can narrow the climate mitigation gap (Wynes & Nicholas, 2017). Even if individuals are knowledgeable and willing to align their behaviour with climate targets, social norms may act as a barrier to uptake of environmentally sustainable behaviours if the current norms reinforce unsustainable behaviours (Cialdini, 2003; Sparkman, Howe, et al., 2020).

## Social norms for behaviour change

Food choices are shaped by habits triggered by situational cues that lie largely outside people’s conscious awareness (Gardner et al., 2011; Riet et al., 2011). People rely on the social context to infer what is acceptable behaviour, and dietary behaviour is related to perceptions of normative behaviour in peer groups (Higgs, 2015). Social norms may be a promising target for changing habitual eating behaviour as they may bypass conscious motivations in their influence on behaviour (Marteau, 2017; Mathur et al., 2021; Stoll-Kleemann & Schmidt, 2017). In line with the Focus Theory of Normative Conduct (Cialdini et al., 1990), portraying desired behaviour (e.g., decreasing meat consumption) as aligned with injunctive or descriptive norms can shift existing behaviours (Higgs, 2015; Jacobson et al., 2011). Descriptive norms refer to the perceived prevalence of a behaviour, while injunctive norms refer to perceptions of expected behaviour (Cialdini et al., 1990). In a series of experiments, Jacobson et al. (2011) demonstrated that descriptive and injunctive norms differ in the motivational forces that drive conformity to each type of norm. Injunctive norms relate both to the intrapersonal goal of accuracy/efficiency, and to the interpersonal goal of social approval. This is thought to evoke thoughts about dual goals, leading to the experience of decision-making conflict, and greater capacity for effortful self-regulation to follow. On the other hand, descriptive norms are said to provide a cue for accurate or efficient behaviour, rather than invoke a sense of social obligation. This in turn is associated with an accuracy/efficiency goal, leading to lesser degree of decision-making conflict, thereby requiring less effortful self-regulation to resist rather than follow. Descriptive and injunctive norms differentially affect behaviour to the extent that each norm is currently salient, even when the norms advocate the same behaviour. Research also suggests that injunctive norms influence behaviour differently in varied cultural contexts, whereas descriptive norms do not (viz., Moon et al., 2018). Manipulating either type of norm typically influences behaviour, and a recent review suggests that injunctive norm manipulations have a stronger effect on behaviour (Rhodes et al., 2020). However, it is worth noting that the design of the analysis does not involve a controlled comparison of the two types of norms. A recent meta-analysis of 100 articles comparing the influence of subjective/injunctive norms, personal norms, and descriptive norms on conservation behaviour found that personal and descriptive norms had a larger relative influence on conservation behavioural intentions and were more often significantly associated with intentions compared to subjective norms (Niemiec et al., 2020; see also Farrow et al., 2017). In instances in which desired behaviour is not aligned with norms, or even contrary to existing norms, portraying a descriptive increase in the minority behaviour can increase people’s conformity to what they perceive to be a future descriptive norm (Sparkman & Walton, 2017, 2019). For example, Cheng et al. (2020) found that female students in high school and college who were exposed to information about an increasing number of women pursuing STEM careers reported higher interest in STEM careers and intentions to enter STEM fields themselves.

Although meat-eating is still widespread, in many parts of the world, people’s dietary behaviours are changing. For example, in the UK meat consumption is declining and the proportions of vegans and vegetarians have doubled in the last 20 years (Baker et al., 2002). In 2016, a third of British survey respondents reported eating less meat than a year before data collection (L. Lee & Simpson, 2016). Similar trends have been observed in Canada, where consumption of beef, pork, and veal has reduced from 1980 to 2020 (34.1%, 41.42%, and 35.25% respectively; Agriculture and Agri-Food Canada, 2020). Similarly, a 2016 survey reports one third of Americans were eating less meat than they were three years previously (Truven Health Analytics, 2016).

Psychological studies utilizing descriptive social norms typically used “static” norm framings communicating current levels of normative attitude/behaviour. While people typically act in line with static descriptive norms when they are performed by the majority, salient static minority norms may have the opposite effect on desired behaviour change (Cialdini et al., 2006). In the past decade, researchers have been “leveraging” changing norms to instigate attitude and behaviour change to reduce meat consumption (Marteau, 2017; Stoll-Kleemann & Schmidt, 2017). By making “dynamic norms” – descriptive norms that are changing – salient, people can begin to conform to behaviour that is on the rise, even if it is not currently the prevailing norm. In contrast to “static” descriptive norm messages which communicate current norms, dynamic descriptive norm messages draw attention to change or trend in the norm over time (Sparkman, Howe, et al., 2020). For example, a static descriptive norm would refer to information about current normative behaviours and beliefs of others (e.g., “most people eat meat” or “some people currently limit eating meat”). Alternatively, a dynamic descriptive norm would refer to changes in normative behaviours or beliefs over time (e.g., “more and more people are eating less meat”).

