A “vegetarian curry stew” or just a “curry stew”? - The effect of neutral labeling of vegetarian dishes on food choice among meat-reducers and non-reducers

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A “vegetarian curry stew” or just a “curry stew”? - The effect of neutral labeling of vegetarian dishes on food choice among meat-reducers and non-reducers

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ABSTRACT

Encouraging meat eaters to eat more vegetarian foods benefits public health and environment. This study examined whether changes in menu design, specifically in the labeling of a dish, increases vegetarian food choice. In an online survey experiment involving a representative sample of Danish meat eaters (n = 955) we investigated the frequency with which dishes are chosen when they have a neutral vegetarian label (with no explicit indication that the dish does not contain meat), an explicit label (as vegetarian, meat-free, vegan, or plant-based), or a label referring to meat. We also examined the role of individual characteristics of the diner (food neophobia, meat-eating identity, meat intake and ethical concern). We found that neutral labeling outperformed explicit labeling among all meat eaters (neutral 17%, meat 10%, explicit labels 5%–7%) and in two sub-groups, namely, non-reducers (who are not actively reducing their meat intake: explicit 3.4%, neutral 10.2%) and meat-reducers (explicit 14.4%, neutral 30.1%). We found no significant differences between the four explicit labels. We show that non-reducers with low meat-eating identity can be nudged to choose a neutrally labeled vegetarian dish, and that, among ethically concerned meat-reducers, the vegetarian dish is chosen more often when the dish is neutrally rather than explicitly labeled. Finally, we show that meat-avoiders (additional convenience sample, n = 148) were as likely to choose a neutrally labeled vegetarian dish as an explicitly labeled one. Our results suggest that neutral labeling sidesteps reactance and moral licensing effects in both meat-reducers and non-reducers, and that food outlets with meat-eating customers should carefully consider their use of explicit labeling and use neutral labeling for vegetarian dishes where possible.

1. Introduction

1.1. Problem statement

Excessive levels of consumption of meat is a public health risk for non-communicable diseases (Afshin et al., 2019) and places a burden on the environment (Poore & Nemecek, 2018). A shift is needed toward more healthy and sustainable diets which involve limited intake of meat. However, it remains unclear how this behavioral shift can be promoted most effectively (Bianchi et al., 2018; Garnett et al., 2015). Information campaigns that aim to increase awareness and change values are the traditional way of promoting sustainable and healthy diets (Marteau, 2017; Marteau et al., 2012). However, many eating decisions are based on “mental shortcuts” and habitual behavior rather than rational decision-making (Byerly et al., 2018; Tversky & Kahneman, 1974).

Given this, choice architecture interventions utilizing the automaticity of behavior could be a promising means of promoting meat reduction where information campaigns fall short. Such interventions are typically arranged in food outlets. Examples include offering a vegetarian menu as the default menu (Campbell-Arvai et al., 2014), changing the physical position of vegetarian dishes (Kurz, 2018) or reduce the amount of meat on a dish (Reinders et al., 2017).

1.2. Menu design & labeling interventions

The main intervention examined in this study is menu design, and specifically manipulating the labeling of a vegetarian dish on a menu. Menus are used in food outlets, where meat consumption is typically high
Most of the existing labeling interventions focus on promoting healthy food choices (Raghunathan et al., 2006; Turnwald et al., 2017, 2019; Wagner et al., 2015) or organic food choices (Poelman et al., 2008; Schultd & Hannahan, 2013). Labeling interventions to reduce meat consumption are more limited and enjoy variable success. Bianchi and colleagues conducted a systematic review of interventions that aim to reduce the demand for meat. They found that only one in five labeling interventions were effective in reducing meat consumption (Bianchi et al., 2018). More recent studies have given mixed results (Bacon et al., 2018; Krpan & Houtsma, 2020; Vennard et al., 2019). However, some patterns are beginning to emerge. The more successful intervention studies have compared indulgent labels (Bacon et al., 2018), neutral labels (i.e. those not explicitly stating via the name of a dish that it is vegetarian) (Krpan & Houtsma, 2020), or labels that highlight social/environmental benefits (Krpan & Houtsma, 2020), with explicitly vegetarian framing/labels (i.e. labeling a dish as “vegetarian”), or as “meat-free” or similar, and thus emphasizing the absence of meat. In all instances, explicit labeling reduced the consumer’s propensity to choose the vegetarian option. Intervention studies with no, or limited, effect compared indulgent labels, labels highlighting social/environmental benefits, and neutral labels with one another (Bacon et al., 2018; Papiets et al., 2020; Vennard et al., 2019). This indicates that it is the explicit labeling that is the barrier to choosing a vegetarian dish. This conclusion is supported in studies of healthy eating behavior. Wagner et al. (2015) compared an explicitly healthy label with a “subtle health label” (where subtle is comparable to neutral labeling), and found that healthy snack choice was higher with the subtle label (Wagner et al., 2015). In another study, vegetable intake increased when it was labeled neutrally or subtly is comparable to neutral labeling), and found that healthy snack choice was higher with the subtle label (Wagner et al., 2015). In another study, vegetable intake increased when it was labeled neutrally or implicitly as compared with explicit health labels (Turnwald et al., 2019). On the other hand, some explicit labels may promote plant-based dishes better than others. Thus, vegetarian and vegan menu items offered in a restaurant on a university campus were more likely to sell as plant-based (Rosenfeld et al., 2022).

This paper focuses on neutral labeling as a means of increasing the likelihood of vegetarian food choice. Neutral labeling could be an important tool, because it may not always be possible to apply indulgent labeling (e.g. when all menu dishes are described appealingly) and because consumers have conflicting values (not everyone will be attracted by similar arguments referring, for example, to social/environmental benefits).

