Dining on Dissonance: Modeling Behavioral Change in Response to the Meat Paradox.

Amélie Gaillard

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Department of Psychology
University of Groningen
Examiner/Daily supervisor:
Dr. Gabriel Muiños Trujillo

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Abstract

Meat consumption significantly contributes to environmental degradation, health issues, and animal suffering, creating a moral conflict for many meat eaters. This phenomenon, known as the meat paradox, is an example of cognitive dissonance. This thesis investigates whether inducing this meat-related cognitive dissonance (MRCD) leads to more unstable patterns of meat consumption change over time, compared to a baseline meat reduction intervention alone. In a 10-day longitudinal experiment (N = 65), participants received either a moral (MRCD) or logistical (control) framing of a meat reduction intervention, and self-reported their meat consumption daily. While participants in the MRCD condition showed slightly higher variability in day-to-day changes in meat intake, no statistically significant differences were observed between groups. Manipulation checks revealed no significant differences in self-reported dissonance, suggesting a potential failure in eliciting sufficient discomfort or possible disengagement. Nonetheless, a bimodal distribution of change variability emerged, suggesting two processes of behavioral change, with more unstable changers in the MRCD group. These findings, while inconclusive, highlight the complexity of dissonance-reduction dynamics and underscore the need for further research into the temporal patterns of behavior change in the context of meat reduction.

Keywords: *cognitive dissonance; meat paradox; dietary behavior change; sustainable eating; meat reduction; environmental psychology; temporal dynamics; modelling behavior change*

Human activity has pushed planetary systems such as biodiversity, freshwater, and greenhouse gas levels past safe boundaries, leading to accelerated global warming, extreme weather events, and ecosystem collapse (IPCC, 2023). Food systems play a significant role in these environmental challenges, including meat, dairy, and animal production that contribute to 57% of food-related emissions, but also require considerably more land, water, and energy than plant-based alternatives (Xu et al., 2021; UNEP, 2021). Meat consumption is also a threat to public health, as it has been recognized as a risk factor for cardiovascular disease and some forms of cancer (Tilman & Clark, 2014; Dinu et al., 2017; Willett et al., 2019). Perhaps most crucially, meat consumption upholds systems of animal exploitation and suffering in factory farms (Anomaly, 2015; Pluhar, 2010).

The Meat Paradox: A Form of Cognitive Dissonance

While an overwhelming majority of people disapprove of the environmental, health, and ethical implications of meat consumption, many individuals simultaneously enjoy eating meat. This so-called meat paradox, which is particularly strong in regards to animal welfare considerations, has been shown to trigger an internal conflict emerging primarily from inconsistency ("I eat meat; I don't like to hurt animals"), aversive consequences ("I eat meat; eating meat harms animals"), or threats to one's self-image ("I eat meat; compassionate people don't hurt animals") (Rothgerber, 2014; Koning, 2021; Bouwman et al., 2022; Fernandez-Lores et al., 2024).

The meat paradox is routinely conceptualized as a form of cognitive dissonance, which refers to a discrepancy between cognitions and behavior, or between cognitions themselves (Festinger, 1957; Harmon-Jones, 2019; Kenworthy et al., 2011). When these internal inconsistencies are made salient, they result in psychological discomfort that manifests in

unpleasant feelings such as guilt, which motivate people to avoid information that triggers dissonance and to engage in various strategies to reduce dissonance when it arises (Kenworthy et al., 2011).

Strategies to Reduce Cognitive Dissonance

Dissonance-reduction strategies broadly consist of removing or decreasing the importance of dissonant cognitions and/or behaviors, and adding or increasing the importance of consonant cognitions and/or behaviors (McGrath, 2017; Snyder & Ebbesen, 1972). Attitude change (e.g., "I don't care about animals") is the most commonly studied strategy since attitudes are rather fluid and flexible (McGrath, 2017; Tueanrat & Alamanos, 2025), but people can also selectively search for information supporting their position to add consonant cognitions (e.g., "eating meat is healthy"), devise external justifications (e.g., "eating plant-based is too costly"), or become overconfident in their position (e.g., "whatever happens, I will continue eating meat") to reduce dissonance (McGrath, 2017; Tueanrat & Alamanos, 2025). Dissonance-minimization strategies include distraction and forgetting (e.g., diverting attention away from animal suffering), trivialization via self-affirmation (e.g., "I'm a good person"), and denial of responsibility (e.g., "the problem is the meat industry, not my diet") (McGrath, 2017; Tueanrat & Alamanos, 2025). Finally, a severely understudied dissonance-reduction strategy is behavior change (e.g., eating less meat), which is typically more difficult as it may require changing habits, involve pain or loss of pleasure, or be disabled by context (McGrath, 2017; Harmon-Jones, 2019; Odou et al., 2019).

In the case of meat-related cognitive dissonance (MRCD), typical dissonance reduction strategies include perceived or actual behavior change (i.e., eating less meat), dissociation (Kunst & Hohle, 2016), denial of animal pain (Loughnan et al., 2010) or animal mind (Bastian et al.,

2012), pro-meat justifications (Piazza et al., 2015; Kubberød et al., 2002; Rothgerber, 2013), and reducing perceived choice. Especially in the context of MRCD, perceptual strategies are usually preferred over behavioral ones since the latter requires changing automatic, engrained, and arguably habitual behavioral patterns (Koning, 2021; Rothgerber, 2020; van't Riet et al., 2011). However, meat reduction can result from dissonance, especially in socially pressured situations that complicate attitudinal changes, when personal values are activated (Bouwman et al., 2022), or when contextual factors facilitate behavioral change (Odou et al., 2019; McGrath, 2017).

Predicting Dissonance-Induced Behavioral Change

As such, informing people about the animal welfare implications of meat consumption can trigger cognitive dissonance and result in behavior change as a dissonance-reduction strategy (e.g. Kunst & Haugestad, 2018; Ruby & Heine, 2012; Wang & Basso, 2019). Such dissonance-based interventions have been equally successful in promoting a range of other pro-environmental behaviors, including support for environmental associations (Priolo et al., 2016; Odou et al., 2019; Bentler et al., 2023), water conservation (Dickerson et al., 1992; Aitken et al., 1994), and energy conservation (Kantola et al., 1984). These procedures aim to create internal inconsistencies that people are motivated to resolve by adjusting their behavior (Bentler et al., 2023).

Dissonance-based interventions have some of the largest effect sizes for driving pro-environmental behavior, compared to goal-setting and social models (Bentler et al., 2023), and were identified as the most powerful intervention method to foster private pro-environmental behavior (Osbaldiston & Schott, 2012). However, such studies often provide participants with a single dissonance-reduction strategy, which is overwhelmingly behavior modification in the context of intervention research (McGrath, 2017). It thus remains unclear how people manage

dissonance via behavioral change in the real world, where several strategies are available to them (McGrath, 2017).

Temporal Modelling of Behavioral Change

Particularly, the temporal dynamics of behavior change in this dissonance-reduction process remain unclear and largely understudied. In response to MRCD, people may reduce their meat consumption rapidly but clumsily, or slowly but steadily. These distinct processes of behavioral change would entail different priorities to design effective dissonance-based meat reduction interventions, by managing potential rebounds and ensuring that behavioral change crystalizes in the long term.

As with other types of dissonance, it appears that meat-eaters begin by avoiding or ignoring the situational triggers of dissonance (Graça et al., 2015, 2016), before turning to dissonance-reduction strategies like behavioral modification if the psychological discomfort persists (Rothgerber, 2014; Rothgerber, 2020). However, if people initially engage in behavioral change as a preferred strategy, cognitive dissonance is challenging to eliminate entirely, which may eventually trigger rebounds in meat consumption by switching to alternative dissonance-reduction strategies (McGrath, 2017; Tueanrat & Alamanos, 2025; Koller & Salzberger, 2012). Furthermore, behavior such as meat consumption bears some resistance to change (Harmon-Jones, 2019; McGrath, 2017; Koller & Salzberger, 2012), making it difficult to predict how long it will be the preferred strategy to cope with dissonance. Investigating the temporal dynamics of behavior change is also relevant given its dynamic nature, with behavior influencing some of its own predictors, such as identity or self-efficacy (van der Werff et al., 2014).

However, most studies only measure behavior once after eliciting dissonance, which prevents from mapping the temporal complexity of dissonance-induced behavioral modifications. More generally, behavior change interventions typically use pre-post-test measurements that only assess behavior once after the manipulation (Steg et al., 2012; van Valkengoed & Steg, 2019), and embed this in regression models that determine the extent to which a person adopts a behavior depending on their scores on the relevant predictor (Muinos & Steg, in review). When using such regression models, the pattern and speed of behavior change over time remain unexamined (Muinos & Steg, in review; van Valkengoed et al., 2022), which calls for formal models of behavior change to evaluate the long-term effectiveness of interventions.

The Stability of Behavioral Change

Given the relevance of MRCD in examining the process of change, this study investigated how eliciting MRCD affected the shape of change in meat consumption over time. Specifically, we examined whether the change in meat consumption would be more unstable for participants who experienced meat-related cognitive dissonance coupled with a baseline meat-reduction intervention (i.e., MRCD condition), compared to participants who only received the intervention without a cognitive dissonance framing (i.e., control condition).