Several studies have demonstrated the effect of dynamic norms on interest in reducing meat consumption. In a series of online studies, Sparkman and Walton (2017) demonstrated the efficacy of using dynamic norm information to increase interest in reducing meat consumption. They extended their findings to a field study conducted in a university campus café where dynamic norms (compared to static norms) doubled the percentage of patrons who ordered a meatless lunch. In a series of studies examining the influence of personal norms on the effectiveness of social norm interventions, de Groot et al., (2021) found that dynamic and static norm information was more effective the weaker one’s personal norms toward the pro-environmental behaviour. They also found that majority dynamic norm information regarding meat consumption was influenced people more strongly than minority dynamic norms. Stea and Pickering (2019) tested six messages presenting information about the environmental impacts of meat production varying in social norm representation (social norm present or absent) and identity salience (Canadian place identity, global place identity, or none). They found that including social norm aspects depicting changing diets (e.g., “people are making dietary changes to reflect their feelings towards these impacts”) in the message did not result in significant differences in intentions to reduce meat consumption compared to the control condition (30.2% v 28.2%). Aldoh et al. (2021) conducted a study investigating the effect of dynamic norms on cognitive factors related to meat consumption, and found no difference between the dynamic norm condition and a static norm control condition on interest, attitudes, and intentions to reduce meat consumption. Another recent study found no comparative advantage of using dynamic norms compared to static norms or no normative messages at all in influencing intentions to eat less red meat (S. J. Lee & Liu, 2021). Interestingly, the authors did find a significant interaction between dynamic/static norm messages and perceptions of future approval of behaviour, where intentions to eat less red meat were higher when participants expected others to approve of this behaviour in the future. In a series of four field experiments, Sparkman et al. (2020) found mixed effects of dynamic norm messages on meatless orders. Although dynamic norm messages ‘modestly’ increased orders of vegetarian dishes, some studies were under-powered and effects were not always significant. In one study, dynamic norm messages appeared to backfire, in leading to a decrease in orders of vegetarian dishes at a fine dining Italian restaurant (Sparkman, Weitz, et al., 2020, Study 4).

Dynamic norms have also shown promising effects over the long term. For instance, Macdonald et al. (2016) tested two types of dynamic norm appeals compared to a control group: an appeal to reduce meat consumption or an appeal to eliminate meat consumption entirely. They found that both dynamic norm appeals were effective in reducing reported meat consumption five weeks from treatment, but there were no significant differences between the ‘reduce’ and the ‘eliminate’ appeals. A later study conducted by Sparkman et al. (2021, Study 1) used a similar design comparing ‘reduce’ and ‘eliminate’ appeals against a control condition. Interestingly, they found that only the ‘reduce’ dynamic norm appeal successfully decreased participants’ self-reported consumption relative to the control condition for the 5-month duration of the study. However, in a follow-up study using a representative sample of the US population, neither the ‘reduce’ nor ‘eliminate’ appeals were successful in changing reported meat consumption over time (Sparkman et al., 2021, Study 2). Their results suggest that the dynamic norm appeal to reduce meat consumption is effective in a subsample matching their initial study’s sample demographics, which was generally younger, more liberal, and more educated. This echoes findings of past research showing that young adults and old adults may be more susceptible to attitude and behaviour change (Rhodes et al., 2020; Visser & Krosnick, 1998). Amiot et al. (2018) designed a multicomponent intervention (to reduce meat consumption) comprised of 5 components: a) social norm component, b) informational/educational component, c) appeal to fear, d) mind attribution induction, and e) goal setting/self-monitoring component. The social norm component included a presentation describing changing social norms regarding reduced meat eating since 1980 in Canada. The intervention resulted in significant decreases in total red meat consumption four weeks from baseline. Although the intervention was effective, it is difficult to ascertain which component (or combination of components) drove the effects.