We will use the term “neutral” labeling in a way that aligns conceptually with a recent, similar study by Krpan and Houtsma (2020). A difference between “subtle” labeling, as used in Wagner et al. (2015), and “neutral” labeling, as used in Krpan and Houtsma (2020), is that the former uses non-semantic logo or lettering to indicate the vegetarian character of a dish (e.g. $V$, or VG, or a green tick mark), while neutral labeling does not signal information in this way. Instead there is, for instance, an asterisk with information elsewhere on the menu card that the meal is (also) suitable for vegetarians.

Like Rosenfeld et al. (2022), we will examine whether certain explicit labels increase the likelihood of vegetarian food choice in comparison with other explicit labels, while also comparing the performance of explicit labeling and neutral labeling.

1.3. This study’s focus

Studies of labeling interventions to reduce meat consumption are still limited and vary in outcome. More research is needed to determine whether and how the interventions affect vegetarian food choice. It is important, moreover, to understand and improve the effectiveness of interventions across different consumer segments and in relation to consumers’ differing past experiences and priorities. We aim to do this by distinguishing two main consumer segments: consumers who already have reduced their meat intake (i.e. “meat-reducers” or “flexitarian”) and consumers who have not done so (“non-reducers”), and by focusing on individual traits/behaviors.

We developed the following research questions: (RQ1) Does neutral labeling increase vegetarian food choice among meat eaters compared to explicit labeling? (RQ2) Is the effect (if any) different for non-reducers and meat-reducers? (RQ3) Are there differences between various explicit labels? (RQ4) Does neutral labeling affect vegetarian choice negatively among meat-avoiders? (RQ5) Are individual traits/behaviors (food neophobia, meat-eating identity, meat-eating habits and ethical concern) associated with the effectiveness of labeling?

This online study contributes to the existing research as follows. First, we include a study sample that is representative of the wider population, in our case Danish consumers. Second, we also investigate the performance of several explicit labels (plant-based, meat-free, vegetarian, and vegan), and compare them with the neutral counterpart. This is important, since restaurants, cafés, canteens and other outlets have many options as regards wording signaling that a dish does not contain meat. It has been demonstrated that some meat-free labels work better than others among university students (Rosenfeld et al., 2022). The study results will help us to ascertain whether some kinds of explicit label can be recommended, or whether explicit labeling is in general less successful in the general population. Third, we compare the propensity to choose a vegetarian dish when it is labeled explicitly, and when it is labeled neutrally, with the propensity to choose a meat dish that is labeled as meat. This enables us to evaluate how often a neutrally and explicitly labeled vegetarian dish will be chosen as compared with meat versions of the same dish. Fourth, we check whether neutral versus explicit labeling has a potentially negative effect on meat-avoiders (since if it does, that may be an argument for continuing to use explicit labels). Lastly, we assess whether neutral labeling impacts different meat consumer segments differently.

1.4. Theoretical framework and hypotheses

The labeling of a dish acts as a cue to consumers about what to expect of the taste of the food (Wansink & Love, 2014) and its characteristics and quality (Lo et al., 2017). These cues can be deliberately altered to steer (or “nudge”) decisions in a certain direction (Byerly et al., 2018). Neutral versus explicit labeling may lead to different individual processing (Ensaff, 2021), and contrasting expectations of a dish, and increase or decrease the likelihood of a dish being chosen.

We expected neutral labeling to be effective as a nudge increasing vegetarian food choice. As eating behavior is steered by cues and past behavior (Mullan & Novoradovskaya, 2018), it is likely that when a certain dish is preferred and chosen by consumers earlier, it will be more likely to be chosen in future situations on the basis of the name of the dish alone (e.g. lasagna, curry) without any particular attention being given to whether the dish contains meat. Conversely, explicit labeling makes the vegetarian characteristic of the meal more salient. This may lead to the rejection of vegetarian dishes for several reasons.

First, among the most dedicated and frequent meat eaters, explicit labeling can be used as exclusion criterion (see Krpan & Houtsma, 2020; Parkin & Attwood, 2021) when menus are being scanned. These consumers may reject the food simply due to its lack of meat. Second, highlighting that a dish is vegetarian may cause reactance. Reactance is a feeling by consumers that they are being pushed towards a certain...
choice and are threatened in their freedom of choice, and that as a result they will opt for the opposite (Brehm, 1966; Wagner et al., 2015). In effect this reduces the likelihood of the vegetarian dish being chosen. We believe that reactance may be especially present among non-reducers. Research has indicated that reactance responses are stronger among those for whom the topic of influence (in this case meat consumption) is important (de Vaan et al., 2019; Miron & Brehm, 2006). Third, if consumers think that they already are making an effort to reduce their meat intake, explicit labeling of a dish as vegetarian may lead to rejection of the vegetarian dish through moral licensing. Moral licensing is defined as a behavior that is perceived as problematic/immoral by the individual, but where the behavior is nevertheless undertaken because he/she has acted unproblematic earlier (Blanken et al., 2015; Merritt & Effron, 2010). One study has suggested that moral licensing could be in play among consumers who eat many vegetarian meals, as these consumers were less prone to choose vegetarian foods when they were made more salient on the menu (Bacon & Krapan, 2016).

For these reasons, and following the findings from earlier studies (Krapan & Houtuma, 2020; Wagner et al., 2015), for RQ1 and RQ2 we expect a neutral label to increase the choice of a vegetarian dish in all meat eaters; and we expect the largest positive effect of neutral labeling to be observed in non-reducers.

Where RQ3 is concerned, we assume that neutral labeling may cancel, or reduce, the three negative effects of explicit labeling mentioned above through a number of individual differences in traits and behavior. We outline this in the hypotheses set out below.

Explicit labeling may discourage choice of vegetarian dishes because the mere mention of the word “vegetarian” (or similar words) sounds unfamiliar or offputtingly novel. Fear of eating unfamiliar, novel or exotic foods can be assessed through food neophobia (Pliner & Hobden, 1992). While food neophobic reactions can occur in all meat eaters, the reaction may be strongest in non-reducers, as they tend to be more food neophobic than meat-reducers (Hielkema & Lund, 2021) and have less experience with vegetarian foods. In short: we hypothesize: (H1) Higher levels of food neophobia are negatively associated with the likelihood of choosing an explicitly labeled vegetarian dish.