We expected all participants' meat consumption to oscillate over the course of the study, given that they received an intervention facilitating dietary change, that the study setting elicited some degree of social pressure, and that they were selected based on their stated intention to eat less meat, while simultaneously encountering barriers to diet change including structural challenges (Collier et al., 2021; Rothgerber, 2014), the cost of behavioral change (Harmon-Jones, 2019; Orbell & Verplanken, 2010), and the habitual nature of meat consumption that makes it

strikingly resistant to change (Bosone et al., 2022; Koning, 2021). Despite anticipating oscillations in meat consumption for participants in both the MRCD and control conditions, we expected the shape of behavior change to differ across conditions.

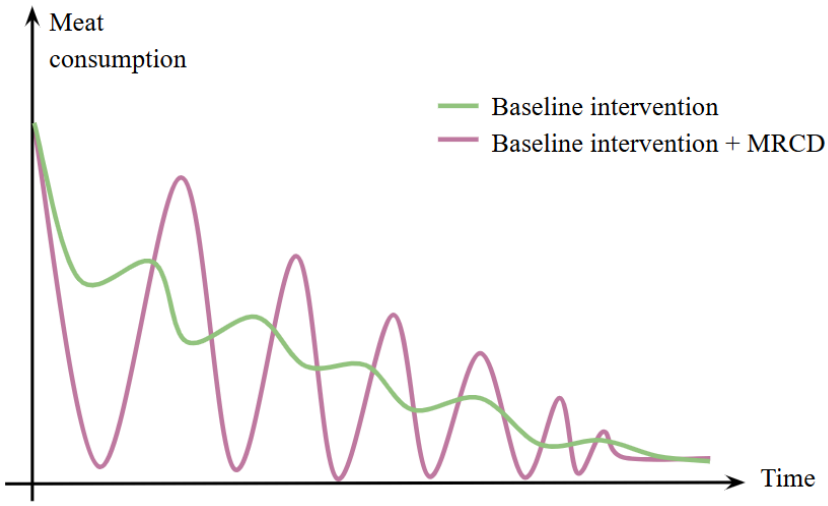
Impact of MRCD on Behavioral Change Stability

Indeed, we predicted that cognitive dissonance would induce a complex, non-linear change in behavior, with setbacks and relapses. Participants experiencing cognitive dissonance would initially be motivated to engage in behavior modification strategies, thus reducing their meat consumption more radically than participants in the control condition in an effort to resolve their psychological discomfort (Harmon-Jones, 2019; Odou et al., 2019). However, when participants in the cognitive dissonance condition would face barriers to diet change or if their dissonance was not fully resolved by behavioral modifications, they would be likely to abandon these efforts and turn to alternative dissonance-reduction strategies (Harmon-Jones, 2019; Koning, 2021), causing an equally stark overshoot in meat consumption.

This unstable undershoot-overshoot process was expected to manifest as an unstable process of change in meat consumption for participants experiencing cognitive dissonance compared to those receiving a baseline intervention, translating into greater change variability for participants in the MRCD group (see *Figure 1*). Therefore, we hypothesized that *when eliciting MRCD in addition to a baseline meat reduction intervention, meat consumption would change with greater day-to-day variability than for the baseline intervention alone (H1)*.

Figure 1

Expected meat consumption over time across experimental conditions.



Note. We expected an oscillating decrease in meat consumption over the course of the study for all participants. We hypothesized that the control group's (i.e., baseline meat reduction intervention) meat consumption would exhibit smaller oscillations than the MRCD group (i.e., dissonance-framed intervention).

Distinct Processes of Behavioral Change

Therefore, we expected to note two distinct processes for behavior change across groups, motivated by different factors and translating into more or less stable patterns of change. One of these processes may be guided by goal-oriented motivation, where people are driven to change by the motivation to reach a target behavior. We expected this process to occur for participants in the control condition, who would change more stably. When changing from how much meat a person is consuming $m(t)$ to how much they would like to W, the motivation is proportional to the inverse difference between those two values, multiplied by the speed k at which the person will change. Even if $m(t)$ is the meat consumption behavior at a single instant, in reality, people

continuously update their motivation as they continue to eat meat. Using the following function of how much the amount of meat will change for goal-oriented motivation:

$$dm/dt = -k(m(t) - W), \quad (1)$$

we can express that the model is not only about how much the person eats, but about how much they change. We can solve it to obtain the steady S function:

$$S = W + (m_0 - W)e^{-kt}, \quad (2)$$

which predicts an approximation of the initial amount of meat m_0 towards W, and the speed of that approximation is faster the further apart m_0 and W are, and the larger k is. However, people do not just increase or decrease directly depending on their goal, sometimes, they overshoot or undershoot, which we expected in response to MRCD. This change process may be driven by the motivation to change rather than a goal behavior, and would be explained by a second-order differential equation using the same function as in Equation 1 but as a second-order derivative:

$$d^2m/dt^2 = -k(m(t) - W). \quad (3)$$

Solving this second-order derivative, we obtain the fluctuating function:

$$F = W + (m_0 - W)cos(\sqrt{k}t) + (v_0/\sqrt{k})sin(\sqrt{k}t), \quad (4)$$

where v_0 is the initial speed at which the person was already changing, and the rest of the variables and parameters are the same as in the S function from Equation 2.

The fluctuating function F predicts that meat consumption will oscillate around the target value W rather than approach it asymptotically, reflecting an unstable change process where individuals vacillate between restraint and relapse. In contrast, those whose change follows the S function engage in more consistent, goal-directed behavioral change. As such, we expected the F

function to best describe participants in the MRCD group (i.e., unstable changers) and the *S* function to best describe participants in the control group (i.e., stable changers).

Exploratory Directions

In addition to this main hypothesis, we also explored whether the frequency of meat consumption oscillations would differ across conditions. Similarly, we also investigated how quickly the behavior change curve in the MRCD condition would stabilize compared to the control condition, namely whether the exponential decay in meat consumption change would differ across conditions.

Method

Participants

Based on a G*Power analysis (effect size = 0.6, $\alpha = .05$, power = .80) and accounting for an expected 35% dropout rate due to the study's intensive 10-day design, we aimed to recruit 110 participants. Inclusion criteria were being 18 or older, consuming meat (to ensure an effective cognitive dissonance manipulation), and expressing a desire to improve their diet (to limit reactance and enable meat reduction during the study). One hundred forty-six participants were recruited via word-of-mouth, a LinkedIn post, and an advert on the website of a French organization promoting plant-forward eating. After excluding participants from a third experimental group, which was irrelevant to our study, 98 participants remained, 79 of whom completed at least one study day. Those who provided fewer than 7 days of data or did not respond on days 1 or 10 were excluded, reducing the final sample for data analysis to 65 participants.

In total, the control condition contained 34 participants, and the MRCD condition contained 31 participants. The majority of participants were younger than 30 years old (*M* =

25.16, *SD* = 9.03) in both the control (*M* = 24.80, *SD* = 8.89) and the MRCD (*M* = 25.50, *SD* = 9.33) groups. Women were overrepresented in both the control (70.6%) and MRCD (80.6%) groups. The groups were relatively balanced in the measured sociodemographic variables (age, gender, and education), despite some variations in employment status (see *Appendix A*). Individual and household cooking arrangements (i.e., household composition, household diets, primary household cook, frequency of cooked and purchased meals) were also well balanced across groups (see *Appendix B*).

Design

We conducted a 10-day longitudinal experiment where participants were assigned to one of three conditions using simple randomization: (1) baseline intervention (control); (2) baseline intervention framed using cognitive dissonance (MRCD), or (3) baseline intervention plus feedback (feedback). We only used the control and MRCD conditions for our analyses because the feedback condition was part of another project for which we jointly recruited participants, and thus fell beyond the scope of this thesis.

The primary outcome was the variability in meat consumption change, which we operationalized as the sample variance of absolute day-to-day changes in self-reported meat intake over the 10-day period. The difference in meat consumption per person *i* per period p of each pair of days was first calculated as:

$$\Delta m_{i,\,p} \;=\; |m_{i,\,d} \;-\; m_{i,\,d-1}|, \tag{5}$$

namely, the absolute difference in meat consumption m between two consecutive days $d - 1$ and d. Therefore, we calculated the average daily change per person i as the average of daily changes across the nine periods p:

$$\overline{\Delta m_i} = \frac{1}{9}\sum_{p=1}^{9} \Delta m_{i,p} . \quad (6)$$

Finally, we calculated our outcome variable change variability s_i^2 as the sample variance of daily changes Δm per person i:

$$s_i^2 = \frac{1}{8}\sum_{p=1}^{9} (\Delta m_{i,p} - \Delta m_i)^2 . \quad (7)$$

Procedure

Participants were randomly assigned to one of the three conditions. Data collection took place over 10 days through Qualtrics. Participants were then presented with an informational text about meat consumption and nine subsequent daily practical resources, each framed either morally (MRCD group) or logistically (control group). Each day, after reading the text, participants reported their affective state using an adapted Cognitive Dissonance Thermometer Questionnaire and their daily meat consumption in a 24-hour Dietary Recall Questionnaire. On the last day, participants also completed a short demographic questionnaire (see *Appendix C*).