Research utilizing information about changing norms varies considerably in its implementation, and diverging results of past studies leave many unanswered questions about the factors affecting the strength of dynamic norm messaging. Although research utilizing social norm manipulations are generally effective at influencing perceived norms, attitudes, intentions, and behaviour, there is a large degree of heterogeneity among effect sizes, suggesting that other study characteristics lead to variations in findings (Rhodes et al., 2020). Further research on the modes of communicating normative information should help improve understanding of the optimal ways of communicating dynamic norms.

## Communicating a change in norms

Although dynamic norm research is quickly growing, there is still ambiguity about the more effective ways of making dynamic norms salient in order to adequately assess their influence on behaviour and its antecedents. With growing awareness of changing meat-eating trends in the UK, it is also unclear if experimental manipulations making dynamic norms salient fail due to the ineffectiveness of dynamic norms in a given context, or because a dynamic norm is salient even in control conditions without experimental manipulation. Manipulating dynamic norms experimentally involves making the change in norms salient. However, it is possible that study participants are already aware of dynamic norms without experimental manipulation. For example, Aldoh et al. (2021) found that the majority of participants in a pilot study were already aware of changing meat-eating norms in the UK, and upwards of 80% of participants in the main study were expecting a future decrease in meat consumption.

To test the effectiveness of dynamic norms, it is likely beneficial to use control groups in which a static (unchanging) norm is similarly made salient. This makes it possible to discern that the dynamic aspect of the information influences the measured outcomes, as opposed to any normative information. Rhodes et al.’s (2020) review found that a control condition making a weaker or opposite norm salient was the most effective for demonstrating the effects of tested norm manipulations. When considering the method of delivering normative information, although the most prevalent method was through written text, studies examining the effect of descriptive norms on behavioural outcomes using multiple modes of delivery outperformed any other mode by itself. One possible way to increase the salience of the dynamic norm experimentally is to use visual cues to depict the norm. Sparkman and Walton’s (2017, Study 3) research utilizes this in comparisons between three groups where text prompts were supplemented with line graphs depicting a dynamic norm, and a pie chart depicting a static norm. They found a difference between a dynamic norm condition depicting future growth in people decreasing their meat consumption using a line chart, and a static norm condition depicting the current prevalence of people decreasing their meat consumption using a pie chart. Whereas a pie chart is useful in showing the current distribution of the norm, it is less useful in portraying the unchanging nature of the static norm. A visual cue depicting a stable trend in the static norm, or increasing trend in the dynamic norm, can increase the distinctiveness of dynamic norms. Visual cues may also be potentially useful in increasing engagement with the information provided, thereby increasing the effectiveness of the manipulation used. In a similar vein, Vasiljevic et al. (2015) cite the use of pictorial presentations of injunctive norms as a possible reason for diverging results of injunctive norms on healthy food choice compared to an earlier study using textual presentation of injunctive norms, which found no effect of injunctive norms on food choice (cf. Robinson et al., 2013).

## The Current Study

The present study investigates the effectiveness of dynamic norm information in the context of reducing meat consumption. Specifically, we are interested in testing the following hypotheses:

Hypothesis 1: Making information about dynamic norms in relation to reduced meat consumption in the UK salient will lead to more positive effects on meat consumption outcomes than does making static norm information salient.

H1a. Participants who view dynamic norm information will have more positive *attitudes* at T1 toward reducing their meat consumption compared to participants who view static norm information.

H1b. Participants who view dynamic norm information will report higher *interest* at T1 in reducing their meat consumption compared to participants who view static norm information.

H1c. Participants who view dynamic norm information will report higher *intentions* at T1 to reduce their meat consumption compared to participants who view static norm information.

Hypothesis 2: Dynamic norm information will positively influence meat consumption outcomes over a period of one week.

H2a. There will be a greater positive change in participants’ *attitudes* toward reducing meat consumption in the dynamic norm conditions compared to the static norm conditions over a period of one week.

H2b. There will be a greater positive change in participants’ *interest* in reducing their meat consumption in the dynamic norm conditions compared to the static norm conditions over a period of one week.

H2c. There will be a greater positive change in participants’ *intentions* to reduce their meat consumption in the dynamic norm conditions compared to the static norm conditions over a period of one week.

H2d. Participants in the dynamic norm conditions will reduce their self-reported *meat consumption* more than more than participants in the static norm conditions over a period of one week.

Hypothesis 3: Including a visual cue will increase the effect of dynamic norm information on meat consumption outcomes.

