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# Dissociation of Dairy From its Animal Origin and the Role of Disgust to Reduce Dairy Consumption

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**Supplementary Materials:** Code, Data, Materials, Preregistration

## Abstract

Human consumption of cow milk dairy is detrimental to both animal welfare and maintaining climate stability. In two studies, we investigated the relationship between dairy consumption and features of cow milk associated with disgust and food rejection: its animal origin as a bodily fluid and pathogen susceptibility. Specifically, we examined whether emphasising these features through the link between cow milk and lactate would reduce willingness to consume dairy through increased disgust. In Study 1 we conducted an online experiment ($N$ = 155; between-persons) manipulating the salience of these features (reading about lactation vs. digestion in cows) and measured the effect on disgust towards cow milk and willingness to consume cow milk and derived dairy products. Compared to the digestion manipulation, the lactation manipulation significantly increased disgust towards dairy, which fully mediated a reduction in self-reported consumption willingness. Study 2 was a conceptual replication with an in-person experiment ($N$ = 76; within-persons) using the same manipulation (reading about lactation in cows) and measuring disgust towards cow milk and behavioural intentions to eat dairy milk chocolate (serving size). We found a similar increase in disgust towards dairy but no effect on milk chocolate serving size. We conclude that emphasising the bodily nature of lactation increases disgust towards cow milk, but this does not reliably decrease intended consumption.

## Keywords

dairy consumption, disgust, animal product consumption, intervention

Dairy farming is unnecessarily cruel to animals. In North America and Europe, over 40 million dairy cows (FAO, 2022) suffer dire mental and physical consequences from farming practices for human dairy consumption (e.g., Johnsen et al., 2016) including premature death. Compounding this problem, global dairy production rose 30% during 2005–2015 (FAO/GDP, 2019), and dairy consumption is projected to rise further by 1.4% annually during 2021–2031 (OECD/FAO, 2021). Humans' strong and growing appetite for dairy is somewhat surprising given the nature of the product. Dairy is an animal product, susceptible to pathogen contamination, and a bodily fluid, all of which are potent elicitors of disgust that should curb consumption (Olatunji et al., 2007; Tybur et al., 2016). Despite the apparent disconnect between consumption and disgust, the psychological mechanisms driving dairy consumption have been neglected. In these studies, we test whether disgust can act as a short-term deterrent of dairy consumption.

Disgust is a potent guide to human behaviour. One important role of disgust is to facilitate the rejection of foods that could be harmful to ingest, e.g., due to toxicity or pathogen contamination (Curtis et al., 2011; Tybur et al., 2016). Disgust towards a given food predicts reported willingness to try it (e.g., Martins & Pliner, 2006) and actual eating behaviour (e.g., Ammann et al., 2020). Furthermore, while the disgust response to a given stimulus is context-dependent, the intensity of this response varies with disgust sensitivity (Olatunji et al., 2007). Hence, foods eliciting disgust are less likely to be consumed, although the intensity of disgust elicited might vary between people.

Foods of animal origin including cow milk and derived dairy products are particularly potent elicitors of disgust. Milk is a fluid from a bodily process, which is a disgust elicitor (Curtis et al., 2011; Olatunji et al., 2007). Studies by Pliner and colleagues (i.e., Pliner & Pelchat, 1991; Martins and Pliner, 2006) showed that willingness to try novel foods (e.g., milk from an Australian walla) versus a familiar counterpart (e.g., cow milk) only decreased for animal-sourced foods compared with plant foods. This increased novelty rejection for animal products was especially the case for milk—more than meat or eggs—and was robustly correlated with higher ratings of disgust. Likewise, people typically reject the consumption of human breast milk with reference to its origin and feelings of nausea (Rozin & Fallon, 1980). This asymmetric disgust response may be due to animal products posing a larger pathogen contamination risk. Compared to pathogens affecting plants, those found in animals are more likely to infect and damage the human body. Furthermore, meat and animal products removed from the body becomes highly susceptible to such human-compatible pathogens in the absence of the immune system (Fessler & Navarrete, 2003; Tybur et al., 2016). Supporting an evolved mechanism, pairing pathogen cues (e.g., an image of an infected toe) with images of food, reduced the expected tastiness and willingness to consume meat, but not for plants nor beverages (Tybur et al., 2016). In short, milk and other animal products can be potent elicitors of disgust, in part, due to inherent contamination risks. While sterilising treatments such as pasteurisation and improved storage in modern dairy production has reduced natural pathogen risks,

large-scale dairy farming has introduced new contamination sources. Milk samples have been found to contain pathogens such as listeria, e-coli, and salmonella contracted from the farming environment; some of which can remain after sterilising treatments (e.g., Oliver et al., 2005). Thus, while the causes of contamination have changed, the pathogen risk disparity between plants and dairy products remains relevant.

Despite the link between animal products and disgust, milk (e.g., Rozin & Fallon, 1980) and meat (Piazza et al., 2015) from familiar sources are not typically perceived as disgusting. This may be due to the failure to link these products to the body of an animal. Habitual eating whereby food choices are cued by contexts rather than decision making (Neal et al., 2011) supports such dissociations. Furthermore, Kunst and Hohle (2016) showed that by explicating the meat-animal link via an image of a pork roast with a head (meat–animal link) or without (no meat–animal link), willingness to eat the roast decreased while intentions to avoid meat (vegetarianism) increased. These effects were partially mediated by increased feelings of disgust towards the roast, but this disgust was moderated by participants' general tendency to dissociate meat from its animal origin. These findings suggest that familiar meat products are not intuitively linked to their origin, potentially, undermining perceived contamination and the link to bodily processes and, in turn, that this dissociation might drive the lack of disgust. Unlike prior work, which has focused on the meat-animal link, the dairy-animal link might be importantly different. While meat and its animal source are rarely linked in media, cows are strongly associated with milk commercially (e.g., Grauerholz, 2007). Hence, it is unlikely that milk is not perceived as a product from cows. However, cows are often depicted as "milk machines" or tools as evidenced by the public's lack of awareness of the necessity of pregnancy (e.g., Pieper et al., 2016) and mother-calf separation in dairy production (see Placzek et al., 2021 for a review), a finding particularly prevalent amongst younger and less educated people. Therefore, cow milk is possibly dissociated from the bodily process of lactation within a cow, which could lead to masking of milk as a possible contaminant of animal origin and as a bodily fluid.

