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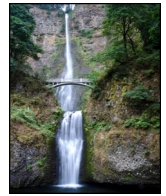
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Unsustainable, unhealthy, or disgusting? Comparing different persuasive messages against meat consumption

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ABSTRACT

Excessive meat consumption is associated with a range of environmental problems. In this investigation, we examined the effectiveness of three types of persuasive messages posited to affect attitudes toward meat consumption. The first two messages contained health and environment-related appeals (e.g., the moral consequences of environmental degradation and animal welfare), which are commonly used in campaigns aimed at meat reduction. A third kind of message – one that is less frequently applied in meat-consumption campaigns – follows from research suggesting that meat aversions are acquired via the emotion disgust. Results across three studies – and a meta-analysis of these studies – suggest that disgust-oriented persuasive messages are more effective than health-oriented messages, and they are at least as effective as moral (i.e., animal welfare) messages in influencing meat attitudes. The practical implications for campaigns to reduce meat consumption are being discussed.

“The less one knows about meat, the more one is able to enjoy it. Meat tastes wonderful, of course, but as with the lad hawking hard-to-find wares at unbelievable prices, it’s best not to ask too many questions.”

Brian South in “The Zombie Sheriff Takes Tucson: A Love Story”

Meat has played an important role in the human diet throughout history (Smil, 2002; 2013), and it is currently a key ingredient in the main meal for many cultures around the world (Seleshe, Jo, & Lee, 2014; Twigg, 1984). Current per capita annual meat consumption averages about 38 kg (84 pounds) globally, and annual consumption in highly meat-cultured countries such as Uruguay, Cyprus, and the United States is three times higher (Speedy, 2003). Despite meat taking a central role in modern eating patterns (Beardsworth & Keil, 1997; Holm & Mohl, 2000), societal-level problems such as global warming and public health raise questions regarding the consequences of current meat consumption patterns.

1. Costs of meat consumption on environmental sustainability

Food production and consumption have been identified as some of the most significant contributors to current environmental problems (Stern, Dietz, Ruttan, Socolow, & Sweeney, 1997). Estimates suggest that 20 to 30 percent of the total environmental impact of Western

countries is derived from the food industry (Tukker & Jansen, 2006). Meat consumption arguably imposes the highest proportion of these environmental costs, indirectly contributing to waste, energy and water consumption, biodiversity loss, and greenhouse gas emissions (Laestadius, Neff, Barry, & Frattaroli, 2013; Steinfeld, Gerber, & Wassenaar, 2006). Plant-based food production is relatively more sustainable (Eshel & Martin, 2006; Tilman & Clark, 2014; de Vries & de Boer, 2010); experts estimate that a vegetarian diet produces about 2.5 times less greenhouse gas emissions than a diet that includes 100 g of meat per day (Scarborough et al., 2014).

Given its many environmental costs, meat consumption should be reduced. But such reduction constitutes a classic resource social dilemma. Although the benefits of meat consumption are immediate and enjoyed by an individual, the negative environmental consequences are delayed in time and shared by all of us (Griskevicius, Cantú, & Van Vugt, 2012; McAndrew, 1993; Van Lange, Balliet, Parks, & Van Vugt, 2013). Take the impact of meat consumption on greenhouse gas emissions. The consequences of emissions generated in the 20th and 21st century will most strongly impact individuals living in the 22nd century and beyond (Houghton et al., 2001). Hence, today’s eating patterns may negatively impact the well-being of generations to come (Dietz, Groom, & Pizer, 2016).

Environmental degradation (in terms of waste, pollution, resource depletion, and biodiversity loss) is not the only unsustainable

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consequence of the modern meat industry. Animal welfare has become a major public concern as well (Grandin, 2010; OIE, 2009; Seng & Laporte, 2005). Although animal welfare was initially considered difficult to define and measure (McGlone, 2001), it is now regarded as a core component of a sustainable environmental policy (Faver, 2013; Llonch, Haskell, Dewhurst, & Turner, 2016). Indeed, environmental and animal welfare concerns underlie most moralized arguments against the meat industry (Pitesky, Stackhouse, & Mitloehner, 2009; Steinfeld et al., 2006).

Alongside environmental and animal welfare, meat consumption also has deleterious health effects. Higher meat intake is associated with increased risk of cardiovascular diseases, type 2 diabetes, and some types of cancer (e.g., colorectal and gastric cancer; Abete, Romaguera, Vieira, de Munain, & Norat, 2014; Barnard, Levin, & Trapp, 2014; Tilman & Clark, 2014; Wie et al., 2014). For instance, one study that compiled global data on diet and health indicated that, compared to a conventional omnivorous meat and vegetarian diet, alternatives with reduced (Mediterranean) or null (Vegetarian and Pescetarian) meat intake were associated with a 20–26% reduction in coronary heart disease and a 16–41% reduction in Type II diabetes (Tilman & Clark, 2014).