Previous literature has also indicated that past eating behavior influences the effectiveness of labeling (Bacon & Krapan, 2018). Habits are a strong predictor of eating behavior (van’t Riet et al., 2011), and an even stronger predictor of meat consumption than having an intention to reduce meat intake (Rees et al., 2018). Explicitly labeled vegetarian dishes are therefore more likely to be rejected by frequent eaters of meat. We therefore hypothesize: (H2) More frequent meat intake is negatively associated with the likelihood of choosing an explicitly labeled vegetarian dish.

Previous research indicates that consumers prefer to match their eating behavior and self-identification, i.e. that, as a consumer, I behave as “people like myself” do (de Boer et al., 2017; Esaaff, 2021; Oyserman et al., 2014). Some meat eaters may feel they do not belong to the in-group of vegetarians (Rosenfeld & Burrow, 2018), in which case explicit labeling may indicate that the food is not appropriate for them. This may be more salient in non-reducers, where the propensity to identify with one’s meat-habit behavior will be stronger (Verplanken & Orbell, 2003). Thus we hypothesize: (H3) Higher levels of meat-eating identity are negatively associated with the likelihood of choosing an explicitly labeled vegetarian dish.

Previous research has shown that willingness to eat less meat is higher among consumers who value care for nature (de Boer et al., 2013) and who are more environmentally concerned (Wang & Scrimgeour, 2021). A recent study found that consumers who are more environment-conscious reacted more positively to sustainability information when choosing a dish from a menu (Remar et al., 2021). These findings suggest that explicit labels could attract ethically concerned meat eaters. Our last hypothesis is therefore: (H4) Higher levels of ethical concern when making food choices are positively associated with the likelihood of choosing an explicitly labeled vegetarian dish.

2. Methods

2.1. Respondents

Data were collected through an online questionnaire in September and October of 2019. Beforehand, we obtained ethical approval from the ethical committee at the Faculty of Science, University of Copenhagen. Other results from the questionnaire have been published (Hielkema & Lund, 2021). We contracted a survey company to collect the data using an online panel. We ended with a sample size of 1005 with a response rate of approximately 16%. In the present analysis we focus on the subgroup of respondents who identified as meat eaters (n = 955).

Demographic characteristics of the sample are shown in Table 1. The sample deviated slightly from the Danish population. For RQ1, RQ2 and RQ3 the data were weighted (see further details in Section 2.5 Analysis).

Additionally, because we were aiming to examine whether neutral labeling and explicit labeling have different impacts on the food choices of meat-avoiders (i.e. vegetarians and vegans), and whether they prefer specific explicit labels, we collected a convenience sample (n = 148) of meat-avoiders (female = 87.8%; age = 18–34 (53.4%) 35–49 (26.0%), 50+ (20.6%)). These respondents were recruited through social media in the fall of 2019.

2.2. Sensitivity analysis

The sample size was determined principally by the previously run study (Hielkema & Lund, 2021). Many similar studies use small samples (<400) (Bianchi et al., 2018). As our study had slightly below 1000 respondents, and six experimental conditions (or three when the explicit labels are merged, see below), the sample size was sufficient to allow comparison with these previous studies. We also performed a series of sensitivity power analyses to discern the effect size required to identify statistically significant associations. Specifically, we used the sensitivity analysis module in the Goodness-of-fit tests for contingency tables (X²-test family) available in G*Power v. 3.1.9.6 (Faul et al., 2007). In all analyses of the representative sample, the sample size allowed significant associations at the small effect size level, i.e. where Cohen’s w is > 0.10 and < 0.30 (Cohen, 1992) (determined at alpha = 0.05 and power = 0.80) to be detected. However, for the convenience sample (meat-avoiders) an effect size at the medium level was required in the comparison of two explicit labels at a time: Cohen’s w meat-avoiders = 0.40. See details in Supplemental file 1.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>The demographic characteristics of the sample in comparison with the Danish population, unweighted data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Sample (n = 955)</td>
</tr>
<tr>
<td>Female</td>
<td>58.3%</td>
</tr>
<tr>
<td>Male</td>
<td>41.6%</td>
</tr>
<tr>
<td>Other</td>
<td>0.1%</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
</tr>
<tr>
<td>18–34</td>
<td>31.9%</td>
</tr>
<tr>
<td>35–49</td>
<td>26.2%</td>
</tr>
<tr>
<td>50+</td>
<td>41.9%</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Primary school</td>
<td>8.2%</td>
</tr>
<tr>
<td>High school or vocational training</td>
<td>34.5%</td>
</tr>
<tr>
<td>Higher education (1–5 years), PhD</td>
<td>56.8%</td>
</tr>
<tr>
<td>Other Region</td>
<td></td>
</tr>
<tr>
<td>East Denmark</td>
<td>44.5%</td>
</tr>
<tr>
<td>West Denmark</td>
<td>55.5%</td>
</tr>
</tbody>
</table>
2.3. Design

The main outcome variable for this paper utilizes a between-subjects experimental design with six conditions in which the description (i.e. labeling) of one target dish on a menu card was systematically varied. The participants were randomly assigned to one of the six conditions. The conditions were: four explicit labeling conditions (vegetarian, vegan, plant-based and meat-free), a neutral label condition and a meat condition. Each respondent was shown one of the six menu cards and prompted with the following text “Imagine you are having dinner with a good friend at an Asian restaurant. Which dish would you want to order?” We opted for Asian cuisine, as it naturally offers both meat and vegetarian versions of the same dish. By contrast, in traditional Danish cuisine meat often is very visible and the centerpiece. The menu included four options, and respondents could also choose “none of these”. The different menus offered in the six conditions can be found in Table 2. The targeted dish was always listed as the third option to avoid a placement effect (e.g. Dayan and Bar-Hillel (2011)).