While the evidence reviewed indicates that disgust may be particularly well-suited to affect consumption of animal products, it may not have a lasting effect. Cross-sectionally, ethically motivated vegetarianism predicted a longer meat avoidance period (current and original motivation) and stronger convictions (original motivation only) compared to vegetarians with health-related motivations (Hoffman et al., 2013). However, depending on cognitive and contextual constraints, not all groups may be susceptible to moral arguments (Lacroix & Gifford, 2020). For these groups, disgust may be a viable alternative intervention to alter behaviour. Palomo-Vélez and colleagues (2018) demonstrated that disgust and moral messages were similarly effective at reducing a range of meat intake beliefs such as perceived tastiness and willingness to buy compared to health and environmental messages. Yet, only disgust messages also served to increase perceived tastiness and willingness to buy for vegetables. Disgust messages were also the most

effective to facilitate intention to take action to improve welfare for farmed fish (e.g., signing a petition or stopping consumption); a group of animals unlikely to gather moral concern (Humane League, 2021). Thus, while disgust effects on consumption may not be as long-lasting as moral arguments, it may be a useful intervention in non-moralising groups and increase willingness to consume animal product alternatives.

## The Current Studies

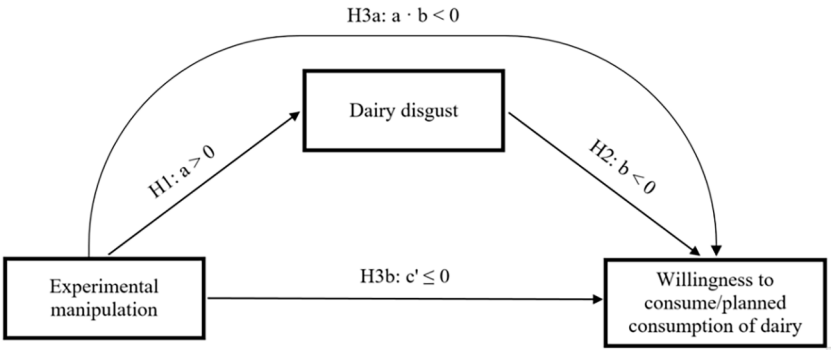
Human dairy consumption is rising and causes harm to millions of dairy cows. The current studies seek to test psychological mechanisms in dairy consumption by examining whether emphasising cow milk as a bodily product reduces intended and planned dairy consumption via disgust. Bodily fluids and animal products from uncommon sources have been linked to increased feelings of disgust and reduced willingness to consume them. However, cow milk and familiar meat products are not typically perceived as disgusting or inedible. There is evidence that dissociating meat from its animal origin reduces the perceived disgustingness of meat and that emphasising this link decreases willingness to eat meat via increased disgust. However, research has neglected whether a similar process is at work for dairy. In two studies, cow milk and its link to lactation and pathogen contamination are manipulated to test the mediating role of disgust on reported willingness to consume (Study 1) and planned consumption (Study 2) of dairy products.

Across these studies, we preregistered the following hypotheses (see Figure 1) on the Open Science Framework (OSF; see Pedersen & Loughnan, 2023):

> Increased salience of the milk-lactation link (experimental manipulation) will increase feelings of disgust towards dairy products/milk (**H1**).
>
> Feelings of disgust towards dairy products/milk will be negatively associated with reported willingness to consume and planned consumption of dairy products/milk (**H2**).
>
> Feelings of disgust towards dairy products/milk will mediate a negative relationship between the salience of the milk-lactation link (experimental manipulation) and reported willingness to consume and planned consumption of dairy products/milk (**H3**).

**Figure 1**

*Hypothesised Relationships*




# Study 1

In Study 1, we investigated whether linking dairy to its animal origin as a product of lactation in cows reduced reported willingness to consume dairy products from cow milk, using an online experiment. We also examined the mediating role of increased feelings of disgust towards dairy.

## Method

### Power Analysis

According to an *a priori* power analysis with the WebPower package (v0.6) in R (v4.1.2), 145 participants would provide .8 (α = .05) power to detect an indirect mediation effect of disgust towards dairy of -.14 (see Figure 1; standardised a = .25; standardised b = -.55). The standardised path coefficients were determined from Study 2B in Kunst and Hohle (2016) and adapted to reflect that the stimuli of the present study targeted disgust unlike Kunst and Hohle (2016) and other differences including the number of tested mediators.

### Participants

The final sample size, $N$ = 155; $M_{age}$ = 31.2, $SD_{age}$ = 12.4; $N_{male}$ = 41 (26%); all demographics in Table S1 of the Supplementary Materials (see Loughnan & Pedersen, 2024), met the recommendation of the power analysis. Participants were recruited via the student research participant pool and compensated with course credits and via social media promotion ($N$ = 81; mean response time = 8 minutes and 16 seconds), and via Prolific ($N$ = 75; mean response time = 6 minutes and 45 seconds), compensated £0.8 (£8.35/hour for the average response time). Forty-three participants were excluded (initial $N$ = 198) by pre-registered criteria: incomplete responses ($N$ = 29), failed one or both attention checks

($N$ = 11), highly influential on model estimation ($N$ = 1; see Results section) or $N \leq 15$ for reported gender identity ($N$ = 2).