Materials

Manipulation

Participants received an initial informational text (see *Appendix D*) and nine daily practical resources, such as simple plant-based recipes, testimonials, and actionable tips for meat reduction (see *Appendix E*), framed differently by condition.

Informational Text. The MRCD group's informational text adopted a moralizing tone (e.g., "the choices we make at mealtime influence the death of 70 billion land animals annually") and highlighted the ethical implications of meat consumption, particularly the suffering of animals in industrial farming systems (e.g., "While some premium meat options are marketed as

"humane" or "free-range," they still sometimes rely on practices such as debeaking, tail docking, and confinement in tiny cages"). This framing and tone were designed to trigger dissonance by confronting participants with the inconsistency between their care for animals, self-perception as moral individuals, and their consumption of meat, which contributes to animal suffering. In contrast, the control group received a logistically framed informational text about meat consumption, providing general information about the affordability, practicality, and health implications of high meat consumption without mentioning moral or emotional appeals (e.g., "While some premium meat options are marketed as "organic" or "free-range," they can come at a higher price, placing them out of reach for many consumers"). Its tone was less moralizing by adopting a vaguer and more balanced approach (e.g., "the choices we make at mealtime influence our health and our wallets").

Daily Resources. The daily resources were designed using the same distinctions. This included three testimonials where fictional interviewees shared their motivations and journey to meat reduction (e.g., "when I learned about the cruel conditions in factory farms" for the MRCD group and "when I moved out for college and had to cook for myself" for the control). Participants were also provided with links to three meatless recipes for ramen, curry, and a burrito bowl, preceded by descriptive texts (e.g., "The umami-rich broth comes together in no time, demonstrating how we can recreate traditional tastes while avoiding": "practices that cause animal suffering" for the MRCD group and "long hours in the kitchen" for the control group). Finally, participants were given three tips for ensuring nutrition, affordability, and convenience when reducing meat in their diet (e.g., "By incorporating a variety of these protein-rich plants [...] you can easily": "choose compassion over cruelty" for the MRCD group or "meet your protein, fiber, vitamin, and mineral requirements" for the control group).

Cognitive Dissonance Thermometer

Cognitive dissonance was measured throughout the study to monitor affective states and evaluate the effectiveness of our manipulation. On days 1 and 10, participants completed the full 24-item version of the validated Dissonance Thermometer Questionnaire developed by Elliot and Devine (1994) and further used by Devine et al. (1999) (see *Appendix F*). On days 2-9, participants rated only two ad hoc items for brevity, as previously used by Vaidis and colleagues (2024). Participants were asked, "For each word, please indicate how much it describes how you are feeling right now". They then rated a set of dissonance-relevant terms (e.g., uncomfortable, guilty) on a 7-point Likert scale (1 = *does not apply at all* to 5 = *applies very much*), with higher scores corresponding to more negative affect. The 24-item Dissonance Thermometer scale measured on days 1 and 10 demonstrated excellent internal consistency reliability: $\alpha = .95$, 95% CI [.93, .97] on both days. Results for the two ad-hoc items (i.e., uncomfortable and in conflict) used on days 2 to 9 were also fairly consistent across days (see *Table 3*).

Table 3

Scores on the 2 Ad-Hoc Items Measuring Cognitive Dissonance

Day	2	3	4	5	6	7	8	9
Uncomfortable								
Mean (SD)	2.39 (1.49)	2.22 (1.45)	2.45 (1.53)	2.25 (1.31)	2.06 (1.38)	2.17 (1.45)	2.08 (1.37)	2.11 (1.22)
In Conflict								
Mean (SD)	2.09 (1.20)	2.28 (1.40)	2.50 (1.41)	2.25 (1.36)	2.31 (1.63)	2.23 (1.41)	1.86 (1.18)	2.12 (1.35)

Note. Average scores on all days are below 3, suggesting low levels of cognitive dissonance.

Daily Dietary Intake

Each day, participants completed a 24-hour Dietary Recall Questionnaire, adapted from the validated Online Oxford WebQ Questionnaire (Measurement Toolkit, n.d.-a; Measurement Toolkit, n.d.-b; University of Oxford, n.d.; Greenwood et al., 2019; Beer-Borst & Amadò, 1995; DeBiasse et al., 2018). Dietary intakes estimated via retrospective self-report are prone to measurement error, which can be minimized using short-term 24-hour recalls. Since the original version of this tool takes an estimated 10-15 minutes to complete and is not freely available in full format, we created a condensed version of the questionnaire, specifically targeting meat consumption and excluding unnecessary food subcategories (e.g., "Cereals and Grains", excluding subcategories from the original tool: e.g., "Bran cereal" or "Porridge, hot oat cereal"). This aimed to shorten and facilitate completion for participants, increasing their likelihood of returning to the study on the following day.

The tool consisted of asking participants, "For each food category, please indicate how many portions you ate over the past 24 hours". Participants then rated 10 food categories (e.g., "Fruits and Vegetables", "Meat and Poultry", "Eggs and Dairy Products", "Plant-Based Alternatives to Meat and Poultry"; see *Appendix G*) on a 5-point Likert scale (0 = *none* to 4 = *four or more*). Participants were also asked to state whether it was a typical day's intake, and to explain why if not. On the last day, participants were asked whether and why they perceived their diet to have changed during the study, with an open answer format. Descriptive statistics (see *Table 4*) and response distributions (see *Figure 2*) for daily meat intake reveal a slight overall decrease in meat consumption, as expected given the meat reduction intervention.

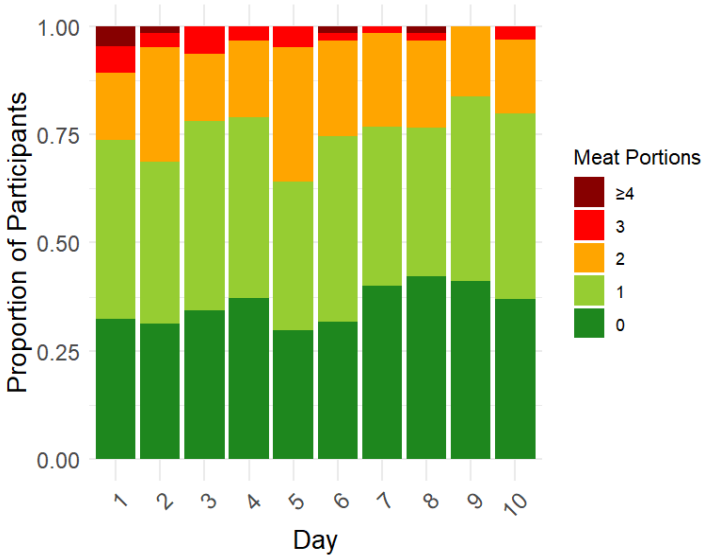
Table 4

Daily Meat Intake Portions

Day		1	2	3	4	5	6	7	8	9	10
Meat intake											
	Mean	1.09	1.05	.95	.90	1.10	1.00	.85	.87	.77	.86
	SD	1.07	.92	.87	.82	.89	.87	.81	.91	.71	.81

Figure 2

Proportion of Reported Meat Portions per Day



Note. Each bar represents a single day, and sections are stacked by reported meat portion count. Values are normalized to reflect proportions per day.

Results

Sample Cleanup

Missing values for participants were imputed using their mean meat intake, to maintain within-person consistency without distorting individual trajectories. Because we explored change stability by investigating whether participants in the MRCD condition showed greater variability

in daily meat intake compared to the control condition, outlier values for change variability were identified and removed using the IQR method, dropping the final sample from 65 to 61 participants (14 male, 46 female, one other, mean age = 25 years).

Manipulation Check

After reverse coding inversely phrased items, we calculated participants' cognitive dissonance index on days 1 and 10 by averaging the 24 items of the Cognitive Dissonance Thermometer. On these days, the average reported cognitive dissonance was slightly higher in the control group than in the MRCD group, although Mann-Whitney U tests did not reveal significant differences on day 1 ($W = 498$, $p = .61$) nor 10 ($W = 483.5$, $p = .76$). On days 2 to 9, participants' self-reported discomfort and conflict scores were either equal across groups or higher in the control group, with no significant differences (see *Appendix H*). In summary, there were no significant differences in self-reported cognitive dissonance between the control and MRCD groups.

Testing Group Differences in Change Variability

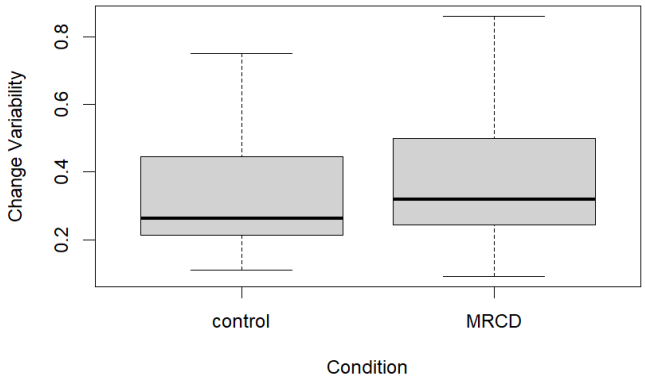
Change variability in daily meat intake ranged from .09 to .86 ($M = .35$, $SD = .17$, $Mdn = .28$). Participants in the MRCD condition had slightly higher change variability ($M = .37$, $SD = .18$, $Mdn = .32$) than those in the control condition ($M = .33$, $SD = .17$, $Mdn = .26$; see *Figure 3*). Before conducting the main analysis, we checked assumptions to ensure the appropriateness of the Mann-Whitney U test to assess whether eliciting cognitive dissonance in the MRCD group led to greater variability in meat intake compared to the control group. Normality checks using the Shapiro-Wilk test indicated that the distribution of change variability scores significantly deviated from normal in the control group ($W = .90$, $p = .004$), and the MRCD group was also

not normally distributed (W = .93, p = .05). Levene's test did not indicate that the variances were statistically different across groups (F(1, 59) = .63, p = .43).