2.4. Measurements

Meat-reducers and non-reducers were identified by asking respondents if they had reduced their meat intake or had plans to do so according to the stages of change model (Prochaska & DiClemente, 1983; Prochaska et al., 1993). The answer options were: no intention to reduce meat intake, recent increase in meat intake, intention to reduce in the distant future (within 6 months), recent reduction in meat intake (within the last six months), and reduction over a longer period (more than six months). If the respondents answered that they had reduced their meat intake (i.e. one of the two last options) they were classified as meat-reducers. Otherwise they were classified as non-reducers.

Food neophobia, or fear of trying out novel foods, was measured using the traditional food neophobia scale containing ten items (examples are: ‘I don’t trust new foods’ and ‘If I don’t know what is in a food, I won’t try it’. See all items in Pliner and Hobden (1992)). We employed a translated version used in earlier Danish research (Videbæk & Grunert, 2017). The scale had acceptable reliability in this data, Cronbach’s α = .795.

(Frequency of) meat intake was measured by asking how many times per week hot meals containing beef/veal, pork or poultry were consumed. Response options here ranged from never to more than once a day. We recoded responses to indicate number of meals per week (if respondents ticked “more than once a day” we recoded it as 14). We then computed a composite variable of the three meat categories. We checked for outliers and found seven respondents who were considerably separated from the rest (i.e. they reported eating meat >30 times per week). These respondents were removed in all analyses where meat intake was included.

Meat-eating identity was measured by the following three items: “Eating vegetarian/vegan does not suit people like me”, “Eating meat feels right for me” and “I am used to eating meat”. The first two items were based on existing literature (de Boer et al., 2017; Oyserman, 2009; Rosenfeld et al., 2020). We included the last item because identity is typically formed in conjunction with behavioral repetition (Verplanken & Orbell, 2003) and to achieve higher variation. Response options were on a 7-point Likert scale ranging from 1 (totally disagree) to 7 (fully disagree) and a “do not know” option. We checked if “do not know” reflected the middle of the scale. This was not the case, so the response was treated as a missing value. Respondents with missing values (n = 100) were removed in all analysis where the variable was used. Principal component analysis returned one factor with eigenvalue>1, and the scale had an acceptable reliability, Cronbach’s α = .734.

Ethical concern when making food choices (“ethical concern”) was measured by three food choice motives asking about the importance attached to eating animal-friendly, climate-friendly and organic foods, respectively. The items were taken from the single food choice questionnaire (Onwezen et al., 2019), a recently developed single-item scale based on a lengthier original food choice questionnaire including the later-added ethical scales (Lindeman & Väänänen, 2006; Steptoe et al., 1995). We slightly adapted the scale by splitting the category environment-friendly into climate-friendly and organic, as these do not necessarily overlap. Principal component analysis returned one factor with eigenvalue>1, and the scale had an acceptable reliability, Cronbach’s α = .828.

We further recorded the following socio-demographic variables: age, gender, education and living in Copenhagen city area. See details in Table 3.

2.5. Analysis

For RQ1, RQ2 and RQ3, we weighted the data on age, gender and region using iterative proportional fitting (Dal Grande et al., 2015). We used Stata’s svy function and we report the Model F for Global tests (the analyses gave the same pattern of results when the data was weighted and unweighted). Binary logistic regression was used to test the effect of the different conditions (see Table 2) on choice of the target dish (dependent variable, DV) in the entire sample of meat eaters (n = 955). First we tested all six conditions, followed by the three main conditions (i.e. neutral (n = 146), explicit (n = 632), meat (n = 177)). Robustness checks were run to check if the results remained the same with the inclusion of the independent (control) variables: age, gender, education and living in Copenhagen. We reported Adjusted Relative Risk (ARR) as effect sizes, as this provides a more straightforward evaluation of differences between groups than Odds Ratio (OR), particularly when the outcome of interest is >10% (Zhang & Yu, 1998). For RQ2, we ran the same analyses separately for non-reducers (n = 660) and meat-reducers (n = 295).

To examine the effect of neutral versus explicit labeling on meat-avoiders we ran two chi-square tests. The first included five conditions (neutral and the four explicit labels) and the second included two conditions (neutral and combined explicit). In both analyses the choice of targeted dish (yes = 1/zero = 0) was inserted as a dependent variable. The meat condition was omitted from this analysis because the likely choice scenario for meat avoiders is to choose the targeted dish and not to choose any of the other options, since all other dishes include meat (we...
3.1. Randomization check

Differences in the socio-demographic characteristics and individual traits/behaviors of meat-reducers and non-reducers (data is unweighted).