## Design

The present study used a pretest–posttest experimental design where outcome variables (reported willingness to consume dairy and disgust towards dairy) were measured before (pre-measure) and after (post-measure) a between-person experimental manipulation of the salience of the dairy–lactation link operationalised as two information sheets about cows (high salience: lactation; control: digestion, see Materials and Procedure).

## Materials and Procedure

Study 1 was conducted online via Qualtrics. All materials including the complete survey are available on OSF (Pedersen & Loughnan, 2023). First, participants completed the Dairy Commitment Scale (DCS; adapted from the Meat Commitment Scale; Piazza et al., 2015) to measure the openness to change dairy consumption behaviour and control for centrality and volume of dairy in participants' diet. The DCS was completed first to mitigate the experimental manipulation influencing the responses. They then read a brief information sheet with neutral information about cows. This provided information unrelated to bodily processes, lactation, pathogens, and farming; it described typical characteristics and species. Participants' comprehension of this information was evaluated using a multiple-choice (three response options) question: "What is the most common species of cattle in the UK?".

Then participants rated how disgusted they felt about consuming cow milk, hereon dairy disgust, and how likely they were to consume it in the future (pre-measures). Dairy disgust was measured with a 3-item scale adapted from Horberg et al. (2009): How "grossed out", "disgusted" and "queasy, sick to my stomach" they felt at the thought of consuming cow milk on a 5-point Likert scale (1 = not at all; 5 = a great deal). Reported willingness to consume dairy was measured with two items on 100-point sliding scales: valence of consuming cow milk in the future (0 = extremely negative; 100 = extremely positive; adapted from Kunst & Hohle, 2016) and likelihood to reduce cow milk consumption (0 = extremely unlikely; 100 = extremely likely; reverse-scored).

Participants were then randomly assigned to read one of two additional information sheets describing cows' bodily process of digestion or lactation and the involvement of pathogens in these processes. This was intended to frame cows as either an animal with bodily processes unrelated to lactation, or an animal that produces milk via the bodily process of lactation during and after pregnancy. The digestion condition controlled for disgust towards dairy from its association with an animal with any bodily process or potential pathogens. An additional comprehension check was administered for the relevant information sheet. Participants in the digestion condition answered: "What role do bacteria and fungi have in the digestion process?", and in the lactation condition,

they answered: "What is the typical source of bacterial contamination of raw milk?". Then, dairy disgust and willingness to consume dairy post-measures were collected. An attention check item was embedded in the dairy disgust post-measure scale.

Finally, the following demographic information was collected: age and highest completed or current education level, both of which have been negatively correlated with unawareness of pregnancy for lactation in cows (Pieper et al., 2016), and gender as females report higher levels of meat disgust, which may generalise to dairy (Kubberød et al., 2002). Participant gender was collected as preferred pronouns (she/her; he/him; they/them) to reduce the number of levels while maintaining inclusivity. We also measured individual-level food disgust sensitivity with the 8-item abbreviated version of the Food Disgust Scale (FDS-short; Egolf et al., 2019), which included a second attention check item.

### Planned Analysis

Our pre-registration provides complete details of the analysis plan including packages and software used (Pedersen & Loughnan, 2023). Observations were excluded if they met any of the following criteria: (a) the response was incomplete, (b) demographic variables contained "prefer not to say", (c) attention checks were not passed, (d) the reported gender identity constituted less than 15 observations, or (e) if it was considered highly influential determined by its Cook's distance. The experimental manipulation (reference: digestion), performance on the comprehension check (reference: answered both correctly), and gender (reference: female) were dummy-coded. Responses to the items of pre-measure willingness to consume dairy, post-measure willingness to consume dairy, pre-measure dairy disgust, post-measure dairy disgust, and DCS were aggregated into separate composite scores via unrotated, 1-component principal component analyses (PCAs). Before generating composite scores, the internal consistency of these measures was evaluated with Cronbach's $\alpha$. Following Egolf et al. (2019), FDS-short was scored by averaging item responses.

A path mediation model was fitted to test the hypothesised relationships in Figure 1. The variables predicting post-measure dairy disgust score included experimental manipulation, comprehension, pre-measure dairy disgust score, FDS-short score, DCS score, and demographic variables. The variables predicting post-measure willingness to consume dairy score were experimental manipulation, comprehension, pre-measure willingness to consume dairy score, DCS score and demographic variables. The significance ($\alpha = .05$) of individual path coefficients including the direct effect (c' in Figure 1) was evaluated with Wald-tests (i.e., z-tests). The significance of the indirect effect ($a \cdot b$ in Figure 1) and the total effect ($a \cdot b + c'$) was evaluated with 95% confidence intervals from 5,000 resample bootstraps due to potential non-normality from multiplication of coefficients.

## Results

Assignment between experimental conditions was approximately equal (lactation: $N$ = 78; digestion: $N$ = 77). FDS-short items, DCS items, pre-manipulation dairy disgust items, and pre-manipulation dairy consumption willingness items were aggregated as planned (Cronbach's αs ≥ .69) We deviated from our planned separate PCA-scoring of the post-manipulation measures of dairy disgust and dairy consumption willingness. Instead, we PCA-scored items of these measures using the item pre-manipulation means and PCA weights. The planned strategy put the pre- and post-manipulation measures on separate, non-aligned numerical scales (see Change to Scoring Scheme in the Supplementary Materials; Loughnan & Pedersen, 2024). The Supplementary Materials provide item-level statistics for each composite variable[1], results and support for each PCA[2], and variable-level statistics[3].

Figure 2 illustrates the pattern of mean (diamond shapes) and distributional changes before and after the experimental manipulation for each condition. The pattern of effects conformed with our hypotheses; both conditions increased dairy disgust and reduced consumption willingness compared to the pre-manipulation baseline, but seemingly more so in the lactation condition than the digestion condition.

Table 1 provides pairwise Spearman Rank correlations of outcome variables (pre- and post-manipulation) and dairy- and disgust-related covariates. Post-manipulation outcomes were moderately correlated with all displayed variables, except food disgust (FDS). Food disgust was moderately correlated only with dairy disgust after the experimental manipulation.