Therefore, to test whether eliciting cognitive dissonance in the MRCD group led to greater change variability in meat intake compared to the control group, we conducted a non-parametric one-tailed Mann-Whitney U test with two independent groups. Results did not show significant difference in change variability between the MRCD and control groups, W = 510.5, p = .24. These findings do not support the hypothesis that participants in the MRCD condition would exhibit greater variability in daily meat consumption changes than those in the control condition.

Figure 3

Variability in Daily Meat Intake Change by Condition



Note. The boxes represent the interquartile range, with medians marked; whiskers denote the full range excluding outliers. No significant difference in change variability was observed between conditions, although the average change variability was slightly higher in the MRCD group.

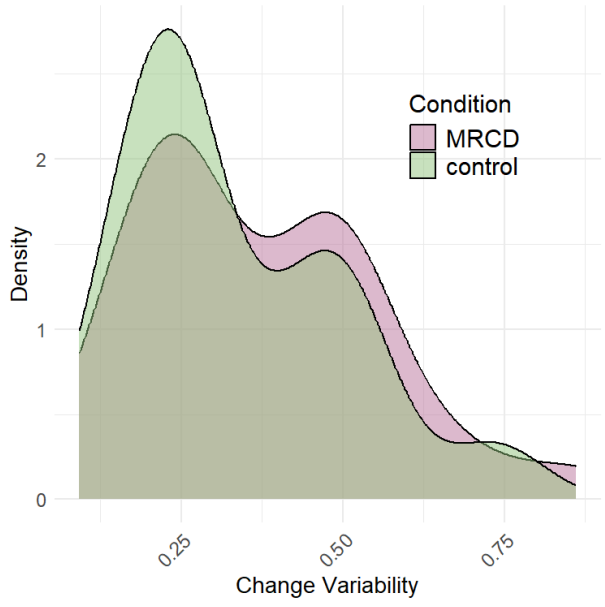
Follow-Up Analyses: Stable Versus Unstable Changers

Despite these non-significant results, interesting patterns in change variability emerged by mapping density plots per condition (see *Figure 4*). These plots depict the distribution of change variability for each group, both of which deviate from normality and resemble a bimodal

distribution. Indeed, both the MRCD and the control group display two distinct peaks: a higher peak at a lower change variability (.24 for MRCD and .23 for control) and a lower peak at a higher change variability (.47 for both groups). Hartigan's dip test was conducted to assess whether the distribution of change variability was multimodal within each condition. The distribution did not significantly deviate from unimodality for the control condition (D = .07, p = .16), but did show significant evidence of multimodality for the MRCD condition (D = .10, p = .03) and all participants taken together (D = .08, p = .004). This bimodal distribution of change variability scores may be interpreted as two distinct clusters of participants, namely those who changed their meat consumption in a stabler trajectory (first peak) and those who changed with greater fluctuation (second peak). More participants from the control condition showed a stabler change (density = 2.76) pattern than MRCD participants (density = 2.14). Oppositely, more participants from the MRCD showed a more unstable pattern (density = 1.69) than participants in the control condition (density = 1.46).

Figure 4

Distribution of Change Variability by Condition



Note. Density plots depicting the distribution of variability in daily meat intake change for participants in the MRCD and control conditions. The first peak is higher in the control condition than the MRCD condition, while the second peak is higher in the MRCD condition than the control condition. The two density plots cross near the midpoint of these peak at .34, which is close to the mean change variability noted earlier (.35).

The bimodal and group-specific patterns observed in the density plots led us to investigate how participants in each group scored on change variability compared to the average participant (i.e., *Mdn* = .28). We found that participants in the MRCD condition were 53% more likely to score higher than the average person on change variability compared to participants in the control condition (OR = 1.53, 95% CI [.5305, 4.3878], p = .43), though this difference was not statistically significant.

Additional Temporal Dynamics of Meat Consumption Change

The Rhythm of Behavioral Change

We investigated whether participants' meat consumption would change with different rhythms across conditions, by observing the frequency of behavioral oscillations. A sinusoidal frequency model was fit to participants' day-to-day change across the 10 days: $f(x) = sin(kx - h) + g$. This yielded three parameters: k, which captures the frequency of behavioral fluctuations over time; h, which represents the phase shift (i.e., when peaks or troughs occur); and g, the vertical shift, or the average level of behavior. The overall median of k was 1.08 (range: 0.22 to 1.95) and a non-parametric Mann–Whitney U test revealed no significant difference in frequency k between conditions (W = 414.5, p = .86). The overall median of h was 0.48 (range: –4.21 to 5.02), and again, no significant difference between conditions was observed (W = 349.5, p = .40). Finally, the overall median of g was 0.73 (range: .09 to 1.73), with no

significant difference between conditions ($W = 368.5$, $p = .59$). These results suggest that the frequency, timing, and average level of behavioral change in meat consumption did not differ significantly between the MRCD and control conditions.

The Speed of Behavioral Change

We also investigated how quickly meat consumption would decrease across conditions, by comparing the exponential decay in meat consumption change across the MRCD and control groups. An exponential decay model was fit to participants' behavior across the 10 days: $f(x) = a * exp(- kx)$. This yielded two parameters: the estimated starting value a (initial level of behavior), and the decay rate k (how quickly the behavior changed over time). The overall median of a was 0.81, ranging from 0.18 to 2.62. A non-parametric Mann-Whitney U test revealed no significant difference in the starting value a between conditions ($W = 135$, $p = 1.00$). The overall median of k was 0.07 with values ranging from –0.16 to 0.41, and there was no significant difference in the decay rate k between conditions ($W = 152$, $p = .55$). This curve failed to fit for 28 rows, primarily due to daily change values of 0 caused by uniform daily values (i.e., constant behavior across time), because the exponential decay model struggles when the values of the dependent variables are 0. These results suggest that neither the initial level of meat consumption behavior nor the rate at which it changed over time differed significantly between the two experimental conditions.

Discussion

This study aimed to determine whether eliciting cognitive dissonance in addition to a baseline intervention would increase the variability in meat consumption change over 10 days, compared to the intervention without dissonance. Although the MRCD group showed marginally higher day-to-day change variability compared to the control group, the difference was not

statistically significant. This finding does not support the hypothesis that participants in the MRCD condition exhibit greater variability in daily meat intake changes than those in the control condition. Density plots revealed a bimodal distribution of change variability (significantly for the MRCD condition and all participants), suggesting two types of participants: those who changed stably and those who changed unstably. More participants in the stable cluster were in the control condition compared to the MRCD condition, and inversely for the unstable cluster. In fact, participants in the MRCD condition were also 53% more likely to score higher than the average participant on change variability when compared to the control condition. However, this difference was not statistically significant. Taken together, these findings do not confidently support the hypothesis that eliciting dissonance in addition to providing resources for meat reduction substantially destabilizes dietary behavior change compared to merely receiving these resources, even if some results may look promising. Several factors may explain these results, methodologically and theoretically.

The Manipulation Failed to Elicit Significant Dissonance

Weak Manipulation

Our manipulation checks revealed no significant differences in self-reported cognitive dissonance between the control and MRCD groups. This suggests that the manipulation meant to elicit cognitive dissonance did not generate more dissonance in the experimental group compared to the control group. When designing the manipulation, we sought to soften wording in the MRCD condition to avoid overwhelming participants and triggering psychological reactance, namely, efforts to regain behavioral freedom when one perceives threats to this freedom (Brehm, 1966). This softening may have caused the MRCD group materials to be insufficiently moralizing, preventing them from eliciting sufficient dissonance to generate a difference with the

control group. This concords with rather low levels of cognitive dissonance observed across groups.

Disengagement

Alternatively, these surprisingly low cognitive dissonance scores could also be explained by the opposite phenomenon, if the resources induced too much discomfort, leading to reactance. This is possible given that psychological reactance has been shown to emerge readily in response to meat-related cognitive dissonance, especially when elicited through moralizing statements about animal welfare (Bouwman et al., 2022; Hinrichs et al., 2022). To regain behavioral control, participants in the MRCD condition may then have disengaged with the materials (Buttlar & Walther, 2018, 2019; Gradidge et al., 2021), ultimately leading them to report low levels of dissonance. Disengagement, in this context, refers to the psychological distancing or avoidance of information that threatens one's self-concept or preferred behaviors (Bastian et al., 2012).