<table>
<thead>
<tr>
<th></th>
<th>Non-reducers (n = 660)</th>
<th>Meat-reducers (n = 295)</th>
<th>Sign. Differences</th>
<th>Total (n = 955)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 18–35</td>
<td>31.4%</td>
<td>33.2%</td>
<td>2.17</td>
<td>31.9%</td>
</tr>
<tr>
<td>- 36–49</td>
<td>27.4%</td>
<td>23.4%</td>
<td>-3.17</td>
<td>26.2%</td>
</tr>
<tr>
<td>- 50+</td>
<td>41.2%</td>
<td>43.4%</td>
<td>1.83</td>
<td>41.9%</td>
</tr>
<tr>
<td>Gender, % female</td>
<td>55.7%</td>
<td>64.4%</td>
<td>3.77</td>
<td>58.4%</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- low</td>
<td>10.0%</td>
<td>6.1%</td>
<td>-3.90</td>
<td>8.8%</td>
</tr>
<tr>
<td>- medium</td>
<td>35.0%</td>
<td>33.2%</td>
<td>-1.81</td>
<td>34.5%</td>
</tr>
<tr>
<td>- high</td>
<td>55.0%</td>
<td>60.7%</td>
<td>5.71</td>
<td>56.8%</td>
</tr>
<tr>
<td>City, % lives in CPH</td>
<td>13.6%</td>
<td>18.0%</td>
<td>4.38</td>
<td>15.0%</td>
</tr>
<tr>
<td>Meat intake(1)\</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(range 0.2–3.0, Mean (SD))</td>
<td>6.5 (4.1)</td>
<td>4.4 (3.1)</td>
<td>t (929) = 5.8 (3.8)</td>
<td>.001</td>
</tr>
<tr>
<td>Food neophobia (range 10–70, Mean (SD))</td>
<td>32.5 (9.9)</td>
<td>27.6 (8.9)</td>
<td>t (983) = 3.1 (1.0)</td>
<td>.001</td>
</tr>
<tr>
<td>Meat-eater identity(2)\ (range 3–21, Mean (SD))</td>
<td>16.0 (3.6)</td>
<td>12.0 (3.9)</td>
<td>t (853) = 14.7</td>
<td>.001</td>
</tr>
<tr>
<td>Ethical concern (range 3–21, Mean (SD))</td>
<td>11.5 (4.4)</td>
<td>14.1 (4.0)</td>
<td>t (953) = 12.3</td>
<td>.001</td>
</tr>
</tbody>
</table>

\(1\) Missing data: non-reducers (n = 640) meat-reducers (n = 291).

\(2\) Missing data: non-reducers (n = 586) meat-reducers (n = 269).

confirmed that meat-avoiders did not choose the meat dishes in additional analysis that is not reported).

To test hypotheses H1 to H4, which focus on the joint effect of labeling and individual traits/behaviors on choice of target dish, we introduced interaction effects into the binary logistic regressions. Specifically, taking the non-reducers and meat-reducers separately, we inserted the interaction between the three main labeling conditions (neutral, explicit, meat) and the following variables: food neophobia, meat-eater identity, meat intake and ethical concern when making food choices. We used hierarchical regression to determine whether an interaction was statistically significant by comparing the likelihood ratio statistic of the baseline model (only main effects) with the model that included interaction effects (where the interaction effects were included and compared one by one) using Stata’s \texttt{test} command. Interaction effects were considered significant at p < .05 level. We report the character of the interaction using Stata’s margins command where predicted probabilities are reported at three levels: 1 SD below Mean, Mean, 1 SD above Mean.

All analyses were conducted in Stata, version 17.

2.6. Characteristics of non-reducers and meat-reducers

In Table 3 we provide a descriptive overview of the different characteristics of non-reducers and meat-reducers. Non-reducers ate meat more frequently, were more food neophobic and had a higher meat-eater identity than meat-reducers. Meat-reducers were more frequently female and more ethically concerned than non-reducers.

3. Results

3.1. Randomisation check

Randomization checks using analyses of variance for continuous variables and chi-square tests for categorical variables disclosed no significant differences between the six conditions and no significant differences in the three conditions relative to the study’s variables (i.e. age, gender, education, Copenhagen area, non-reducer or meat-reducer, food neophobia, meat-eater identity, meat intake and ethical concern).

3.2. Effects of labeling on all meat eaters

Fig. 1 gives a descriptive overview of the menu choices in all six conditions. In each condition the first column (with stripes) reports the share of respondents choosing the targeted dish. Many of the apparent differences in Fig. 1 are statistically significant (Global test: F (5, 949) = 3.25, p = .007). Compared with the neutral label, a vegan label made it less likely that the targeted dish was chosen (ARR = 0.419 (0.220–0.798), p = .008). Similarly, the neutral label outperformed the other explicit labels (vegetarian: ARR = 0.427 (0.224–0.814), p = .010; plant-based ARR = 0.451 (0.234–0.872), p = .018; meat-free: ARR = 0.272 (0.125–0.591), p = .001). The likelihood of choosing the meat dish versus the neutrally labeled dish, and of choosing the explicitly labeled dish versus the meat dish, was not significantly different. The above-mentioned statistically significant differences were still present after the robustness check.

As can be seen from the findings on Model 1 in Table 4, we found the same pattern of results when collapsing the four explicit conditions into one, F (2, 952) = 7.69, p = .001. The targeted dish was 2.6 times more likely to be chosen in the neutrally labeled condition than it was in the explicitly labeled condition, p < .001. In the meat condition, the targeted dish was not significantly more likely to be chosen than it was in the explicitly labeled condition, p = .135. The findings on Model 2 show that the likelihood of choosing the targeted dish in the neutrally labeled condition and meat condition were not significantly different, p = .067. Our robustness check did not alter these findings.

3.3. The effect of neutral labeling on non-reducers and meat-reducers

The likelihood of choosing the targeted dish also differed across the three conditions (explicit (combined), neutral, meat) both for non-reducers (F (2, 657) = 7.01, p = .001) and for meat-reducers (F (2, 293) = 5.37, p = .005). See Fig. 2 for an overview of actual shares. For non-reducers (see details in upper part of Table 5) the vegetarian dish was chosen 3.0 times more in the neutrally labeled condition than it was in the explicitly labeled condition, p = .005. The likelihood of choosing the targeted dish in the meat condition was 3.4 times higher, p = .001, than it was in the explicitly labeled condition. The likelihood of choosing the targeted dish in the neutral condition was not significantly different from the likelihood of choosing it in the meat condition.

Turning to meat-reducers (see details in lower part of Table 5), the likelihood of choosing the targeted dish in the neutrally labeled condition was 2.1 times higher, p = .007, than it was in the explicitly labeled condition. The likelihood of choosing the targeted dish in the neutrally labeled condition was 5.3 times higher, p = .006, than it was in the meat condition. The targeted dish was not chosen significantly more in the explicitly labeled condition than it was in the meat condition. The results were unaffected by the robustness check.