**Table 1**

*Spearman Rank Correlations Between Dairy and Disgust-Related Variables*

| Variable | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| 1. Dairy disgust score (pre) | 0.78 | -0.55 | -0.54 | -0.42 | 0.11 |
| 2. Dairy disgust score (post) | | -0.49 | -0.62 | -0.32 | 0.22 |
| 3. Dairy consumption willingness score (pre) | | | 0.87 | 0.63 | 0.08 |
| 4. Dairy consumption willingness score (post) | | | | 0.57 | -0.02 |
| 5. Dairy commitment score | | | | | 0.05 |
| 6. FDS score | | | | | |

*Note.* Spearman Rank correlations were computed due to the non-normal distributions of some of the variables.

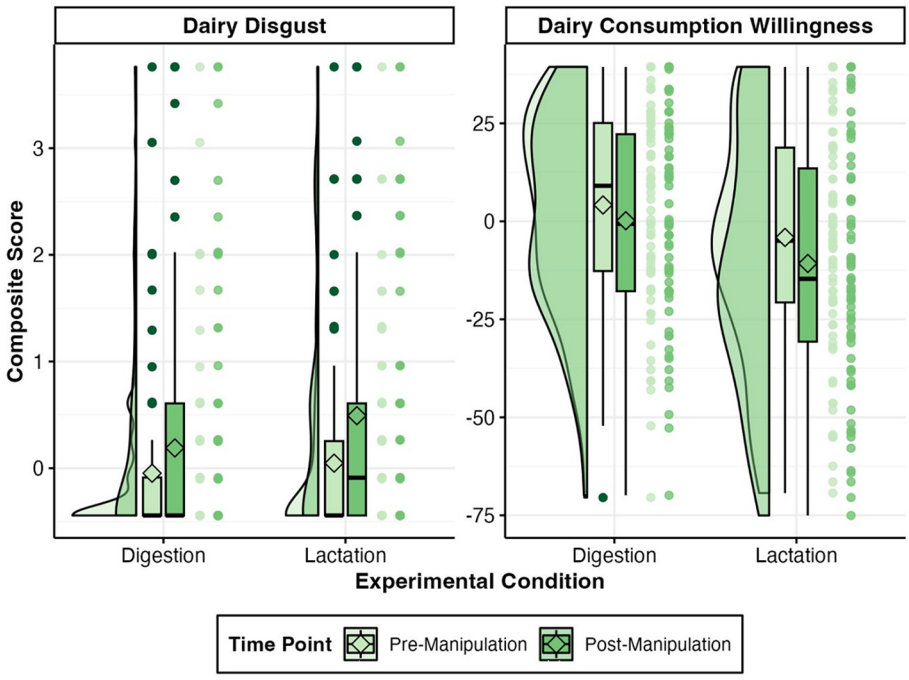
1) Marginal distributions, pairwise scatterplots and correlations, Cronbach's αs, and means and *SD*s.

2) Principal components and variance explained for single-component and full decomposition, and indications of the appropriate number of components.

3) Marginal distributions and pairwise scatterplots and correlations for continuous variables.

**Figure 2**

*Outcome Means (Diamonds) and Distributions by Experimental Condition*




*Note.* The diamonds indicate group means. Variables were mean-centred with the mean of the pre-manipulation variable. Scores are unstandardised. Each plot has individual observations (the light green dots), quartiles and range of these indicated by the boxplot (outliers in dark green), and the density of the distribution of observations.

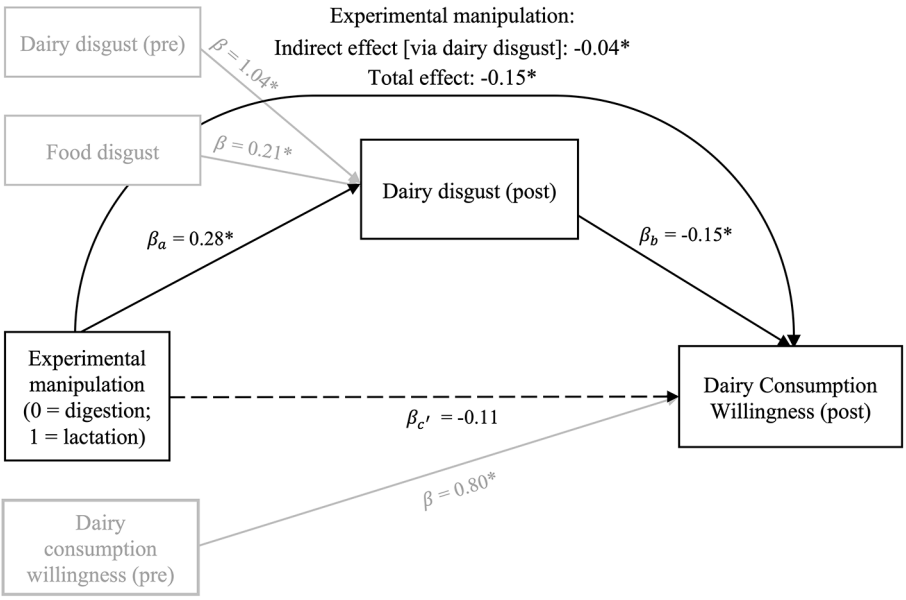
## Path Mediation Model

We excluded one additional data point (for all analyses including those above) due to its large generalised Cook's distance (gCD = 42.57; see Figure S18 in the Supplementary Materials; Loughnan & Pedersen, 2024) in the initial model fit ($N$ = 156; parameter estimates in Table S19 of Loughnan & Pedersen, 2024). The subsequent model ($N$ = 155; see gCDs in Figure S19, Loughnan & Pedersen, 2024) fit the data well (SRMR = .01; CFI = .97; see all fit indices in Table S18 in the Supplementary Materials, Loughnan & Pedersen, 2024). Figure 3 provides an overview of the significant path coefficients (all coefficients are presented in Table 2). Following the planned analysis, we evaluated all regression paths with 95% confidence intervals from 5,000 resample bootstraps due to non-normality in the variables. In line with H1, the lactation condition significantly increased post-manipulation dairy disgust beyond the effect of the digestion condition;