Given the emotionally and morally charged nature of meat consumption and meat reduction, which are routinely associated with animal welfare concerns in public discourse (Piazza et al., 2015), even participants in the control group may have experienced a desmeasurably high degree of dissonance and disengaged with the study. Indeed, meat-related cognitive dissonance is especially easy to elicit, with studies revealing that the mere presence of a vegetarian generated dissonance (Rothgerber, 2014, 2020; Minson & Monin, 2012). Therefore, merely by broaching the topic of meat reduction without explicitly mentioning animal suffering or exploitation, the materials provided in both conditions may have prompted even those in the control group to consider ethical dilemmas, experience a high degree of cognitive dissonance, react by disengaging, and ultimately report low discomfort scores. This is especially likely given that participants were omnivores, who tend to disengage more readily (Buttlar & Walther, 2018).

Similarly, participants were recruited by word-of-mouth and based on an interest in improving their diet, suggesting they may have been more exposed to debates surrounding diets like vegetarianism and veganism, and thus connected meat reduction encouragements to ethical dilemmas more automatically.

Limited Manipulation Check

While our manipulation check revealed no significant differences in dissonance across conditions, it is important to note that the Cognitive Dissonance Thermometer used to measure participants' dissonance level has been criticized on several grounds. Vaidis and Bran (2019) argue that Cognitive Dissonance Theory presents concerning methodological flaws, including how dissonance is defined, operationalized, induced, and assessed, the latter referring to said thermometer. Furthermore, the full 24-item version was used only on days 1 and 10, while two ad-hoc items (discomfort and conflict) were used on the other days, chosen based on the importance of discomfort in cognitive dissonance (Devine et al., 2019). These 2 items have only been used to assess dissonance state in one study, not focused on meat-related dissonance (Vaidis et al., 2024), where they were combined with an adapted version of the Positive and Negative Affect Schedule (PANAS). This raises questions regarding the validity and reliability of these items in measuring cognitive dissonance.

Given the methodological limitations of our manipulation check, the absence of a significant difference in cognitive dissonance levels across groups does not entirely eliminate the possibility that participants did in fact experience more dissonance in the MRCD group compared to the control group. Assuming that the dissonance manipulation did work, the lack of significant differences in change variability across conditions may also be explained conceptually.

Dissonance Failed to Increase Behavioral Change Variability

Non-Behavioral Dissonance Reduction

We expected that those who experienced cognitive dissonance in addition to receiving the daily materials would engage in several dissonance reduction strategies throughout the study, generating ample fluctuation in their meat consumption change as they cyclically engaged in behavior change, cognition change, and trivialization. When anticipating multiple dissonance-reduction strategies, we assumed that behavior change would be one of the strategies adopted, due to the activation of personal values (Bouwman et al., 2022) and contextual facilitation (Odou et al., 2019; McGrath, 2017) via the provided resources.

It is possible, however, that participants in the MRCD condition resolved their dissonance exclusively through non-behavioral strategies. Despite few studies exploring the factors that explain choosing one dissonance-reduction strategy over another, this is believed to depend on the availability of different reduction modes, the likelihood of successful dissonance reduction with each strategy, their effortfulness (i.e., resistance to change), and the potentially habitual nature of behavior (McGrath, 2017). Participants may thus have deprioritized behavior change compared to other dissonance-reduction strategies (Tueanrat & Alamanos, 2025; Harmon-Jones, 2019; Odou et al., 2019), particularly given that meat consumption is a habitual behavior (Koning, 2021; Rothgerber, 2020; van't Riet et al., 2011) that is associated with sensory pleasure (Ciobanu et al., 2023; Forde & de Graaf, 2023) and depends on contextual cues (Laffan, 2021).

Furthermore, the discomfort experienced by participants in the MRCD condition, which was expected to destabilize behavioral adjustments, may instead have triggered efforts to regain behavioral stability, in line with theories about tension reduction and self-consistency maintenance (Lecky, 1951; Weibel et al., 2019). Especially in the context of food choices,

self-consistency is an important decisional factor (Weibel et al., 2019), which means that dissonance may have led participants to rationalize their meat consumption, thus solidifying their behavior rather than changing it. Overall, it is possible that participants in the MRCD condition opted exclusively for non-behavioral dissonance-reduction strategies to resolve their discomfort. In this case, the behavior change noted for all participants was due only to the resources given to both groups, not their dissonance-eliciting framing. This would explain why the groups did not show significant differences in their variability in meat consumption change.

Stabilized Behavioral Change

Alternatively, several factors may have limited day-to-day fluctuations in meat consumption, stabilizing meat reduction in both groups and thus softening differences across groups. By completing the daily dietary recalls, all participants engaged in a form of self-monitoring, namely the process of systematically observing and recording one's own behaviors, which increases awareness and can promote behavioral consistency (Burke et al., 2011; Frie et al., 2022). Self-monitoring is a well-established behavior change technique that has been successfully applied to induce dietary change (Carter et al., 2013; Michie et al., 2009) and specifically meat reduction (Frie et al., 2022; Stewart et al., 2022), which may have made participants more mindful and consistent, artificially stabilizing the meat consumption change in both groups. Similarly, the daily resources' practical framing (e.g., recipes) may have increased participants' perceived behavioral control by providing them with specific, concrete, and immediate behaviors for reducing meat consumption, further stabilizing their behavior change towards meat reduction (Cheah et al., 2020; Kwasny et al., 2022; Harguess et al., 2020).

Finally, meat consumption patterns in people's daily life may naturally fluctuate within a limited range, leaving little room for greater instability, even under dissonance. Similarly,

perhaps selecting participants with high initial meat intake levels would have made space for more clearly observable change and variability in said change. This could be described as a floor effect, where the behavior's initially low level limits the potential for further decrease or fluctuation (Buttlar et al., 2023). The limited time frame of the study (i.e., 10 days) may have further limited meat reduction, invisibilizing the behavioral fluctuations involved in this meat reduction process. Longitudinal studies suggest that significant and sustained changes in meat consumption typically require longer intervention periods, with meaningful reductions only emerging over several weeks, months, or even years (e.g., Reuzé et al., 2023; Milfont et al., 2021). Overall, several factors may have stabilized behavioral change in both groups, thus reducing differences in change variability between the control group that received resources and the MRCD group that received the same resources but also experienced dissonance.

Non-Significant But Directionally Coherent Change Variability Differences

Although the factors above could explain why experiencing dissonance did not significantly destabilize the trajectory of behavior change compared to the baseline intervention, it is relevant to note that all results were directionally coherent with our hypothesis. As such, the lack of significance could be due to power limitations, especially since our sample was slightly below our target size and effects may have been smaller than anticipated due to the short timeframe that decreased fluctuations. Therefore, the directionally coherent albeit non-significant results merit further conceptual interpretation.

Undershoot-Overshoot Conceptual Framework

Participants who experienced cognitive dissonance in addition to receiving meat reduction resources exhibited numerically but not significantly higher change variability than those who merely received the resources, which corresponds to more unstable changes in meat

consumption. Similarly, participants who experienced cognitive dissonance in addition to the intervention were 53% more likely (than those who only received the intervention) to display a more unstable change in meat consumption than the average participant. These results, though not significant, directionally align with our undershoot-overshoot framework for MRCD-induced behavioral change, whereby cognitive dissonance induces a complex, non-linear change in behavior, with many setbacks and relapses.

Stable Versus Unstable Change Processes

In addition, density plots revealed a bimodal distribution of change variability (significantly for the MRCD group and the full sample), revealing two seemingly distinct clusters of participants: the stable and unstable changers. The aforementioned *S* and *F* functions may explain the bimodal distribution of variability and offer a theoretical foundation for distinguishing between two distinct psychological mechanisms driving dietary change. Based on our undershoot-overshoot conceptual framework for dissonance-induced meat reduction, we expected the *S* function to better explain the control group (i.e., goal-oriented change) and the *F* function to better explain the MRCD group (i.e., change-motivated change).

In line with this expectation, the stable participant cluster contained more participants from the control condition compared to the MRCD condition, while the unstable cluster contained more participants from the MRCD condition compared to the control condition. This means that amongst those who changed their meat intake with greater stability—possibly because this change was driven by the motivation to reach a target level of meat consumption—more had experienced cognitive dissonance rather than only received the resources without dissonance. Inversely, amongst those who changed their meat intake with greater instability—possibly because this change was driven by the motivation to change—fewer

had experienced cognitive dissonance than only received the baseline intervention. If future research were to reveal significant cross-group differences across these clusters, it may suggest that experiencing cognitive dissonance tends to trigger a change-motivated and highly fluctuating process of behavioral change, compared to the more linear and stable goal-motivated process of behavioral change triggered by a basic intervention.

Given that none of our results revealed significant cross-group differences, methodological limitations should be acutely considered. As stated earlier, the manipulation may have failed to generate significant differences across groups, but it is also possible that the manipulation check itself was flawed, leaving room for other methodological barriers to observing significant differences in change variability.