H3a. Participants who view dynamic norm information accompanied by a visual cue will have more positive *attitudes* toward reducing their meat consumption compared to participants who view dynamic norm information without the visual cue.

H3b. Participants who view dynamic norm information accompanied by a visual cue will report higher *interest* in reducing their meat consumption compared to participants who view dynamic norm information without the visual cue.

H3c. Participants who view dynamic norm information accompanied by a visual cue will report higher intentions to reduce their meat consumption compared to participants who view dynamic norm information without the visual cue.

Hypothesis 4: Including a visual cue will increase the effect of dynamic norm information on meat consumption outcomes over a period of one week.

H4a. Participants who view dynamic norm information accompanied by a visual cue will show more positive *attitude change* regarding reducing their meat consumption compared to participants who view dynamic norm information without the visual cue (between time 1 to time 2).

H4b. Participants who view dynamic norm information accompanied by a visual cue will show more *interest change* in reducing their meat consumption compared to participants who view dynamic norm information without the visual cue (between time 1 to time 2).

H4c. Participants who view dynamic norm information accompanied by a visual cue will show higher *intentions change* to reduce their meat consumption compared to participants who view dynamic norm information without the visual cue (between time 1 to time 2).

H4d. Participants who view dynamic norm information accompanied by a visual cue will reduce their self-reported *meat consumption* more than participants who view dynamic norm information without the visual cue (between time 1 to time 2).

# Pilot study

We present here the results of an initial study investigating the effect of dynamic norms on meat consumption using visual cues. The study was conducted to test the materials used and to estimate the influence of dynamic norms on measured outcomes. The study included two conditions: a dynamic norm prompt with a visual cue, a static norm prompt with a visual cue. For the pilot study, we hypothesized that dynamic norms will positively influence meat consumption outcomes relative to static norms. All relevant study materials, data, and analyses are publicly hosted on Open Science Framework (OSF; <https://osf.io/qe739/>).

## Participants

A total of 1075 individuals took part in the study online. Seventeen were excluded from the sample as they were vegan or vegetarian, and 16 were excluded for starting, but not completing the survey, resulting in 1042 participants. Using a robust Mahalanobis distance based on the Minimum Covariance Determinant (Leys et al., 2018, 2019), 147 multivariate outliers were detected and removed. The final sample included in analyses (*N* = 895) ranged in age from 18 to 80 years (*Mage* = 36.47, *SD* = 13.46). The participants were predominantly female (55.75%). They received £0.25 for successfully completing the 2-3 minute task. The average reward was £5.60/hr. We intended to collect data until a threshold of *B* > 5 or *B* < 1/5 was reached for the primary hypotheses. After collecting data from over 1000 participants, however, we had still not reached the threshold for all measured outcomes, but we terminated data collection due to funding limitations. A randomization check revealed no systematic differences between conditions in age, gender, political position, and home country (all *p*s > .05).

## Procedure

Participants were recruited from Prolific and were redirected to a survey hosted on Qualtrics. We used Prolific’s pre-screening criteria to exclude participants who are not eligible; specifically, we did not make the study visible to participants who: a) were not UK nationals, b) followed a vegan/vegetarian diet, and c) who had previously participated in other related studies conducted by the primary author. Participants were randomly allocated to one of two conditions: a) dynamic norm with visual cue or b) static norm with visual cue. Then participants completed single item measures of interest in reducing meat consumption, attitudes towards reducing meat consumption, expectations to reduce own meat consumption, and intentions to reduce meat consumption. Measures of expectations and intentions were later combined into a composite measure of expectations and intentions due to large inter-correlation between them (*r* = .97). Participants also provided estimates of people who are currently/will be reducing their meat consumption now, next year, and six years from now. Finally, participants answered some demographic questions, and the study was concluded.

## Results

We used a path analysis to test differences between conditions in measured meat consumption outcomes (see Table 1 for results). There was no evidence for or against the presence of a difference between conditions in interest in reducing meat consumption (visual dynamic: *M* = 54.89, *SD* = 34.34; visual static: *M* = 50.97, *SD* = 34.27), or attitudes towards reducing meat consumption (visual dynamic: *M* = 60.43, *SD* = 27.23; visual static: *M* = 56.73, *SD* = 26.87). There was a difference between conditions in average intentions and expectations to reduce own meat consumption (visual dynamic: *M* = 51.42, *SD* = 32.95; visual static: *M* = 46.41, *SD* = 31.94).