$\beta_a$ = 0.28, 95% bootstrap CI [0.07, 0.51]. Supporting H2, larger post-manipulation dairy disgust was associated with a significantly lower post-manipulation dairy consumption willingness; $\beta_b$ = -0.15, 95% bootstrap CI [-0.23, -0.07]. Combined, this demonstrated a significant negative indirect effect of the experimental manipulation via increased dairy disgust on consumption willingness; $\beta_a \cdot \beta_b$ = -0.04, 95% bootstrap CI [-0.09, -0.01], supporting H3a. The experimental manipulation had no remaining direct effect on dairy consumption willingness; $\beta_{c'}$ = -0.10, 95% bootstrap CI [-0.24, 0.04], falling within our hypothesised range (H3b: c' ≤ 0). Thus, post-manipulation dairy disgust fully mediated the total effect of the experimental manipulation on dairy consumption willingness; $\beta_a \cdot \beta_b + \beta_{c'}$ = -0.15, 95% bootstrap CI [-0.30, -0.003].

**Figure 3**

*Simplified Path Diagram of Mediation Model (N = 155)*




*Note.* β-coefficient subscripts denote path labels used in Figure 1. Coefficients are unstandardised but estimated with standardised variables. Grey reflects covariate paths. Non-significant covariates were omitted. Dashed lines indicate non-significant coefficients. See Table 2 for all parameter estimates.

* Significant by non-zero bootstrap 95% confidence interval.

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**Table 2**

*Parameter Estimates for Path Mediation Model (N = 155)*

| | M: Dairy disgust (post) | | | DV: Dairy Consumption Willingness (post) | | | Mediation Effects | | |
|---|---|---|---|---|---|---|---|---|---|
| **Predictor** | **Estimate** | ***SE*** | **95% CI** | **Estimate** | ***SE*** | **95% CI** | **Estimate** | ***SE*** | **95% CI** |
| Condition [lactation] | 0.28 | 0.11 | [0.07, 0.51] | -0.11 | 0.07 | [-0.25, 0.04] | | | |
| DCS | -0.04 | 0.07 | [-0.18, 0.12] | 0.04 | 0.07 | [-0.09, 0.18] | | | |
| Gender [male] | 0.003 | 0.14 | [-0.27, 0.29] | 0.09 | 0.08 | [-0.08, 0.24] | | | |
| Age | 0.01 | 0.01 | [-0.01, 0.02] | -0.01 | 0.003 | [-0.01, 0.001] | | | |
| Education | -0.03 | 0.08 | [-0.19, 0.14] | 0.07 | 0.04 | [-0.02, 0.15] | | | |
| Comprehension [animal] | -0.07 | 0.19 | [-0.45, 0.31] | 0.11 | 0.13 | [-0.15, 0.37] | | | |
| Comprehension [condition] | 0.04 | 0.27 | [-0.50, 0.55] | -0.05 | 0.13 | [-0.29, 0.21] | | | |
| Dairy disgust (pre) | 1.04 | 0.08 | [0.91, 1.22] | | | | | | |
| FDS | 0.21 | 0.07 | [0.09, 0.36] | | | | | | |
| Dairy disgust (post) | | | | -0.15 | 0.04 | [-0.23, -0.07] | | | |
| Dairy consumption willingness (pre) | | | | 0.80 | 0.07 | [0.67, 0.92] | | | |
| Indirect effect | | | | | | | -0.04 | 0.02 | [-0.09, -0.01] |
| Total effect | | | | | | | -0.15 | 0.08 | [-0.30, -0.003] |

*Note.* M = mediator. DV = dependent variable. *CI* = confidence interval. *SE* = Standard Error. Bold: significant by non-zero bootstrap 95% confidence interval.

Beyond the hypothesised relationships, food disgust significantly predicted post-manipulation dairy disgust; β = 0.21, 95% bootstrap CI [0.09, 0.36]. The pre-measures of dairy disgust; β = 1.04, 95% bootstrap CI [0.9, 1.22], and consumption willingness; β = 0.8, 95% bootstrap CI [0.67, 0.92], also strongly predicted their respective post-measures (see Table 2 for all parameter estimates and 95% bootstrap CIs). Sensitivity analyses supplied in the Supplementary Materials (Loughnan & Pedersen, 2024 supported the robustness of these results against moderately influential cases and any lack of comprehension of the study materials.

In short, we found that experimentally increasing the salience of the milk-lactation link directly increased feelings of disgust towards cow's milk (supporting H1) and that this higher disgust fully explained an overall reduction in self-reported willingness to consume cow milk (supporting H2 and H3). This pattern of effects indicates that disgust towards dairy can be evoked by inherent features of cow milk, specifically its bodily nature and pathogen contamination risks, and this reduces consumption intentions. These results match findings on the link between eating behaviour and disgust (Ammann et al., 2020; Curtis et al., 2011). They also replicate the pattern of effects found in meat-animal dissociation (Kunst & Hohle, 2016), supporting a potential psychological dissociation between milk and lactation extending the findings of meat-animal dissociation to dairy consumption. Before considering the implications for psychological theories and potential applications to interventions, we tested whether these results translate into observable changes in eating behaviour in Study 2, as predicted by research on the reflexive inhibitory effect of disgust on eating behaviour.

# Study 2

In Study 2, we replicated the findings of Study 1 in a laboratory setting using a behavioural measure of planned consumption of dairy from cow milk.