3.4. Differences between explicit labels and effect on meat-avoiders

For RQ3 we ran 1x1 comparisons (binary logistic regressions) of the different explicit labels (e.g. vegetarian versus vegan) to test whether one explicit label performed better or worse than the others as regards likelihood of choosing the targeted dish (see shares in Fig. 3). None of the comparisons returned statistically significant results. In other words, we found no comparative differences here in the individual explicit labels.

For RQ4, we examined whether neutral labeling had a negative effect on the additional sample of meat-avoiders (n = 148). We found that all explicitly labeled targeted dishes were frequently chosen (vegan, n = 35,
82.9%; vegetarian, n = 26, 80.8%; plant-based, n = 25, 100%; and meat-free, n = 34, 85.3%), albeit with the neutrally labeled dish being chosen slightly less (n = 28, 75%), but none of the differences here were statistically significant, \( \chi^2(4) = 2.01, p = .734 \). Nor did we find significant differences when the explicit labels were combined (n = 120, 86.7%) and compared with the neutral label, \( \chi^2(1) = 1.54, p = .214 \).

### 3.5. How labeling affects choice of vegetarian dish across individual differences in food neophobia, meat-eater identity, meat intake, and ethical concern

#### 3.5.1. Interactions among non-reducers

In the non-reducer subgroup we found a significant interaction effect between meat-eater identity and the likelihood of choosing the target dish in the three labeling conditions (\( \chi^2 (2) = 7.26, p = .027 \)). Fig. 3 shows that the likelihood of choosing the target dish is particularly strongly associated with meat-eater identity in the neutral condition. By contrast it is relatively fixed in the explicit condition (at 0–5% share) and meat condition (appr. 10% share). The likelihood of choosing the neutrally labeled dish is particularly high among non-reducers with low meat-eater identity (18%), and higher than the likelihood of choosing the target dish in the meat condition (11%). At the mean meat-eater identity level, the likelihood of choosing the meat targeted dish (11%) and that of choosing the neutrally labeled targeted dish (11%) are roughly equal, but for individuals with stronger meat-eater identity the meat dish is favored (11% vs 7%). The other interactions (food neophobia, meat intake, and ethical concern) tested were not statistically significant.

#### 3.5.2. Interactions among meat-reducers

In the subgroup of meat-reducers we found a significant interaction effect between ethical concern and the three conditions (\( \chi^2 (2) = 7.16, p = .028 \)). Fig. 4 illustrates this interaction effect. It can be seen that the likelihood of choosing the target dish is highly associated with ethical concerns in the neutral condition, where the probability increases from 19% (at the low level of ethical concern) to 56% (at

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**Table 4**

Logistic regression for the influence of conditions (combined explicit conditions, neutral labeling and meat) on likelihood of targeted dish choice.

<table>
<thead>
<tr>
<th>Model 1 (Reference: explicit labels (n = 632))</th>
<th>Predictor</th>
<th>B (SE)</th>
<th>t</th>
<th>ARR</th>
<th>95% CI for ARR</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.63 (0.16)</td>
<td>-16.89</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral label (n = 146)</td>
<td>1.06 (0.27)</td>
<td>3.91</td>
<td>2.56</td>
<td>[1.62, 4.05]</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Meat dish (n = 177)</td>
<td>0.44 (0.30)</td>
<td>1.48</td>
<td>1.50</td>
<td>[0.88, 2.55]</td>
<td>.135</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2 (Reference: meat dish (n = 177))</th>
<th>Predictor</th>
<th>B (SE)</th>
<th>t</th>
<th>ARR</th>
<th>95% CI for ARR</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.19 (0.25)</td>
<td>-8.63</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral label (n = 146)</td>
<td>0.62 (0.34)</td>
<td>1.84</td>
<td>1.71</td>
<td>[0.96, 3.03]</td>
<td>.067</td>
<td></td>
</tr>
<tr>
<td>Explicit labels (n = 632)</td>
<td>-0.44 (0.30)</td>
<td>-1.48</td>
<td>0.67</td>
<td>[0.39, 1.14]</td>
<td>.135</td>
<td></td>
</tr>
</tbody>
</table>

Note: For both models: F (2, 952) = 7.69, p < .001.

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82.9%; vegetarian, n = 26, 80.8%; plant-based, n = 25, 100%; and meat-free, n = 34, 85.3%, albeit with the neutrally labeled dish being chosen slightly less (n = 28, 75%), but none of the differences here were statistically significant, \( \chi^2 (4) = 2.01, p = .734 \). Nor did we find significant differences when the explicit labels were combined (n = 120, 86.7%) and compared with the neutral label, \( \chi^2 (1) = 1.54, p = .214 \).
the high level). The likelihood of choosing the dish is also associated with ethical concern in the explicit condition, but clearly less strongly than it is in the neutral condition, where the probability of choosing the target dish increases from 11% (low level of ethical concern) to 20% (high level). Finally, reversing these patterns, in the meat condition the probability of choosing the target dish decreases from 17% (low level of concern) to 3% (high level of concern). The other interactions (food neophobia, meat intake, and meat-eater identity) tested were not statistically significant.

4. Discussion

We found that neutral labeling of a vegetarian dish more than doubles vegetarian food choice among meat eaters as compared with an explicit label, regardless of whether the meat eaters are meat-reducers or non-reducers. All four of the explicit labels performed more poorly than the neutral vegetarian label. Further, with neutral labeling the average propensity to choose a vegetarian dish is comparable with that of choosing a similar meat dish. Lastly, a neutral label did not reduce the frequency of how often meat-avoiders chose the vegetarian dish.