Table 1

*Differences between conditions in meat consumption outcomes (pilot study)*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Item | *b* (%) | *SE* | *p* | 95% CI | *B*HN(0,5%) | RR | Conclusiona |
| Interest | 4.15 | 2.28 | .069 | [-0.57, 8.41] | 3.08 | 0.05, 15 | None |
| Attitude | 3.82 | 1.80 | .034 | [0.16, 7.25] | 4.83 | 4.6, 15 | None |
| Average Intentions + Expectations | 5.22 | 2.16 | .016 | [0.77, 9.26] | 9.09 | 1.9, 14.6 | H1 |
| *Note.* *b* = raw regression slope, CI = confidence interval. *N* = 895.  aH0 = evidence for null hypothesis, None = no conclusion, H1 = evidence for alternative hypothesis. | | | | | | | |

## Conclusion

The results suggest a positive effect of dynamic norms on intentions/expectations to reduce own meat consumption. Only the effect of dynamic norms on intentions and expectations to reduce meat consumption provided sufficient evidence for the alternative hypothesis. Furthermore, it is not clear if using visual cues for each condition drove the effects found, or if the messages would be equally effective using text alone. It is also unclear if the effects persist over a longer period of time, and if there would be effects on actual reported behaviour. Past research suggests that effects of norm manipulation on behaviour tend to dissipate over time, but time passed since message exposure did not influence attitudes, intentions, or perceived injunctive norms (Rhodes et al., 2020). Using one-time snapshots of outcomes make it difficult to make claims about long-term influence of norms or the causal relationship between norm perception and behaviour. Research on the effects of social norms relying on longitudinal or experimental methods allowing claims about influence of norm manipulations are underrepresented in the field (Shulman et al., 2017). Accordingly, we designed a mixed design study to examine the effects of dynamic norms on meat consumption using different formats.

# Methods

## Sampling plan

We plan to collect data from a minimum of 100 participants in each between-subject condition (500 participants in total). We will use a Bayesian stopping rule for data collection, and plan to stop collecting data when a threshold of *B* < 1/5 or *B* > 5 is reached for the study hypotheses (see Schönbrodt et al., 2017). If the thresholds for stopping are reached at 500 participants, we will terminate data collection. If the thresholds are not reached, we will continue to collect data at 100 participant intervals. If we do not reach our evidential thresholds after reaching a final sample of 1500 participants, we will terminate data collection regardless, and acknowledge the limitations of our sample. We will detect multivariate outliers in the data using a robust Mahalanobis distance based on the Minimum Covariance Determinant with a breakdown point of 0.25, and a chi-square at *p* = 0.001 (Leys et al., 2018, 2019). Participants who are identified as multivariate outliers on measured meat consumption outcomes in the first wave will be excluded from the sample at both time-points.

## Participants

Participants will be recruited from Prolific and redirected to the survey hosted on Qualtrics. The following will be excluded from the study sample in order: 1) participants who are vegan/vegetarian, 2) participants who spend three seconds or less on the reading task, 3) and participants who are identified as multivariate outliers. Informed consent will be obtained from all participants, and their data will be identifiable via IDs generated by Prolific for the purpose of the study. Participants in the first wave will be invited to the second and final wave of the study using Prolific’s internal messaging system. Participants will be paid the equivalent of £5.60/hr at the first timepoint, then £7.50/hr at the second timepoint.

## Design and procedure

The study will be presented as a survey on eating behaviour. The study uses a 2x2 mixed design (type of norm [dynamic/static] x visual cue [present/absent]) and includes an additional control group with no normative information provided. Participants will complete the measure of actual meat consumption, then they will be randomly allocated to one of the five conditions. Participants will then proceed to the remaining outcome measures, followed by demographic questions. After one week, participants will complete the outcome measures again. Participants will be debriefed at the conclusion of the study.

To create norm statements, we relied on estimates provided by participants from the same sample population in a previous unpublished study (<https://osf.io/gq6s3/>). Specifically, we used the average estimate of current percentage of British people reducing their meat consumption provided by participants in a control condition. This was estimated at 32.52%, which is close to other estimates used in dynamic norm research in the context of meat consumption (e.g., Aldoh et al., 2021; Sparkman & Walton, 2017), as well as national estimates of people limiting their meat consumption in recent years (e.g., Knight, 2019; L. Lee & Simpson, 2016; *Waitrose & Partners: Food and Drink Report 2018-2019*, 2018). Accordingly, we used 33% as the current estimate of people limiting their meat consumption.