## Method

These methods have been updated to reflect the completion of the study including minor changes to the experimental paradigm to accommodate for the layout of the research facilities. The Stage 1 manuscript with the planned procedure and pre-registration are available at Pedersen and Loughnan (2023).

### Power Analysis

According to an *a priori* power analysis with the WebPower package (v0.6) in R (v4.1.2), 75 participants provided .8 (α = .05) power to detect an indirect mediation effect of disgust towards dairy of -.23 (see Figure 1; standardised a = .36; standardised b = -.64).

The increased expected effect size reflects the less strict control condition compared to Study 1.

### Participants

Our final sample, $N$ = 76; $M_{age}$ = 21.99, $SD_{age}$ = 7.95; $N_{male}$ = 20 (26%); all demographics in Table S1 of the Supplementary Materials (Loughnan & Pedersen, 2024), met the recommendation of the power analysis. From this, 28 participants had been excluded (initial $N$ = 104) due to deviation from the experimental procedure (e.g., declining the chocolate snack pre-manipulation and other instances; $N$ = 16) or participants being under 18 ($N$ = 4). Otherwise, exclusions followed pre-registered exclusion criteria (incomplete data: $N$ = 3; incomplete demographic information: $N$ = 2; failed one or both attention checks: $N$ = 2; gender identity constituted less than 15 observations: $N$ = 1). The sample was recruited through the student research participant pool (compensated with course credit) and through social media and campus advertisement (compensated £5 after completing the survey and 20-minute experiment).

### Design

Study 2 implemented a pretest–posttest experimental design where outcome variables (planned dairy consumption and disgust towards dairy) were measured before (pre-measure) and after (post-measure) a within-person experimental manipulation of the salience of the dairy-lactation link operationalised as two information sheets about cows (high salience: lactation; control: neutral; see Materials and Procedure in Study 1). The digestion control condition of Study 1 was not included to reduce the required sample size.

### Materials and Procedure

All materials and measures were the same as Study 1. Complete Study 2 materials are provided in Pedersen & Loughnan, (2023). Covariates were collected online via Qualtrics when participants signed up for the study. These included the Dairy Commitment Scale (DCS; adapted from the Meat Commitment Scale; Piazza et al., 2015), Food Disgust Scale short (Egolf et al., 2019; embedded with an attention check item), age, gender, and education level items. Participants provided a memorable, anonymous identifier to link the responses to their laboratory data.

In a private room at the laboratory, participants first read the neutral information sheet and completed the associated comprehension check and dairy disgust pre-measures on a computer delivered via Qualtrics and without the experimenter present. Then, they had been told upon arrival and were prompted by the survey to leave the room and prepare a bowl of dairy snacks (Milk Chocolate Buttons) with the experimenter, the weight (in grams) of which constituted the pre-measure of planned dairy consumption. Participants then returned to read the lactation information sheet and completed the associated comprehension check and dairy disgust post-measures (embedded with an

attention check item). Finally, they prepared another bowl of the same snack, the weight (in grams) of which constituted the planned dairy consumption post-measure.

As the procedure might reveal the purpose of the study, which might influence responses and planned consumption, the following deception was used. Initially, the experimenter explained that the study consisted of two parts; first, reading some information and answering questions about it and, second, watching a 15-minute video about caves with snacks provided. The experimenter also explained that they would prepare their snacks after the first half of the survey (i.e., the pre-measure bowl) as a break to reduce strain on attention; and that their study slot overlapped with that of another participant, who had already started the task. Lastly, the experimenter explained that they would have the snack with the movie after completing the second text in the reading task. After the participant left the room, their bowl was placed in a separate room. Upon completing the lactation information sheet and dairy disgust post-measures, participants were told that their bowl was accidentally given to another participant and asked to make another serving. After confirming that they had finished making their serving, the experimenter debriefed the participant and weighed and recorded both servings. The Supplementary Materials in Loughnan & Pedersen, 2024 provide a detailed outline of the experimental procedure for replication and clarification purposes.

### Planned Analysis

Our analysis plan was pre-registered on the OSF (Pedersen & Loughnan, 2023) and followed the procedures of Study 1. We conducted a within-person mediation analysis (procedure detailed in the pre-registration). We included comprehension, FDS-short score, DCS score, and demographic variables as covariates of the change in post-measure dairy disgust score. For change in post-measure of planned dairy consumption, comprehension, DCS score, and demographic variables were included as covariates.

## Results

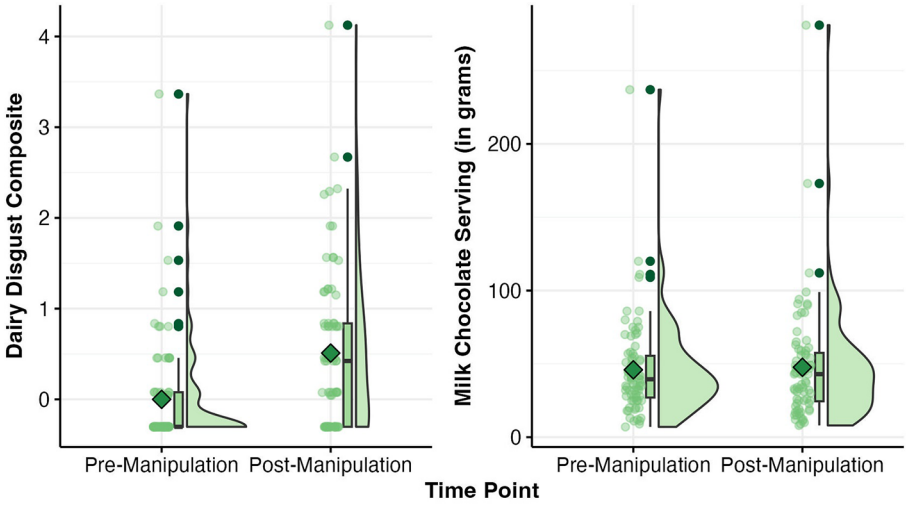
FDS-short, DCS, and pre-manipulation dairy disgust items each had reasonable internal consistency (Cronbach's $\alpha$s $\geq .67$) and were aggregated into composites. Post-manipulation dairy disgust was scored and standardised using the pre-manipulation PCA-scoring key as described in Study 1. This deviated from the pre-registered approach to maintain numerical consistency between the two measures (see Changes to Scoring Scheme in the Supplementary Materials; Loughnan & Pedersen, 2024). The Supplementary Materials provide item-level statistics for each composite variable[4], results and support for each PCA[5], and variable-level statistics[6].