As expected, we found the largest relative effect of the neutral versus explicit label among non-reducers (3.0 times more likely, compared to 2.1 times for meat-reducers). On the other hand, the absolute effect was largest in meat-reducers (from approx. 14.4% (explicit) to 30.1% (neutral)), but modest in non-reducers (from ca. 3.4% (explicit) to 10.2% (neutral)). Non-reducers make up the majority (69%) of the Danish population (Hielkema & Lund, 2021). In light of the modest propensity to choose the target dish in this group, it remains an important task to persuade non-reducers to reduce their meat intake (i.e. become meat-reducers) so that the substantial reduction in choice of meat dish that neutral labeling offers can be capitalized upon.

Earlier studies also suggesting that subtle and neutral labelling increases the choice of a target dish were conducted in specialized populations (Krpan & Houtsma, 2020; Wagner et al., 2015). With our representative sample of Danish citizens, we are able to confirm that the same logic applies to the general population (at least, in a hypothetical setting).

Our results differ from those reported in a study by Bacon and Krpan (2018) where they compared an explicit menu strategy (putting vegetarian dishes in a separate section) with a neutral strategy (where vegetarian dishes were not placed in a separate section). This study found that the explicit strategy decreased vegetarian food choice among consumers who frequently ate vegetarian meals while having no effect on infrequent eaters of vegetarian meals. Due to differences in set-up (section labeling, as against dish labeling) our results are not directly comparable with those of Bacon and Krpan (2018). Nevertheless, the different results here could indicate that labeling of an individual dish has a less negative impact on meat-reducers than section labeling does.
More research is clearly needed to explain the differential effects of differing menu designs on non-reducers and meat-reducers.

Our results also differ from those obtained by Rosenfeld et al. (2022), as we did not find that one explicit label performed significantly better than others. The contrasting results here could be ascribed either to actual differences in the populations studied or to differences in the design of the two studies (Rosenfeld and colleagues examined the effect of explicit labels in a natural setting with a large sample size).

We were unable to confirm hypothesis H1, that higher levels of food neophobia are negatively associated with the likelihood of choosing an explicitly labeled dish. A possible reason for this is that we chose a target dish – Asian style, with sweet potatoes and coconut – which is a relatively common dish nowadays in Denmark. Food neophobia could play a role where more unfamiliar dishes/foodstuffs including, for example, tofu or meat substitutes are concerned. Hoek et al. (2011) found that food neophobia was a strong barrier to meat substitute acceptance.

We were also unable to confirm hypothesis H2, that the likelihood of choosing an explicitly labeled vegetarian dish is negatively associated with frequent meat intake. Obviously, meat intake correlates with meat-eater identity (r = 0.28, p < 0.001) (as we discuss below). It is therefore interesting that the identity component is the factor with the most important effect on choice, even though we cannot rule out that the measure of meat-eating behavior (based on self-reported food frequency questions) is not wholly reliable and does not measure the volume of meat intake precisely.

Among non-reducers we found a significant interaction effect between label condition and meat-eater identity. Although we could not confirm hypothesis H3, that meat-eater identity is negatively associated with the propensity to choose an explicitly labeled dish, we consider it an important insight that neutral labeling can nudge diners toward vegetarian food choice when the diners are non-reducers with a low meat-eater identity, but not when they are non-reducers with a high meat-eater identity. This highlights that the theoretical proposition laid out by (Rosenfeld & Burrow, 2018), namely that decisions about what to eat rely on dietary identity, also are important in food outlets (at least where meat identity is concerned).

Our finding of a significant interaction effect between label condition and ethical concern among meat-reducers did not support H4: that there is a positive association between ethical concern and having a propensity to choose the targeted dish when it is explicitly labeled. Instead, we observed a greater propensity under neutral labeling here. Willingness to follow a plant-based diet has been found to increase with higher levels of environmental concern (Wang & Scrimgeour, 2021), but our findings show that higher levels of ethical concern do not necessarily translate into vegetarian food choice when the 'wrong' label is used. Explicit labeling may have led to reactance or moral licensing (we discuss below). It is therefore interesting that the identity component is the factor with the most important effect on choice, even though we cannot rule out that the measure of meat-eating behavior (based on self-reported food frequency questions) is not wholly reliable and does not measure the volume of meat intake precisely.

Some meat eaters may have failed to identify the neutrally labeled vegetarian dish as vegetarian. This may lead to an accusation that nudging via neutral labeling is manipulative. Manipulation occurs when a person’s capacity for reasoning is bypassed, so that he or she no longer exercises autonomy and chooses in accordance with one’s own preferences (Blumenthal-Barby & Burroughs, 2012). However, in the case of labeling, we would argue that individuals can still exercise their autonomy and make choices that are based on their own preferences. Further, it seems that those who find it very important that a dish contains meat will make sure that meat is part of the dish (e.g. see Fig. 5).

4.1. Implications for practitioners

Since neutral labeling is a successful tool with which to steer vegetarian food choice in both non-reducers and meat-reducers, and outperforms many competing explicit labels, it would seem important for food outlets to avoid (or carefully consider before using) explicit labeling when they want to promote vegetarian food choices among meat eaters. Also, a neutral vegetarian labeling strategy does not negatively affect meat-avoiders – it will not turn them away. Changes to menu design would come with limited costs for food outlets (only the menu has to be changed, not their offered dishes) and are relatively easy and scalable. However, food outlets may have to consider their margins on vegetarian and meat dishes, to ensure that an increase in vegetarian dishes will be economic. Although explicit vegetarian labeling of dishes is best avoided, information about sustainability elsewhere on the menu might be beneficial for overall restaurant image (Remar et al., 2021).

Policy-makers could use labeling interventions as a supportive tool in their overall campaign strategy to reduce meat intake. For example, they could apply them in the canteens of public institutions like schools or homes for the elderly. Menu design interventions may be preferred over more invasive interventions such as a meat tax or obligatory meat-free days, as labeling interventions do not interfere with freedom of choice and are more discrete and unobtrusive (De Vaa et al., 2019; Thaler & Sunstein, 2009).