Table 2

*Conditions for Study*

|  |  |  |  |
| --- | --- | --- | --- |
| Control (no information) | | Type of norm | |
| Dynamic norm | Static norm |
| Providing information in visual form | Visual cue | Dynamic norm with visual cue  *(visual.dynamic)* | Static norm with visual cue  *(visual.static)* |
| No visual cue | Dynamic norm with text only  *(text.dynamic)* | Static norm with text only  *(text.static)* |

## Materials

### Normative information

**Text prompts.** Participants in the dynamic norm condition will read the following text:

“In 2020, 33% of British people - a figure increasing every year over the previous 5 years - successfully engaged in one or more of the following behaviours to eat less meat:

* Eating small portions of meat
* Opting out of eating meat several days of the week
* Adopting a vegan/vegetarian diet”

Participants in the static norm condition will read the following text:

“In 2020, 33% of British people - roughly the same figure as in the previous 5 years - successfully engaged in one or more of the following behaviours to eat less meat:

* Eating small portions of meat
* Opting out of eating meat several days of the week
* Adopting a vegan/vegetarian diet”

**Visual cues.** In conditions with an additional visual cue, participants will either see a line graph showing the percentage of British people limiting their meat consumption from 2016 to 2020. In the static norm condition, the graph will depict a stable trend averaging about 33% every year. In the dynamic norm condition, the graph will depict an increasing trend of people decreasing their meat consumption, starting at roughly 20% in 2016, reaching about 33% in 2020.

### Meat consumption outcomes

**Attitude.** Participants will respond to the statement “My attitude towards eating less meat is…” adapted from Fishbein and Ajzen (2010) on a slider scale of 0 (*extremely unfavourable*) to 100 (*extremely favourable*).

**Interest.** Participants will answer a single-item measure of interest in reducing meat consumption adapted from Sparkman and Walton (2017) “How interested are you in eating less meat?” on a slider scale of 0 (*not at all interested*) to 100 (*extremely interested*).

**Intention.** Participants will respond to the statement “I intend to eat less meat within the next week” adapted from Fishbein and Ajzen (2010) on a slider scale of 0 (*strongly disagree*) to 100 (*strongly agree*). Participants will also answer an additional single-item exploratory measure of intentions to reduce meat consumption adapted from Sparkman et al. ((2021) “Do you intend to increase or to decrease your meat consumption over the next week (7 days)” on a slider scale of 0 (*greatly decrease*) to 100 (*greatly increase*).

**Actual meat consumption.** Participants will complete the Food Frequency Questionnaire (FFQ) adapted from Sparkman et al. (2021), covering consumption of all food groups over the period of one week. The scale has been adapted to a one-week measurement period (*Never, Once (during those 7 days), twice, three times, four times, five times, six times, seven times, 2 times per day, 3 times per day, 4 or more times per day*). The sum of servings across meat groups will be used to measure this outcome. Participants who are detected as outliers on the FFQ using the median absolute deviation (MAD). Responses above 3 MAD on the FFQ index of meat servings will be excluded from analyses on the FFQ.

**Estimates of consumption.** Participants will be asked to estimate the percentage of British people they think are eating less meat this year, next year, and six years from now on a 0-100% slider scale. The exact value participants choose will be displayed onscreen above the slider.

### Checks

**Careless responses.** To detect low-quality responding, we will check response time in seconds per item (SPI; see Wood et al., 2017). SPI is correlated with other validity indicators such as statistically improbable responses, disqualification in pre-screening, and unusual responses to open-ended questions (Chmielewski & Kucker, 2020). Based on an average reading speed of about 200 words per minute, the text prompts should take roughly 13 seconds to read. Accordingly, we assume that 3 s is a conservative estimate of minimum reading time, and we will exclude the data of participants who spend 3 s or less on the reading task.

**Manipulation check.** Participants will be asked “What has happened to meat consumption in the last 5 years? *(more people are eating less meat, people are eating about the same amount of meat, fewer people are eating less meat*). The manipulation will be considered successful in the following conditions: a) participants in the dynamic norm conditions select “more people are eating less meat”, and b) participants in the static norm conditions select “fewer people are eating less meat”. We will report analyses conducted without those who failed the manipulation check separately in the supplementary materials.

### Demographic questions

Participants will be asked to report their political position on a 1-7 scale (1 = *very left wing*, 7 = *very right wing*). They will also report their age, gender, and if they are vegan/vegetarian.