Methodological Limitations

First, our sample presented several limitations that reduce the internal validity of our findings and constrain their generalizability.. Although the final sample of participants used for analysis approached our objective ($n = 65$), it was slightly underpowered to detect small effects, especially in a field-like setting with high natural variability in eating behavior. Our sample was biased towards female students in their twenties, and participants were recruited based on a stated interest in improving their diet, likely biasing our sample towards individuals with a pre-existing motivation to reduce their meat intake. Given that participants were recruited via word of mouth and wanted to improve their diet, they may have experienced particularly high pressure to reduce their meat consumption. The social desirability bias may then have motivated participants to underreport their meat intake in response to perceived study expectations (Hebert et al., 1995; Mathur et al., 2021).

The timeframe of our study is another limitation. The 10-day window may have been too limited for dissonance-induced behavior change to reveal significant patterns, while long-term effects of cognitive dissonance might include more variability in meat reduction. Change variability calculated from day-to-day changes may also have failed to capture the larger-scale trajectory of meat consumption change over time. Instability may occur over weeks, rather than days, and would thus fail to be observed by day-to-day changes across 10 days.

The materials used in our study were also imperfect. Participants self-reported their daily meat intake in number of portions, which may have failed to capture granular differences by equivocating small and large portions, and enabled participants to underreport their meat intake motivated by social desirability. Furthermore, our manipulation materials may have been either too strong or too soft, and our measurement tool for cognitive dissonance also presented limitations. Finally, we failed to measure participants' engagement levels and attitudes towards meat consumption throughout the study, compromising the thorough interpretation of our results, as it remained unclear what strategies participants were engaging in to reduce their dissonance.

Future Research Directions

In light of these interpretations and limitations, several directions emerge for future research. This study may be replicated with a larger and more representative sample, over longer timeframes, using improved materials. It may be necessary to actively target men and older adults, given that most environmental psychology research overrepresents university students (Henrich et al., 2010; Sears, 1986) and women (Clayton, 2012; Ballew et al., 2018). We also recommend tracking how dissonance unfolds over more sustained periods, such as one or several months, which could reveal longer-term patterns of change variability and allow different conceptualizations of change variability (e.g., as the variability in week-to-week rather than

day-to-day change). Our manipulation should also be revised to ensure that they produce reliable MRCD differences across groups, possibly by adapting existing dissonance manipulations to the case of meat, including induced compliance, insufficient justification, disconfirmed expectancies, selective exposure, free choice, and induced hypocrisy (Kenworthy et al., 2011; Odou et al., 2019). To observe how different dissonance-reduction strategies are employed over time, it is also relevant to measure not only behavior, but also participants' engagement levels and meat-related attitudes. This would better reveal how participants alternately adopt non-behavioral dissonance-reduction strategies like cognition change, trivialization, and avoidance, gaining clarity on temporal fluctuations. Similarly, behavioral measures could be refined by using continuous measures (e.g., grams or calories) to better detect small daily fluctuations and avoid estimation biases associated with portion-based measurements.

In addition to replicating this study with a more robust methodological framework, directions for novel research also emerge. It may be interesting to investigate whether the effect of cognitive dissonance on the stability of behavioral change depends on certain individual characteristics. Additional analyses may be run on our dataset or replicated datasets, to determine whether pro-environmental self-identity and personal values affect the influence of cognitive dissonance on change variability. Men have also been shown to experience particularly high levels of meat-related cognitive dissonance (Semmler et al., 2023; Loughnan et al., 2014; Dowsett et al., 2018), raising questions about the effects of dissonance on behavior change across genders. Insights may also be gained from recreating this study with another dissonance-eliciting environmental behavior. Because meat consumption is deeply habitual, pleasure-related, and context-dependent, behavior change may not be the preferred dissonance-reduction strategy in this case. It would be relevant to see whether other environmental behaviors that elicit

dissonance, such as online purchases (Fernandez-Lores et al., 2024), reveal interesting temporal patterns of behavior change in response to dissonance.

Overall, the food system transition requires developing effective behavior change interventions to drive sustainable eating decisions (UNEP, 2021; Ivanovich et al., 2023), including cognitive dissonance interventions for meat reduction, which draw on the meat paradox. However, to ensure the effectiveness of said interventions, it is relevant to investigate the process and temporal dynamics of meat reduction in response to cognitive dissonance, providing a starting point for developing formal models of behavior change.

Conclusion

Given the environmental, health, and ethical implications of the meat industry, consumer choices present a hopeful avenue to reshape the global food system in more sustainable ways, which underpins the importance of developing effective behavior change interventions to drive eating decisions (UNEP, 2021). Cognitive dissonance interventions appear particularly appropriate for meat reduction, as they draw on eaters' motivation to reduce their pre-existing internal conflict between meat enjoyment and disapproval of its consequences (i.e., the meat paradox). However, to promote stable and lasting dietary change, it is relevant to understand the complex mechanics of dissonance-reduction, particularly its temporal dynamics outside of the lab. Therefore, meat-related cognitive dissonance provides a useful starting point for the development of formal models of behavior change.

This thesis set out to explore whether eliciting cognitive dissonance destabilizes meat consumption change. Although the main hypothesis was not statistically supported, results revealed suggestive patterns: a higher proportion of unstable changers emerged in the MRCD group, and variability trends aligned directionally with theoretical expectations. These patterns,

alongside a bimodal distribution of change trajectories, indicate that dissonance may trigger more erratic behavior in some individuals, potentially due to cycling between behavioral and cognitive dissonance-reduction strategies. However, methodological limitations likely hindered the full observation of these effects. Future studies should refine dissonance manipulations, track strategy adoption, and examine longer-term dynamics using more diverse samples. Despite its limitations, this research contributes to a nuanced understanding of how internal conflict might shape sustainable eating trajectories and calls for deeper modeling of behavioral instability in the face of psychological tension.

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Appendix A

Participant Sociodemographics by Condition

On the last day of the study, participants filled a series of short standardized sociodemographic questionnaires, reporting their age, gender, education, and employment.

	Control (N = 34)	Cognitive Dissonance (N = 31)
Age (years)		
Mean (SD)	24.9 (8.76)	25.2 (8.94)
Gender (%)		
Male	26.5	19.4
Female	70.6	80.6
Other	2.9	0
Education (%)		
No formal education		
High school diploma or equivalent	29.4	29
Associate degree	5.9	0
Bachelor's degree	29.4	32.3
Master's degree	29.4	35.5
Doctoral degree	0	3.2
Professional degree	0	0
Other	5.9	0
Employment (%)		
Employed full-time	8.8	22.6
Employed part-time	2.9	9.7
Self-employed	2.9	0
Unemployed	5.9	3.2
Student	76.5	64.5
Retired	0	0
Other	2.9	0

Appendix B

Participant and Household Cooking Habits by Condition

On the last day of the study, participants filled a questionnaire about their individual and household cooking behaviors. The largest proportion of participants lived with roommates, had omnivorous household members, but usually cooked for themselves. The majority of participants cooked their meals daily, and a rather large proportion cooked often, namely five to six times a week. Conversely, most participants only rarely opted for purchased meals, namely once or twice per week.

	Control (N = 34)	Cognitive Dissonance (N = 31)
Household Composition (%)		
Alone	14.7	25.8
Spouse/partner only	8.8	12.9
Spouse/partner and children	5.9	0
Children only	0	0
Parents or family members	23.5	9.7
Roommates (non-family)	47.1	51.6
Other	0	0
Household Diet (%)		
Vegetarian/vegan	2.9	3.2
Mixed	20.6	35.5
Primarily omnivorous	64.7	58.1
Pescatarian	0	0
Other	11.8	3.2
Primary Cook (%)		
Participant	61.8	71
Household member	8.8	6.5
Shared	29.4	12.9
Takeout/prepared meals	0	6.5
Other	0	3.2
Cooked Meal Frequency (%)		

Never	0	0
Rarely (1–2 per week)	2.9	3.2
Sometimes (3–4 per week)	5.9	12.9
Often (5–6 per week)	23.5	29
Always (daily)	67.6	54.8
Purchased Meal Frequency (%)		
Never	8.8	9.7
Rarely (1–2 per week)	76.5	71
Sometimes (3–4 per week)	14.7	12.9
Often (5–6 per week)	0	6.5
Very often (daily)	0	0

Appendix C

Demographic Questionnaire

On the last day of the study, we collected participants' age, gender, education level, and employment using standardized self-report questionnaires. We also collected information about participants' weekly frequency of cooked and purchased meals, as well as their household composition, diets, and cooking arrangements.

What is your age group?

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

What is your gender?

- Male
- Female
- Non-binary / third gender
- Prefer not to say

What is the highest level of education you have completed?

- No formal education
- High school diploma or equivalent (e.g., GED)
- Associate degree (e.g., AA, AS)
- Bachelor's degree (e.g., BA, BS)

- Master's degree (e.g., MA, MS, MBA)
- Doctoral degree (e.g., PhD, EdD)
- Professional degree (e.g., MD, JD)
- Other (please specify):___

What is your current employment status?

- Employed full-time (35+ hours per week)
- Employed part-time (less than 35 hours per week)
- Self-employed
- Unemployed
- Student
- Retired
- Other (please specify):___

Which best describes your current household composition?

- Live alone
- Live with spouse/partner only
- Live with spouse/partner and children
- Live with children only
- Live with parents or other family members
- Live with roommates (non-family)
- Other (please specify):___

How is cooking typically handled in your household?