4) Marginal distributions, pairwise scatterplots and correlations, Cronbach's $\alpha$s, and means and *SD*s.

Figure 4 provides an overview of the changes in the composite dairy disgust scores and milk chocolate serving sizes pre- and post-manipulation. Only dairy disgust demonstrated the expected effect; replicating Study 1, the mean (indicated by the diamond shape) increased from the lactation condition compared to the neutral condition. However, there was no visual change in planned dairy consumption behaviour.

**Figure 4**

*Outcome Means (Diamonds) and Distributions Means by Time Point*




*Note.* The diamonds indicate group means. For dairy disgust, these were centred on the pre-manipulation mean. Each plot has individual observations (the light green dots), quartiles and range of these indicated by the boxplot (outliers in dark green), and the density of the distribution of observations.

Table 3 shows pairwise Spearman Rank correlations between these variables before and after the experimental manipulation and the food disgust and dairy commitment scores. Like in Study 1, dairy disgust scores were correlated negatively with dairy commitment and positively with food disgust, especially, post-manipulation. Planned dairy consumption was not strongly correlated with pre- or post-manipulation dairy disgust, but somewhat negatively correlated with food disgust.

5) Principal components and variance explained for single-component and full decomposition, and indications of the appropriate number of components.

6) Marginal distributions and pairwise scatterplots and correlations for continuous variables.

**Table 3**

*Spearman Rank Correlations Between Dairy and Disgust-Related Variables*

| Variable | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| 1. Dairy disgust score (pre) | 0.68 | -0.09 | -0.12 | -0.20 | 0.12 |
| 2. Dairy disgust score (post) | | -0.10 | -0.16 | -0.28 | 0.23 |
| 3. Chocolate weight (pre) | | | 0.85 | 0.09 | 0.29 |
| 4. Chocolate weight (post) | | | | 0.03 | 0.25 |
| 5. Dairy commitment score | | | | | -0.06 |
| 6. FDS score | | | | | |

*Note.* Spearman Rank correlations were computed due to the non-normal distributions of some of the variables.

## Path Mediation Model

Before estimating the model, we downscaled age (1 unit = 10 years) and serving size (1 unit = 100 g) to reduce deviance in the magnitude of variances. The final model had no influential observations excluded (see gCDs in Figure S23 of the Supplementary Materials; Loughnan & Pedersen, 2024) but fit the data poorly (SRMR = .09; CFI = .39; see Table S22 for all fit indices; Pedersen & Loughnan, 2023). This indicated that the hypothesised mediation structure was unsuited for the data and that the model parameter estimates might not account for and provide valid inferences about the patterns in the data. Therefore, these results are reported in the Supplementary Materials (Loughnan & Pedersen, 2024) with 95% bootstrap confidence intervals (see Table S23 and Figure S22 in the Supplementary Materials; Loughnan & Pedersen, 2024) due to non-normality. Sensitivity analyses supplied in the Supplementary Materials (Loughnan & Pedersen, 2024) supported that the poor fit of the mediation model was not an artefact of poor comprehension of the manipulation, moderately influential values, or overfitting with covariates. Below, we provide the results of alternative statistical tests.

## Alternative Testing of Hypotheses

The parameter estimates of the path model were not in line with our hypothesised mediation structure (see Figure 1). However, given the unreliability of its estimates for insights into the actual pattern of the data, we conducted additional tests of the marginal effects of the manipulation on dairy disgust and on planned dairy consumption behaviour as well as whether changes in dairy disgust score were correlated with changes in planned dairy consumption. In line with H1, a paired Wilcoxon signed rank test showed that dairy disgust significantly increased after reading the lactation information sheet ($W$ = 0, $p$ < .001). However, the mean milk chocolate serving size was unaffected by the experimental manipulation ($W$ = 1,324, $p$ = .635), indicating no total effect to mediate

and failing to support H3. Likewise, inconsistent with H2, there was no correlation between the change in dairy disgust and change in planned dairy consumption from the manipulation (Spearman $r$ = -0.08, $p$ = .512) where change was computed as the difference between the pre- and post-manipulation measures.

Overall, Study 2 demonstrated that highlighting the bodily nature and pathogen susceptibility of dairy increased reported feelings of disgust. It also suggested a disconnect between this immediate disgust response and planned dairy consumption as participants did not decrease their chocolate servings post-manipulation. Seemingly, these findings are not in line with the proposed dissociation account of dairy from its bodily origin.

## General Discussion

Extensive human dairy consumption harms millions of cows and exacerbates the climate crisis. This research examined the psychological processes involved in dairy consumption and sought to understand the disconnect between the public's large appetite for milk and milk products, and the disgust-eliciting properties of cow milk as a lactate susceptible to pathogens. We tested whether highlighting the inherent link between cow milk and the bodily process of lactation would deter reported willingness to consume cow milk (Study 1) and planned milk chocolate consumption (Study 2) through increased disgust towards dairy. Study 1 supported our hypotheses; we found that experimentally increasing the salience of the milk-lactation link directly increased feelings of disgust towards cow milk relative to a control bodily process (supporting H1). This heightened disgust response fully mediated an overall reduction in willingness to consume cow's milk (supporting H2 and H3). In Study 2, we replicated the increase in disgust towards dairy relative to participants' baseline (consistent with Study 1 and H1). However, we found no effect on milk chocolate serving size (inconsistent with H2 and H3). Combined, the results indicate a deviance in dairy consumption willingness measured by self-report and behaviour. These findings provide initial insights into the psychological mechanisms driving and maintaining dairy consumption and have important implications for intervention development.