## Intended analyses

*Hypothesis 1: Making information about dynamic norms in relation to reduced meat consumption in the UK salient will lead to more positive effects on meat consumption outcomes than does making static norm information salient.*

We intend to test this hypothesis using direct contrasts comparing the combination of dynamic norm experimental conditions against the combination of static norm control conditions for each measured meat consumption outcome at time 1.

(μ visual.dynamic, μ text.dynamic ) > (μ visual.static, μ text.static).

*Hypothesis 2: Dynamic norm information will positively influence meat consumption outcomes over a period of one week.*

We intend to test this hypothesis by comparing between conditions difference on each pre to post-test difference in score.

(μ dynamic.pre - μ dynamic.post) > (μ static.pre - μ static.post)

*Hypothesis 3: Including a visual cue will increase the effect of dynamic norm information on meat consumption outcomes.*

We intend to test this hypothesized interaction by comparing the differences between conditions using visual cue, and differences between conditions using text only for each measured outcome at time 1 using an interaction term (see Palfi & Dienes, 2019).

(μ visual.dynamic - μ visual.static ) > (μ text.dynamic - μ text.static)

*Hypothesis 4: Including a visual cue will increase the effect of dynamic norm information on meat consumption outcomes over a period of one week.*

We intend to test this interaction by comparing the differences between conditions using a visual cue, and the differences between conditions using text only for each measured outcome from time 1 to time 2 will compare between conditions difference on each difference in scores of outcomes from time 1 to time 2.

(μ visual.dynamic.diff- μ visual.static.diff ) > (μ text.dynamic.diff- μ text.static.diff)

We will conduct all analyses using the statistical software R. We conduct direct contrasts to test all hypotheses rather than omnibus tests. We will use Bayes factors to make any inferences about the hypotheses. Bayes factors are advantageous for several reasons: a) they allow us to place probabilities on models that are updated using data, b) they quantify support for the null and the alternative hypothesis, c) they allow us to distinguish between null effects and insufficient data, c) they make optional stopping possible without inflating type 1 error rates (Schönbrodt et al., 2017). Although Bayes factors are continuous measures of evidence, we make Inferences about our hypotheses using a threshold of *B* > 3 or *B* < 1/3, reflecting moderate strength of evidence (Schönbrodt & Wagenmakers, 2018).

### Models of H1

We will use half-normal distributions for all models of H1 across hypotheses, where the mode is set to 0, and the standard deviation (*SD*) is set to the expected effect. This assumes directional predictions and that smaller effects are more probable than larger effects (Dienes, 2014). Bayes factors will be notated as *B*HN(0,x) where HN indicates that the model is half-normal, and x is a scale factor of the expected effect, and 0 represents the mode of the distribution. We estimate the expected effect using results of previous studies, in combination with the results of our pilot study. All reported Bayes factors represent evidence for H1 over H0.

Previous studies found mean differences between dynamic and static norm conditions ranging from 0.6-0.78 units on a 1-7 Likert scale measuring interest in reducing meat consumption. This is equivalent to 9.86 on a 0-100% scale. Conversely, Aldoh et al. (2021) found (no) difference of 0.03 units on a 1-7 Likert scale, equivalent to 0.43%. In our pilot, we found a mean difference of 4.15% between conditions. Based on the range of differences found, we expect to find a difference between conditions of roughly 5%.

The average difference between dynamic and static norm conditions in measured outcomes was similar across outcomes measured in the pilot, and therefore we will use the same prior for all outcomes in the main study, apart from self-reported meat consumption. Sparkman et al. (2021) found a dynamic norm appeal to reduce meat consumption resulted in a 6.8% reduction one month from baseline in self-reported meat consumption relative to a control condition. This is roughly equivalent to a difference of one serving reduction between groups. Similarly, we expect to find a difference in reduced meat consumption of one serving between dynamic and static norm conditions.

### Sensitivity analyses

We will also report robustness regions for all Bayes factors, indicating the range of prior scale factors that would lead to the same conclusion. Robustness regions will be notated as RR[min, max], where min indicates the smallest *SD* and max indicates the largest *SD* that would result in the same conclusion.