4.2. Strengths, weaknesses and future research

The strengths of our study were that we studied sub-groups of meat eaters as well as meat-avoiders. We also focused on the role of individual characteristics, where comparable studies (Bacon et al., 2018; Vennard et al., 2019) have only examined the main effects of labeling on food choice (Krpán and Houtsma (2020) and Turnwald et al. (2019) are exceptions, as individual differences were included in those studies). This dual perspective helps to explain how two important components from the COM-B model interact. Graça et al. (2019) suggested that the COM-B model, originally developed by Michie et al. (2011), can be used as an way to conceptualize behavioral change involving meat reduction. The model focuses on Capability (ability to perform the behavior), Opportunity (social and physical features, including availability, that support or hinder the behavior), and Motivation (automatic and reflective decision-making processes, including values/attitudes, goals, and beliefs). These components operate in conjunction and have to be aligned for sustained change (Graça et al., 2019). Intervention studies are a useful tool with which to understand Opportunity barriers and enablers. Our labeling experiment, then, clearly falls under this component, and we further have shown that the Opportunity (through meal service provision) and Motivation components interact. It was a further strength of our study that we included a meat version of the targeted dish in the experimental design, since that made it possible to assess the impact of labels relative to a meat version.

The limitations of our study were that it took place online and that real food consumption was not measured. However, online study of food choices has been shown to be effective in the investigation of the impact of interventions (Ensaff, 2021). Further, it facilitates the collection of additional measures, which we used to segment consumers on meat reduction intentions and individual characteristics. We tried to make our hypothetical online food choice more realistic by offering multiple options on the menu, which had the consequence that the number of respondents choosing the targeted dish was somewhat low. Future research should pre-test the existing popularity of the targeted dish to ensure that a larger expected share of participants choose it. Alternatively, several vegetarian options on the menu could be offered (see Bacon and Krpan (2018), Krpan and Houtsma (2020) or Parkin and Attwood (2021)). Nevertheless, it is difficult to assess the external validity of our results, and it would be important to replicate this study in the field to test the real-life impact of neutral labeling.

We calculated the effect sizes obtained in this study for non-reducers, meat-reducers and all meat eaters (see details in Section 1.4 of Supplemental file 1). They were all found to be in the small effect size range (Cohen’s w = 0.13–0.22). In a similar comparison of a “subtle” and
explicit health label in a natural setting of attendees at a scientific conference, Wagner et al. (2015) identified a small effect (Cohen’s $r = 0.17$; our own calculation based on information in the paper). Since the two studies are quite different where the study population and setting (hypothetical versus natural) are concerned, it is recommended that future research focusing on neutral or subtle labeling should power their samples so that low effect sizes can be detected.

We have mentioned various explanations of why explicit labeling might decrease, and neutral label labeling increase, vegetarian food choice (exclusion criterion, reactance or moral licensing). We believe that our results support the general explanations we have set out, but it is a limitation that we have no direct measurements of these constructs. Further, we cannot say directly which one is the main cause, or whether a mix of causes is involved. Future research could examine the mechanisms behind the effect of neutral labeling in more detail by including individual specific measures of reactance (Reynolds-tylus, 2019) and moral licensing (Blanken et al., 2015).

We focused on Asian cuisine, as many Asian dishes are generally offered in a meat-free form. Future research could examine whether our findings translate to other cuisines, in particular those heavy in meat, such as many European cuisines. Other recommendations on future research are to study the effect of menu design interventions over the long-term and in other realms of eating. The question whether interventions provide potential positive spillover effects that lead to an increase in vegetarian food choices in other situations (e.g. other food outlets or at home) is currently understudied (Marchiori et al., 2017).

A recent study found that a subtle V logo did not significantly differ from no vegetarian labeling in its impact on vegetarian food choice (Parkin & Attwood, 2021). Subtle indicators like V logos may work the same way as neutral indicators (where asterisks with remote text are used). However, this could change over time, when V logos become better known to meat eaters. More research is needed to study possible differences between neutral versus subtle labeling on vegetarian food choice.

We focused on non-reducers and meat-reducers, but the behavior of other consumer segments could also be interesting. These might include the consumer with an intention (but no action as yet) to reduce meat intake, meat-reducers who recently reduced (in whom automatic behavior might still steer toward meat), and meat-reducers over a longer period. Unfortunately, our sample size was too small to target those subgroups in this study.

4.3. Conclusion

The present study showed that neutral labeling, as compared with explicit labeling, regardless of whether the explicit label states “vegan,” “vegetarian,” “plant-based” or “meat-free,” increases vegetarian food choice among meat eaters. This supports earlier findings by Krpan and Houtsma (2020) that alternative framings all increased vegetarian food choice in comparison with explicit vegetarian framing. Our study adds to the literature by demonstrating the positive impact of neutral labeling both in the general population and among two sub-groups: non-reducers and meat-reducers. It also confirms that neutral labeling offers the potential to nudge a segment of non-reducers – specifically, those with low meat-eater identity – to choose a vegetarian dish. Neutral labeling is also more effective among meat reducers, and surprisingly it increases the choice of a vegetarian dish among the highly ethically motivated. By contrast, explicit labeling is less successful, presumably because it prompts reactance or moral licensing. Finally, we did not find that neutral labeling negatively affects vegetarian food choice among meat-avoiders. This indicates that food outlets can safely use neutral labels irrespective of their consumer subgroups. Avoiding the explicit labeling of vegetarian meals can make the choice of vegetarian dishes easier for meat eaters and, with that, contribute to a healthier and more sustainable diet.

Credit

Marijke H. Hielkema:Conceptualization; Data curation; Formal analysis; Methodology; Project administration; Visualization; Roles/Writing - original draft; Writing - review & editing.
Thomas B. Lund: Conceptualization; Methodology; Project administration; Supervision; Writing - review & editing.

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Declaration of competing interest

none.

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Appendix A. Supplementary data

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References


