# 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 longitudinal study utilizes a 2x2 between-subjects 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.

*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 and government resources 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 (Sparkman et al., 2020).

## Social norms for behaviour change

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 (reference for this theory?), portraying desired behaviour (e.g., decreasing meat consumption) as aligned with injunctive or descriptive norms can shift existing behaviours (Higgs, 2015). Descriptive norms refer to the perceived prevalence of a behaviour, while injunctive norms refer to perceptions of expected behaviour (Cialdini et al., 1990). In instances in which desired behaviour is not aligned with norms, or even contrary to existing norms, portraying an increase in the minority behaviour can increase people’s conformity to what they perceive to be a future 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). 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 did three years previously (Truven Health Analytics, 2016).

In the past decade, researchers have been “leveraging” these changing norms to instigate attitude and behaviour change to reduce meat consumption (Marteau, 2017; Stoll-Kleemann & Schmidt, 2017). By making “dynamic norms” – 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.

Several studies have demonstrated the effect of dynamic norms on interest in reducing meat consumption (Macdonald et al., 2016; Mortensen et al., 2019; Sparkman & Walton, 2017). 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.

Amiot et al. (2018) designed a multicomponent intervention to reduce meat consumption that included a presentation describing emerging social norms regarding reduced meat eating. 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. In a test of six messages varying in social norm representation and identity salience, Stea and Pickering (2019) found that including social norm aspects in the message resulted in the highest intentions to reduce meat consumption. However, this effect was not statistically different from 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.

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. 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 most effective ways of making dynamic norms salient. 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 experiment influence. 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. Another 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.

## 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 changes in meat consumption outcomes than does making static norm information salient.

Hypothesis 2: Including a visual cue will increase the effect of dynamic norm information on meat consumption outcomes.

Hypothesis 3: Dynamic norm information will positively influence meat consumption outcomes in the long term.

# 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 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 task. 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. 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 meat consumption, and intentions to reduce meat consumption. 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

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Item | *b* (%) | *SE* | *p* | 95% CI | *B*HN(0,5%) | RR | Conclusiona |
| Interest | 3.92 | 2.29 | .087 | [-0.57, 8.41] | 2.63 | 0.05, 15 | None |
| Attitude | 3.71 | 1.81 | .040 | [0.16, 7.25] | 4.24 | 0.05, 15 | None |
| Average Intentions + Expectations | 5.01 | 2.17 | .021 | [0.77, 9.26] | 7.41 | 2.15, 11 | 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 meat consumption outcomes. However, 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. Accordingly, we designed a longitudinal 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 exclude multivariate outliers from the data using a robust Mahalanobis distance based on the Minimum Covariance Determinant (Leys et al., 2018, 2019).

## Participants

Participants will be recruited from Prolific and redirected to the survey hosted on Qualtrics. The following will be excluded from the study sample: participants who are vegan/vegetarian, participants who fail the attention check, and participants who provide careless responses. 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.

## Design and procedure

The study will be presented as a survey on eating behaviour. The study uses a 2x2 between-subjects design (type of norm [dynamic/visual] x visual cue [present/absent]) and includes an additional control group with no normative information provided. Participants will be randomly allocated to one of the five conditions, then they will proceed to the outcome measures, followed by demographic questions. Participants will then respond to items measuring careless responding, and will also be asked to indicate if they think their data should be used (Meade & Craig, 2012). 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; 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

*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, reaching about 33% in 2020.

### Meat consumption outcomes

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

**Interest.** Participants will respond to the statement “I am interested in eating less meat” on a slider scale of 0 (*not at all interested*) to 100 (*extremely interested*).

**Intention.** Participants will answer the question “Do you intend to increase or to decrease your meat consumption over the next month (30 days)” on a slider scale of 0 (*greatly decrease*) to 100 (*greatly increase*).

**Actual meat consumption.** Participants will complete the Food Frequency Questionnaire (FFQ, reference needed) 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, 5 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 report consuming over 59 servings of meat a week 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

**Attention check.** Participants will be asked to estimate the percentage of British people who engaged in behaviours to limit their meat consumption in 2020. Participants who select an estimate within ± 5% of the estimate provided will be considered successful in completing the attention check. 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.

**Careless responses.** Participants will respond to two basic statements used in past research to measure careless responses (e.g., “I have been to the moon 3 times”, Bago et al., 2019; Beach, 1989). Participants who give an incorrect response to any of these statements will be excluded from the data.

**Manipulation check.** Participants will be asked “what has happened to meat consumption in the last 5 years? (*it has decreased, stayed the same, increased*).

### 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: We hypothesize that dynamic norms will have a more positive influence on meat consumption outcomes than static norms. We intend to test this hypothesis using direct contrasts comparing dynamic norm experimental conditions against 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: We hypothesize that the effect of dynamic norms will be larger when a visual cue is present, as compared to when the visual cue is absent. We intend to test this hypothesis by comparing the differences between conditions using visual cue, and differences between conditions using text only for each measured outcome at time 1 (see Palfi & Dienes, 2019).

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

Hypothesis 3: We hypothesise that dynamic norm information positively influences meat consumption outcomes in the long term. We intend to test this hypothesis by comparing between conditions difference on each post-test score, using each pre-rest score as a covariate.

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

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.

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 3.92% 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

*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 changes in meat consumption outcomes than static norms? | H1: Making salient the dynamic norms regarding reduced meat consumption in the UK will lead to more positive changes in meat consumption outcomes thanstatic norm information. | 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 separate 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 visual cues influence the effect of normative information on meat consumption outcomes? | H1: Including a visual cue will increase the effect of norms (which ones?) on meat consumption outcomes. | See above. | We will extract the mean and SE of the difference between the text only groups, and the difference between the visual only groups. We will use these figures to find the difference of the difference between groups resulting in a mean and SE of the interaction. 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%.  raw\_interaction = visual\_diffs - text\_diffs | 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. |
| Does dynamic norm information influence meat consumption outcomes in the long term? | H1: Dynamic norm information positively influences meat consumption outcomes in the long term. | See above. | 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. This will create a new variable indicating the change in consumption for all participants. Finally, we will use contrast coding to compare the change in consumption between dynamic norm conditions and static norm conditions.  Non-crucial test: The same approach will be applied to the remaining outcomes: a) attitude, b) interest, and c) intention.  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 on the long term. |

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