We found that emphasising dairy's bodily nature and pathogen contamination risks increased reported disgust towards cow milk across Study 1 and Study 2. However, this enhanced disgust response only mediated a decrease in self-reported willingness to consume dairy (Study 1). We found no change in the planned eating behaviour of milk chocolate (Study 2). This difference between self-reported intentions and behaviour aligns with the well-documented intention-behaviour gap evidenced across contexts including eating habits (see Webb & Sheeran, 2006 for a review). However, this line of research typically examines goal-oriented behaviour change. In contrast, the present research examined disgust-motivated food rejection (e.g., Ammann et al., 2020). We initially argued that this is a reflexive aversion to objects of disgust, which may differ

from effortful behaviour change (e.g., when morally motivated; Couture & Loughnan, in press). Despite these differences, our results match the intention-behaviour gap observed for goal-oriented behavioural change.

One possible explanation is that we did not capture the type of disgust that we hypothesised. Studies on consumption aversion towards stimuli contaminated with disgust-elicitors (e.g., Ammann et al., 2020) typically assess actual or intended consumption as a measure of disgust rather than self-reported feelings of disgust. Self-report measures of disgust may capture other negatively valanced emotions (Piazza et al., 2018) or demand characteristics (Ammann et al., 2020). Consequently, the measured increase in disgust from the milk-lactation link salience might have been more reflective or cognitive in nature (i.e., 'I should be disgusted by that') rather than the reflexive aversion response that we targeted. This interpretation could explain the difference in results of Study 1 and Study 2, and how this occurred despite an increase in self-reported disgust towards dairy across studies. It is also in line with previous intervention comparison studies, which demonstrate that disgust- and morally-focused interventions have seemingly similarly sized effects on self-report outcomes related to meat (Palomo-Vélez et al., 2018) and fish (Humane League, 2021) consumption. In short, linking milk to its bodily origin may not induce a reflexive aversion to dairy products, but might rather affect intentions and induce a reflective increase in disgust, similar to interventions targeting effortful behaviour change.

Our findings are somewhat compatible with a dissociation account. We hypothesised that the dissociation account proposed in the context of meat consumption (Benningstad & Kunst, 2020; Kunst & Hohle, 2016) may be adapted to dairy consumption: dissociating dairy products from their biological origins aids consumption by suppressing feelings of disgust. In turn, disrupting the dissociation by linking cow milk to its bodily origin should reduce consumption. In Study 1, we found precisely this effect on consumption intentions, extending the effect beyond meat to encompass other animal products. In Study 2, we found that increased disgust did not translate into changes in behaviour. This finding is interesting, as previous work in the meat context has stopped short of looking at consumption behaviours (Benningstad & Kunst, 2020), future work should examine meat-eating behaviour. Such research may be especially important given the recent challenges to meat-animal dissociation (e.g., Possidónio et al., 2022).

## Limitations and Future Directions

The present research conducted a large online experiment and a smaller laboratory experiment to balance strengths and weaknesses across approaches. Across these studies, we found both convergent and divergent results. The disparity between the outcomes of Study 1 and Study 2 may be caused by study-specific limitations. One possibility is that the observed deviance between intentions and behaviour occurred because milk chocolates are an atypical dairy product and thus the disgust-eliciting properties of cow milk

targeted by the experimental manipulation may have failed to generalise (see Heit, 2000). Consequently, it is unclear if the experimental manipulation would affect behaviour in the context of consumption of dairy products that were more closely associated with cow milk, e.g., milk, yoghurt, or cheese. To investigate this, future research may replicate Study 2 with a more typical dairy product (e.g., lunch box cheese snacks). A different kind of deception than movie watching may be more appropriate for these kinds of dairy products. The conclusions of this research are limited by the potentially atypical target of dairy consumption; future research should replicate our findings using a more typical product.

In the context of interventions to deter dairy consumption, inducing feelings of disgust remains a promising pathway. The lactation information sheet used in both studies mostly described disgust elicitors related to the bodily origin of cow milk to test the proposed milk-lactation dissociation hypothesis. In an intervention context, a manipulation targeting external contamination factors, e.g., faecal contamination risks (Oliver et al., 2005), may be more effective. Intervening with such external contaminators has been shown to reduce willingness to consume specific foods (e.g., faecal contamination of chocolate; Ammann et al., 2020). Future research may investigate if a stronger emphasis on external disgust elicitors such as faecal contamination risks would be more effective than the intervention of the present research.

## Conclusions

The strong human appetite for dairy is unnecessarily cruel to dairy cows while accelerating the process of climate change. In two pre-registered studies, we tested if previous findings from meat-eating would extend to dairy consumption and could inform interventions to reduce it; i.e., whether highlighting the disgust-eliciting features of cow milk by linking cow milk to lactate, would deter dairy consumption by increasing disgust towards it. We found mixed support; increased salience of the dairy-lactation link reduced self-reported willingness to consume dairy mediated by increased disgust (Study 1). We replicated this rise in disgust in Study 2, but we did not find a corresponding decrease in behavioural intentions to consume dairy products (Study 2). Our results align with prior work on meat-dissociation, showing that they might expand to other areas of animal product consumption and point to important limitations for actual consumption behaviour. Reminding consumers of the bodily elements of dairy production may be a promising avenue for reducing the consumption of a product all too easily dissociated from its animal origin.

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**Competing Interests:** The authors have declared that no competing interests exist.

**Data Availability:** The preregistration of Study 1 and 2, data for Study 1 and 2, code for Study 1 and 2, and materials for Study 1 and 2 are available at Pedersen and Loughnan (2024).

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