Table 3

*Hypothesis registration table*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Question | Hypothesis | Sampling plan | Analysis Plan | Rationale for deciding the sensitivity of the test for confirming or disconfirming the hypothesis | Interpretation given different outcomes | Theory that could be shown wrong by the outcomes |
| Do salient dynamic norms regarding reduced meat consumption in the UK lead to more positive effects on meat consumption outcomes than static norms? | H1: Making information about dynamic norms in relation to reduced meat consumption in the UK salient will lead to more positive effects on meat consumption outcomes than does making static norm information salient. | We will use a Bayesian stopping rule where we will stop data collection when a threshold of *B* < 1/5 or *B* > 5 is reached for the study hypotheses comparing dynamic norm conditions to static norm conditions. We will recruit a maximum of 1500 participants due to funding restraints. | We will use contrast coding to compare dynamic norm conditions against static norm conditions. We will run analyses for each outcome: a) attitudes, b) interest, and c) intention. We will use the raw difference in scores and the SE of the difference to calculate a Bayes factor for each outcome. We will model H1 using a half-normal distribution with a mode of 0 and *SD* of 5%.  Non crucial test: we will compare dynamic norm conditions to control condition using the same method. | A difference of 5% is a rough average of the differences found across outcomes in prior research. We use a Bayes factor threshold of *B* < 1/3 or *B* > 3, which is considered moderate evidence for the null or alternative hypotheses. | H1 is supported if a Bayes factor equal to or more than 3 is reached. H0 is supported if a Bayes factor less than or equal to 1/3 is reached. Bayes factors in between will not be considered evidence for either, and we will conclude that the results are insensitive. | Dynamic norm information does not positively influence meat consumption outcomes, namely, attitudes toward meat consumption, interest in reducing meat consumption, and intentions to reduce meat consumption. We can deduce that dynamic norm information are not effective in this context. |
| Do salient dynamic norms regarding reduced meat consumption in the UK lead to more positive effects on meat consumption outcomes than static norms over a period of one week? | H2: Dynamic norm information will positively influence meat consumption outcomes over a period of one week.  H2a – H2c | See above. | At time 2, we will calculate the difference between pre-test and post-test scores on: a) attitudes, b) interest, and c) intentions. We will then use contrast coding to compare the change in outcomes between dynamic norm conditions and static norm conditions.  Non crucial test: we will compare dynamic norm conditions to control condition using the same method. | A difference of difference of 5% across outcomes. We use the same Bayes factor threshold specified above. | H1 is supported if a Bayes factor equal to or more than 3 is reached. H0 is supported if a Bayes factor less than or equal to 1/3 is reached. Bayes factors in between will not be considered evidence for either, and we will conclude that the results are insensitive. | Dynamic norms are not effective means of influencing cognitive meat consumption outcomes over a period of one week. |
| H2d | See above. | At time 2, we will calculate two new variables totalling all reported meat consumption at baseline and follow-up. We will then subtract the post-intervention meat consumption from baseline meat consumption. Finally, we will use contrast coding to compare the change in consumption between dynamic norm conditions and static norm conditions.  Non crucial test: we will compare dynamic norm conditions to control condition using the same method. | We expect that participants in the dynamic norm condition will have reduced their overall meat consumption by one serving more than participants in the static norm control. We use the same Bayes factor threshold specified above. | See above. | Dynamic norms are not effective means of changing actual meat consumption over a period of one week. |
| Do visual cues influence the effect of normative information on meat consumption outcomes? | H3: Including a visual cue will increase the effect of dynamic norms on meat consumption outcomes. | See above. | We will compare the differences between the conditions including a visual cue, to the differences between the conditions using text only using an interaction term. The corresponding raw interaction and its SE will be used to calculate a Bayes factor for each outcome: a) attitudes, b) interest, and c) intention. We will model H1 using a half-normal distribution with a mode of 0 and *SD* of 5%. | We expect a visual cue will increase the efficacy of dynamic norm information over and above text alone by about 5%. We use the same Bayes factor threshold specified above. | See above. | Including a visual cue while depicting dynamic norm does not improve the efficacy of dynamic norm messaging. |
| Do visual cues influence the effect of normative information on meat consumption outcomes over a period of one week? | H4: Including a visual cue will increase the effect of dynamic norm information on meat consumption outcomes over a period of one week. | See above. | We will use the same approach outlined above, using the changes from time 1 to time 2 as outcomes. | A difference of difference of 5% across cognitive outcomes (attitudes, interest, intentions). Additionally, a difference of one serving for reported meat consumption. We use the same Bayes factor threshold specified above. | See above. | Including a visual cue while depicting dynamic norm does not improve the efficacy of dynamic norm messaging over a period of one week. |

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