In sum, multiple lines of evidence suggest that meat consumption carries negative consequences for the environment, the self, and others (including animals). But how can such negative consequences be attenuated? What interventions might reduce meat consumption?

2. Effects of highlighting environmental and health consequences of meat consumption

Persuasive arguments about the effects of the meat industry on environmental sustainability (Fessler, Arguello, Mekdara, & Macias, 2003; de Boer, Schösler, & Boersema, 2013) and animal treatment have had limited effectiveness (Ifat & Christian, 2014). One study reported that (1) showing consumers how their food choice contributes to climate change, and (2) increasing consumers' self-efficacy to select alternatives to meat products better predicted intentions to adopt climate-mitigating food actions than did fear appeals ("if greenhouse gas emissions continue at current levels, sea-levels will rise by 1–2 m"; Hunter & Rös, 2016, p.153). However, consumers do not see the reduction of meat consumption as having the same environmental benefits as, for example, avoiding excessive packaging and buying locally produced foods (Macdiarmid, Douglas, & Campbell, 2016; Tobler, Visschers, & Siegrist, 2011). In fact, many underestimate the environmental harm caused by the meat industry (Truelove & Parks, 2012; Vanhonacker, Van Loo, Gellynck, & Verbeke, 2013). Concerns regarding animal treatment might also influence consumers' dietary attitudes and behaviors (Napolitano, Pacelli, Girolami, & Braghieri, 2008; Verbeke & Viaene, 2000; de Backer & Hudders, 2015). For instance, perceptions of moral obligation towards animals influence preferences for products from ethical brands (McEachern, Schröder, Willock, Whitelock, & Mason, 2007). Similarly, positive animal welfare attitudes predict people's preferences for diets with less meat (de Backer & Hudders, 2015). That said, a recent meta-analysis showed that consumers would only be willing to pay a modest premium on meat for improved animal welfare in farms (Clark, Stewart, Panzone, Kyriazakis, & Frewer, 2017).

The literature further suggests that health concerns associated with meat consumption affect people's attitudes toward – and, subsequently, intentions to consume – meat. Research on the effects of media on meat-related diseases (e.g., mad cow disease) shows that health-related appeals change attitudes toward meat (Verbeke, Viaene, & Guiot, 1999). One study reported that health beliefs regarding beef were the strongest predictors of attitudes towards beef consumption, which in turn, influenced behavioral intentions (McCarthy, de Boer, O'Reilly, & Cotter, 2003). Furthermore – and germane to the present research – the same study found that animal welfare and environmental concerns were not

associated with attitudes towards beef consumption. Other research suggests that health-related persuasive attempts to reduce meat consumption are effective, but only when information is presented in a factual way (rather than in a pre-factual manner that presents information as it is an hypothetical scenario relying in "if... then" propositions) (Bertolotti, Chirchiglia, & Catellani, 2016).

In sum, although some findings suggest that attitudes toward meat can be influenced by concerns related to health, environmental degradation, and animal welfare, these are small and seem to depend on specific situational factors. Is there any other way to change consumer's meat attitudes?

3. Reducing meat consumption through disgust

Recent anecdotal evidence suggests that an altogether different motivator might decrease meat consumption: the emotion disgust. In 2013, the Irish and the United Kingdom Food Standards Agencies disclosed that horsemeat was found in ground beef (Hull, 2013). News of this scandal spread quickly across Europe and greatly impacted meat sales (Yamoah & Yawson, 2014). Importantly, some research indicates that consumers viewed the horsemeat scandal as disgusting rather than as health threatening (Tse, Zhang, Doherty, Chappell, & Garnett, 2016). A similar case has been reported in U.S. with the use of mechanically-separated meat in school lunches that takes the form of a substance labeled "Pink Slime" (Chung, Runge, Su, Brossard, & Scheufele, 2016). These two scandals suggest that information that elicits disgust directly might shape meat eating habits. But why?

Evolutionary psychological reasoning argues that humans possess psychological adaptations to avoid pathogens (Curtis, 2014; Tybur & Lieberman, 2016). People experience the emotion disgust, which motivates the avoidance of physical contact with disgust-eliciting objects, when they detect sensory cues (e.g., smells, colors, and textures) associated with pathogens (Fleischman, 2014; Tybur, Lieberman, Kurzban, & DeScioli, 2013). Consequently, disgust shapes aversions (Rozin, Haidt, & McCauley, 1993), especially for foods (Rozin & Zellner, 1985; Rozin, Wrzesniewski, & Byrnes, 1998). Indeed, people who are more easily disgusted are more food neophobic (i.e., avoiding to consume unfamiliar food; Al-Shawaf, Lewis, Alley, & Buss, 2015; Martins & Pliner, 2006), and these people are especially reluctant to eat novel animal foods (Martins, Pelchat, & Pliner, 1997). Further, disgust is activated more easily with meats than with vegetables. Tybur, Laakasuo, Ruff, and Klauke (2016) reported that pathogen cues (i.e., disgust eliciting images) more effectively influenced attitudes towards meat than they influenced attitudes towards vegetables.