- I cook most or all of my meals
- Someone else in my household cooks most or all meals

- Cooking is shared among household members
- I mostly eat takeout or prepared meals
- Other (please specify):___

Which of the following best describes the dietary habits of the people you live with?

- Mostly plant-based (vegetarian, vegan)
- Mixed (some eat meat, some are vegetarian/vegan)
- Primarily omnivorous (includes meat regularly)
- Pescetarian (no meat, but eats fish)
- Other (please specify):___

How often do you eat home-cooked food?

- Never
- Rarely (1-2 times per week)
- Sometimes (3-4 times per week)
- Often (5-6 times per week)
- Always (daily)

How often do you eat food from cafeterias, restaurants, cafés, or takeout/delivery?

- Never
- Rarely (1-2 times per week)
- Sometimes (3-4 times per week)
- Often (5-6 times per week)
- Very often (daily)

Appendix D

Initial Informational Text by Condition

On the first day of the study, participants received an informational text about meat consumption. Across both groups, the initial messages were inspired by the Value-Belief-Norm (VBN) model, which has been successful in predicting a range of pro-environmental behaviors, including policy acceptability, environmental activism, and consumer behaviors (Stern 2000; de Groot & Steg, 2008, 2010; Stern et al., 1998). The texts were designed to fill participants' knowledge gaps about the implications of the meat industry and the benefits of plant-based eating, encouraging them to ascribe consequences to meat-eating behavior (Vermeir et al., 2020; Chamcham et al., 2024; Collier et al., 2021). They also pointed to the importance of individual consumer choices, targeting the ascription of responsibility component of the VBN model.

Control Condition

Our eating habits are profoundly shaped by our culture, whether through family traditions, locally meaningful meals, or norms about what is right or wrong to eat. However, many of use can feel uneasy about some of these traditions, or troubled by their implications. This isn't surprising, since the choices we make at mealtime influence our health and our wallets. Diets high in red and processed meats have been associated with long-term health risks, including heart disease and certain cancers. While some premium meat options are marketed as "organic" or "free-range," they can come at a higher price, placing them out of reach for many consumers. Taste is a powerful motivator, and plant-based foods have come a long way in recent years. From rich, hearty lentil stews to innovative meat substitutes that mimic familiar flavors and textures, these options make it easier than ever to enjoy delicious and diverse meals without over-relying on meat. While meat consumption also raises issues surrounding sustainability and

animal welfare, exploring plant-based meals offers an opportunity to prioritize health and make affordable choices—all while keeping your diet flexible and adaptable.

MRCD Condition

Our eating habits are profoundly shaped by our culture, whether through family traditions, locally meaningful meals, or norms about what is right or wrong to eat. However, many of us can feel uneasy about some of these traditions, or troubled by their moral implications. This isn't surprising, since the choices we make at mealtime influence the death of 70 billion land animals annually. Most animals raised for meat endure overcrowded, filthy conditions that deny them any semblance of a natural life. While some premium meat options are marketed as "humane" or "free-range," they still sometimes rely on practices such as debeaking, tail docking, and confinement in tiny cages. The journey to slaughter is often brutal, with newborns separated from their mothers within hours of birth, and animals subjected to long transports without food or water. Slaughter practices are not less inhumane, with improperly stunned animals sometimes left conscious as they are shackled, bled out, or dismembered. While meat consumption also raises issues surrounding health and affordability, exploring plant-based meals offers an opportunity to prioritize empathy and make ethical choices—all while keeping your diet flexible and adaptable.

Appendix E

Daily Intervention Resources by Condition

On days 2 to 10, participants received daily practical resources (i.e., recipes, testimonies, tips) framed either logistically (control condition) or morally (MRCD condition). These were designed to increase their perceived self-efficacy, which is another key component of the VBN model for behavior change (Steg & Nordlund, 2018), thus empowering participants with the belief that they were capable of reducing their meat intake and making sustainable food choices in their daily lives.

Recipes

On days 2, 5, and 8, participants were provided with meatless recipes, preceded by an introductory text framed logistically (control condition) or morally (MRCD condition). At the end of each survey, we included a link to the recipe (curry, ramen, burrito bowl).

Day 2: Sweet Potato and Peanut Curry

Control Condition. Today's recipe is a beginner's journey into healthy and delicious eating. This delightful curry is a nutritious choice that tantalizes your taste buds while boosting your wellbeing. Packed with nutrient-dense ingredients, this is a meal that's not only bursting with flavor but also provides you with abundant vitamins and minerals to support your health.

MRCD Condition. Today's recipe is a beginner's journey into compassionate and delicious eating. This delightful curry is a compassionate choice that tantalizes your taste buds while making a positive impact. Packed with nutrient-dense ingredients, this is a meal that's not only bursting with flavor but also spares animals from factory farming and its associated cruelties.

Day 5: Vegan Ramen

Control Condition. Today, we're offering you a quick and flavorful solution to your dinner dilemma. Slurp up this flavorful ramen and savor the taste of convenience in every bite. By choosing simple, effective ingredients, you're enjoying a quick version of a classic dish that's ready in minutes and full of authentic flavors. The umami-rich broth comes together in no time, demonstrating how we can recreate traditional tastes while avoiding long hours in the kitchen.

MRCD Condition. Today, we're offering you a quick and ethical solution to your dinner dilemma. Slurp up this flavorful ramen and savor the taste of compassion in every bite. By choosing plant-based alternatives, you're enjoying a cruelty-free version of a classic dish that's kind to animals and full of authentic flavors. The umami-rich broth comes together in no time, demonstrating how we can recreate traditional tastes while avoiding practices that cause animal suffering.

Day 8: A New Take on the Classic Burrito Bowl

Control Condition. This evening's culinary adventure takes us on a global taste exploration. This vibrant burrito bowl is a feast for your eyes and a journey for your taste buds. Packed with colorful Mexican-inspired ingredients, it's a delicious way to explore international cuisines and broaden your culinary horizons. The combination of spicy black beans, sweet corn, and zesty lime offers an authentic taste of Mexican flavors, while proving that traditional dishes can evolve. Each bite is a celebration of flavors.

MRCD Condition. This evening's culinary adventure takes us on a global taste exploration. This vibrant burrito bowl is a feast for your eyes and a relief for animals everywhere. Packed with colorful Mexican-inspired ingredients, it's a delicious way to reduce animal suffering and support a compassionate food system. The combination of spicy black

beans, sweet corn, and zesty lime offers an authentic taste of Mexican flavors, while proving that traditional dishes don't have to compromise on ethics. Each bite is a celebration of flavors that doesn't come at the cost of animal welfare.

Testimonials

On days 3, 6, and 9, we provided participants with fictional testimonials from meat eaters who decided to stop consuming meat, explaining their reasons for doing so. These justifications were either ethical (MRCD condition) or more nuanced and personal (control condition).

Day 3: Lisa's Family Transition

Control Condition. Today, let's hear from Lisa, who embarked on a dietary shift with her family: "I started exploring plant-based cooking out of curiosity, because I love experimenting with flavors from different cultures. But I was truly convinced after watching a cooking show highlighting creative vegan recipes inspired by experienced chefs. So my family decided to try Meatless Mondays in the new year of 2023, and it was a revelation. It's opened up a whole new world of food for me. We've discovered new recipes together, and I love sharing this new way of cooking with my kids. It's been a fun transformative experience and a great way to teach my children to try out new flavors!"

MRCD Condition. Today, let's hear from Lisa, who embarked on a dietary shift with her family: "I started exploring plant-based cooking out of curiosity, because I love experimenting with flavors from different cultures. But I was truly convinced after watching a documentary highlighting the dire conditions in cattle farms and slaughterhouses. So my family decided to try Meatless Mondays in the new year of 2023, and it was a revelation. It's opened up a whole new world of food for me. We've discovered new recipes together, and I love sharing this kind way of cooking with my kids. It's been a morally transformative experience and a great way to teach my

children to care for others!"

Day 6: Mark's Journey to Wellness

Control Condition. Today, we're happy to share with you Mark's journey to wellness through meat reduction: "After my colleague advised me to cut down on red meat due to my high cholesterol, I switched to a plant-based diet. As an athlete, I was skeptical about going plant-based as I worried about protein intake when reducing meat. After trying it for a month, I discovered new legumes and pulses that I had never heard of before. My energy levels soared, and more unexpectedly my grocery bills decreased quite significantly! Today, I've been fully plant-based for a little over 2 years. I've found that plant-based foods give me sustained energy without the heaviness of meat. I feel lighter and more active than ever, and my performance has improved! I would advise to start at your own rhythm, but it was definitely easier than I expected."

MRCD Condition. Today, we're happy to share with you Mark's journey to wellness through meat reduction: "After my colleague advised me to cut down on red meat due to the suffering inflicted upon animals in factory farms, I switched to a plant-based diet. As an athlete, I was skeptical about going plant-based as I worried about protein intake when reducing meat. After trying it for a month, I discovered new legumes and pulses that I had never heard of before. My energy levels soared, and more importantly I am no longer contributing to the death of innocent animals! Today, I've been fully vegetarian for a little over 2 years. I've found that plant-based foods give me sustained energy without the guilt of eating meat. I feel lighter and more active than ever, and my performance has improved! I would advise to start at your own rhythm, but it was definitely easier than I expected."