In sum, diverse strategies might change public attitudes toward meat and reduce meat consumption. Which messages are most effective? The present studies investigate these questions. Study 1 investigates the effect of three persuasive messages (related to health content, disgust content, and moral appeals related to both environmental degradation and animal welfare) on attitudes toward meats and vegetables. Study 2 builds upon Study 1 by separating environmental degradation and animal welfare appeals. Study 3 tests whether disgust and/or empathy (with animals) mediate the effects of these different appeals on meat attitudes. Finally, we present a meta-analysis of the aggregate effects across the three studies. We expect that messages with moral, health, and disgust content will influence attitudes toward meat more than neutral messages. A key goal of these studies is to identify which type of message most strongly influences these attitudes.

4. Study 1

4.1. Materials and methods

4.1.1. Participants

Three-hundred-twenty-eight American participants (41.5% males; $M_{age} = 34.1$ years, $SD_{age} = 11.8$ years) were recruited through

Amazon's Mechanical Turk (MTurk). Nineteen participants were excluded because they indicated they were vegetarians. Thus, the final sample was 309 participants.

4.1.2. Procedure, design, and analytic strategy

After providing informed consent form, participants were told that they would read a short essay before performing a subsequent recall test. In reality, participants were randomly assigned to read one of three persuasive essays highlighting the disgusting (e.g. "...ABC News recently broke a story highlighting the amount of "pink slime" that is added to the ground beef that you see in grocery stores, restaurants, and even school cafeterias..."), health (e.g. "...A building body of research indicates that our meat consumption has led to a sharp increase in chronic disease and, for many people, to an early grave..." or moral (environmental and animal welfare) issues of meat consumption (e.g. "...Up to 10 distressed and suffering birds are shoved into a single small cage, in one huge shed with up to 90,000 other chickens..." and "...Increases in meat production have led to incredible strain on our natural resources; in fact, we currently use one-third of the world's fresh water and one-third of total arable land just to raise livestock..."), or a neutral essay about the 1980 Winter Olympics (e.g. "...The Winter Olympics were held in the United States of America for the third time in 1980...", which served as the control condition (supplemental materials, Appendix 1). After reading the essay, participants saw five images of meats and five images of vegetables presented in random order (supplemental materials, Appendix 2) and were asked to rate each food by answering single-item measures on perceived healthiness ($\alpha_{\text{meat}} = 0.84$; $\alpha_{\text{vegetables}} = 0.81$), moral wrongness ($\alpha_{\text{meat}} = 0.95$; $\alpha_{\text{vegetables}} = 0.79$), anticipated taste ($\alpha_{\text{meat}} = 0.83$; $\alpha_{\text{vegetables}} = 0.77$), general valence ($\alpha_{\text{meat}} = 0.87$; $\alpha_{\text{vegetables}} = 0.79$), buying likelihood ($\alpha_{\text{meat}} = 0.82$; $\alpha_{\text{vegetables}} = 0.72$), and eating desire ($\alpha_{\text{meat}} = 0.84$; $\alpha_{\text{vegetables}} = 0.74$). We included images of vegetables to test whether the essays also affected ratings of a non-meat food, either due to overall decreases in appetite (e.g., via the disgust-eliciting content of one of the essays) or greater preferences for meat alternatives. All photographs were presented on a screen with a black background, all questions were rated on a 7-point (1 = *Not at all*; 7 = *Very much*) scale, and the order of the dependent measures was randomized. Participants then completed the Three Domain Disgust Scale (Tybur, Lieberman, & Griskevicius, 2009), which includes pathogen ($\alpha = 0.83$), sexual ($\alpha = 0.87$) and moral ($\alpha = 0.94$) subscales, and seven items regarding their global attitudes towards meat eating. These two measures were not used for the primary analyses. Lastly, participants were asked questions regarding their current diet (i.e., number of meals containing meat), and provided some demographic information before being debriefed and thanked for their participation.