Day 9: Ayomide's Cultural Exploration Through Food

Control Condition. Today, let's hear how Ayomide found a new way to honor her heritage: "Growing up in a Nigerian household, I always thought our traditional dishes required meat. But when I moved out for college and had to cook for myself, I decided to try plant-based versions of my family's recipes. It was challenging at first, but I discovered that many of our ancestral dishes were actually plant-based! Beans, yams, and plantains were staples long before industrialized food production. Now, I make vegan egusi soup and jollof rice that even my grandmother enjoys. It's been a beautiful journey of reconnecting with my roots while saving time and money as a student. I feel like I'm honoring both my culture and my time by choosing quick and easy, plant-based ingredients."

MRCD Condition. Today, let's hear how Ayomide found a new way to honor her heritage: "Growing up in a Nigerian household, I always thought our traditional dishes required meat. But when I learned about the cruel conditions in factory farms, I decided to explore plant-based versions of my family's recipes. It was challenging at first, but I discovered that many of our ancestral dishes were actually plant-based! Beans, yams, and plantains were staples long before industrialized meat production. Now, I make vegan egusi soup and jollof rice that even my grandmother enjoys. It's been a beautiful journey of reconnecting with my roots while aligning my diet with my values of compassion. I feel like I'm honoring both my culture and the animals by choosing cruelty-free ingredients."

Tips

On days 4, 7, and 10, participants respectively received highlights about nutritional, affordability, and convenience considerations related to meat reduction, along with tips on navigating them.

Once again, these either emphasized logistical aspects with a neutral tone (control condition) or ethical aspects with a somewhat moralizing tone (MRCD condition).

Day 4: Nutrition Highlight: How to Get Your Protein?

Control Condition. It is not uncommon to worry about meeting your protein needs when reducing your meat consumption. However, with proper planning, it's entirely possible to get adequate protein from delicious plant sources. Legumes and pulses offer abundant protein that can help prevent deficiencies. Some great options include lentils, chickpeas, black beans, edamame, or peas. By incorporating a variety of these protein-rich plants into your daily meals, along with other plant-based protein sources like nuts, seeds, and whole grains, you can easily meet your protein, fiber, vitamin, and mineral requirements. It's not just about food – it's about making a change in your health.

MRCD Condition. It is not uncommon to worry about meeting your protein needs when reducing your meat consumption. However, with proper planning, it's entirely possible to get adequate protein from cruelty-free plant sources. Legumes and pulses offer abundant protein that can help prevent needless suffering. Some great options include lentils, chickpeas, black beans, edamame, or peas. By incorporating a variety of these protein-rich plants into your daily meals, along with other plant-based protein sources like nuts, seeds, and whole grains, you can easily choose compassion over cruelty. It's not just about food – it's about making a change in the lives of factory animals.

Day 7: Affordability Highlight: Plant-Based on a Budget

Control Condition. Today, we're exploring the common misconception that eating healthily means spending more. As it turns out, many plant-based proteins are not only kind to your body and tastebuds but also to your wallet. Legumes and pulses offer an affordable way to

meet your protein needs without straining your finances. Budget-friendly options like lentils, chickpeas, and beans are packed with protein and nutrients. By choosing these affordable alternatives over costly meat products, you're not just saving money – you're investing in your long-term health. Every meal becomes an opportunity to nourish your body without breaking the bank.

MRCD Condition. Today, we're exploring the common misconception that eating ethically means breaking the bank. As it turns out, many plant-based proteins are not only kind to animals but also to your wallet. Legumes and pulses offer an affordable way to meet your protein needs without contributing to animal suffering. Budget-friendly options like lentils, chickpeas, and beans are packed with protein and nutrients. By choosing these compassionate alternatives over costly meat products, you're not just saving money – you're making a statement against the cruel practices of factory farming. Every meal becomes an opportunity to nourish your body without the moral downside.

Day 10: Convenience Highlight: Don't Beans Take Hours to Cook?

Control Condition. Many worry that choosing plant-based protein sources might be time-consuming, but it's surprisingly convenient. Canned legumes and frozen peas are quick, nutritious protein options that require minimal preparation. By keeping your pantry stocked with these healthy staples, you can easily create balanced meals in minutes. Precooked lentils or canned chickpeas can be quickly added to salads or stir-fries, making it simple to boost your protein intake without spending hours in the kitchen. With a little planning, you can effortlessly align your meals with your busy schedule, proving that healthy eating doesn't have to be a hassle.

MRCD Condition. Many worry that choosing cruelty-free protein sources might be time-consuming, but it's surprisingly convenient. Canned legumes and frozen peas are quick,

ethical protein options that require minimal preparation. By keeping your pantry stocked with these animal-friendly staples, you can easily create compassionate meals in minutes. Precooked lentils or canned chickpeas can be quickly added to salads or stir-fries, making it simple to choose kindness over convenience foods that contribute to animal suffering. With a little planning, you can effortlessly align your meals with your values, proving that ethical eating doesn't have to be a hassle.

Appendix F

Cognitive Dissonance Thermometer

On days 1 and 10, participants filled the full 24-item version of the Cognitive Dissonance Thermometer as displayed below. On days 2 to 9, we used the 2 ad-hoc items “uncomfortable” and “in conflict” for brevity, following Devine and colleagues (2019).

Below are words that can describe different types of feelings. For each word, please indicate how much it describes how you are feeling right now by circling a number on the scale. "1" means "does not apply at all" and "7" means "applies vert' much" to how you are feeling right now. Don't spend much time thinking about each word, just give a quick, gut-level response.

	does not apply at all						applies very much
1. content	1	2	3	4	5	6	7
2. uncomfortable	1	2	3	4	5	6	7
3. angry at myself	1	2	3	4	5	6	7
4. shame	1	2	3	4	5	6	7
5. uneasy	1	2	3	4	5	6	7
6. negative	1	2	3	4	5	6	7
7. friendly	1	2	3	4	5	6	7
8. disgusted with myself	1	2	3	4	5	6	7
9. concerned	1	2	3	4	5	6	7
10. embarrassed	1	2	3	4	5	6	7
11. bothered	1	2	3	4	5	6	7
12. optimistic	1	2	3	4	5	6	7
13. annoyed at myself	1	2	3	4	5	6	7
14. frustrated	1	2	3	4	5	6	7
15. tense	1	2	3	4	5	6	7
16. disappointed with myself	1	2	3	4	5	6	7
17. happy	1	2	3	4	5	6	7
18. guilty	1	2	3	4	5	6	7
19. anxious	1	2	3	4	5	6	7
20. self critical	1	2	3	4	5	6	7
21. energetic	1	2	3	4	5	6	7
22. distressed	1	2	3	4	5	6	7
23. regretful	1	2	3	4	5	6	7
24. good	1	2	3	4	5	6	7

Appendix G

Daily Food Intake Questionnaire

Participants self-reported their dietary intake on each day of the study, after having read the daily resources and completed the cognitive dissonance questionnaire:

For each food category, please indicate how many portions you ate over the past 24 hours. Note that some of these categories may overlap (e.g., plant-based alternatives may be made out of vegetables, legumes, grains, or seeds). Please select the raw food category if you ate the item in its original form (e.g., chili with beans), and select the plant-based alternative category if you ate a processed item meant to substitute an animal-based product (e.g., bean patty).

- Cereals and Grains (e.g., bread, pasta, rice, etc.)
- Fruits and Vegetables (also includes sprouts, algae, compote, soup, etc.)
- Legumes (e.g., beans, peas, lentils), Nuts (e.g., peanuts, macadamia nuts), and Seeds (e.g., sunflower seeds, chia seeds)
- Meat (e.g., beef, pork, lamb) and Poultry (e.g., chicken, turkey, etc.)
- Fish (e.g., salmon, tuna) and Seafood (e.g., shrimp, crab, mussels, clams, fish eggs)
- Eggs and Dairy Products (e.g., milk, cheese, yogurt, cream)
- Plant-Based Alternatives to Meat and Poultry (e.g., soy-based chorizo, pea-based patty, tofu, seitan, etc.)
- Plant-Based Alternatives to Fish and Seafood (e.g., algae-based caviar, mushroom-based clams, tofu-based fish, jackfruit-based crab cakes, etc.)
- Plant-Based Alternatives to Eggs and Dairy Products (e.g., scrambled tofu, flaxseed egg oat milk, soy cream, coconut yogurt, cashew cheese, etc.)
- Sweets, Biscuits, and Pastries (e.g., candy, cookie, cake, croissant, etc.)

Appendix H

Manipulation Checks on Days 2 to 9

Given that we used 2 ad-hoc items (i.e., discomfort to measure cognitive dissonance on days 2 to 9, we ran two Mann-Whitney U tests for each day to compare cognitive dissonance levels across conditions. Results of these tests are displayed in the table below, revealing no significant differences in internal discomfort and conflict between the MRCD and control group, on any of these days.

Day		2	3	4	5	6	7	8	9
Uncomfortable									
	W	461.5	515	427.5	549.5	360	464	497.5	422.5
	p	.84	.30	.79	.11	.36	.98	.42	.19
In Conflict									
	W	402.5	451.5	434	464	394.5	468	538	394
	p	.48	.96	.87	.78	.73	.93	.14	.43