4.2. Results

To test whether the essays differentially affected ratings of meats and vegetables, a 2 (food type: meat versus vegetable product ratings – within-subjects) \times 6 (rating: perceived healthiness, eating desire, anticipated taste, perceived moral wrongness, general attitude and buying likelihood – within-subjects) \times 4 (essay condition – between subjects) \times 2 (sex – between subjects) mixed MANOVA was carried out. We had no predictions concerning interactions involving participant sex. However, since the sexes differ in their meat preferences and consumption (e.g. research shows that men tend to eat more meat than women do; Gossard & York, 2003; Kiefer, Rathmanner, & Kunze, 2005; Prättälä et al., 2007), we report results of the interaction effect between sex and food type across the three studies in supplemental materials (Appendix 9).¹ A two-way interaction between food type and the essay conditions

would indicate that differences in meats and vegetables ratings vary across essay conditions. If such interaction was detected, a paired samples *t*-test was conducted to analyze differences in ratings of meats versus vegetables products in each of the five conditions.

Analysis did not indicate an interactive effect between food type and essay conditions, $F(3, 301) = 1.46, p = .22$; Wilk's $\Lambda = 0.98, \eta_p^2 = .014$. However, the analysis did show a significant interaction between food type, essay conditions, and ratings, $F(15, 820.28) = 2.76, p < .001$; Wilk's $\Lambda = 0.87, \eta_p^2 = .044$. This interaction indicated that effects of essay condition varied across rating type (and that this difference further varied across ratings of meats and vegetables). Therefore, we examined the two-way interactions between food type and the essay conditions for each rating, separately. If these interactions were detected, paired samples *t*-tests were conducted to analyze differences in ratings of meats versus vegetables products in each of the four essay conditions.

Analyses showed significant interactions between food type and essay condition for three of the six evaluations of foods: eating desire, $F(3, 301) = 3.01, p = .03, \eta_p^2 = .029$, perceived moral wrongness, $F(3, 301) = 11.80, p < .001, \eta_p^2 = .105$, and general attitude, $F(3, 301) = 4.73, p = .003, \eta_p^2 = .045$. No other interactions were significant ($p > .07$). As illustrated in Fig. 1, the desire to eat vegetables was significantly higher than the desire to eat meats only in the moral condition, $t(75) = -2.37, p = .02, d = -0.42$, and disgust condition, $t(78) = -3.76, p < .001, d = -0.66$, whereas in health condition, $t(78) = 0.29, p = .76, d = 0.04$, and control condition, $t(74) = -0.45, p = .65, d = -0.06$, such difference was not present. Follow-up interaction contrasts indicated that only the disgust essay condition differed significantly from the control condition, $p = .01$. Across all conditions, analyses showed significant differences on perceived moral wrongness of buying meats and vegetables, *health condition*: $t(78) = 6.14, p < .001, d = 0.79$; *moral condition*: $t(75) = 10.95, p < .001, d = 1.64$; *disgust condition*: $t(78) = 8.65, p < .001, d = 1.12$; *control condition*: $t(74) = 6.01, p < .001, d = 0.75$, and general attitudes toward them, *health condition*: $t(78) = -3.73, p < .001, d = -0.54$; *moral condition*: $t(75) = -5.87, p < .001, d = -1.01$; *disgust condition*: $t(78) = -6.82, p < .001, d = -1.13$; *control condition*: $t(74) = -3.59, p = .001, d = -0.51$, with participants viewing meat less positively and as being more morally wrong to consume. Follow-up interaction contrasts indicated that only the disgust, $p_{\text{general attitude}} = .002$; $p_{\text{moral wrongness}} = .004$, and moral conditions, $p_{\text{general attitude}} = .005$; $p_{\text{moral wrongness}} < .001$, were significantly different from the control condition in those ratings.

4.3. Discussion

Based on previous literature on persuasive attempts against meat consumption, Study 1 aimed to test how essays highlighting moral (environmental and animal welfare), health, and disgust consequences of meat affect meat attitudes – and affect them uniquely from vegetable attitudes. Overall, results indicate that the moral and disgust essays had the strongest effects, especially on perceived moral wrongness and overall feeling toward meat. Thus, moral and disgust appeals related to meat consumption may be more persuasive than health appeals. Attitudinal changes compared with the control condition in moral wrongness and general feeling were driven by both disgust and moral conditions. That said, the moral condition combined two potentially dissociable moral consequences of the meat industry: those related to animal welfare versus those related to environmental degradation.

(footnote continued)

buying intentions, $F(3, 301) = 2.68, p = .047, \eta_p^2 = .026$, and eating desire, $F(3, 301) = 2.97, p = .032, \eta_p^2 = .029$, were observed only in Study 1. Such complex interactions did not replicate across Studies 2 and 3, therefore they were not explored further.

¹ Three three-way significant interactions between essay condition, food type, and sex on perceived healthiness, $F(3, 301) = 4.53, p = .004, \eta_p^2 = .043$,

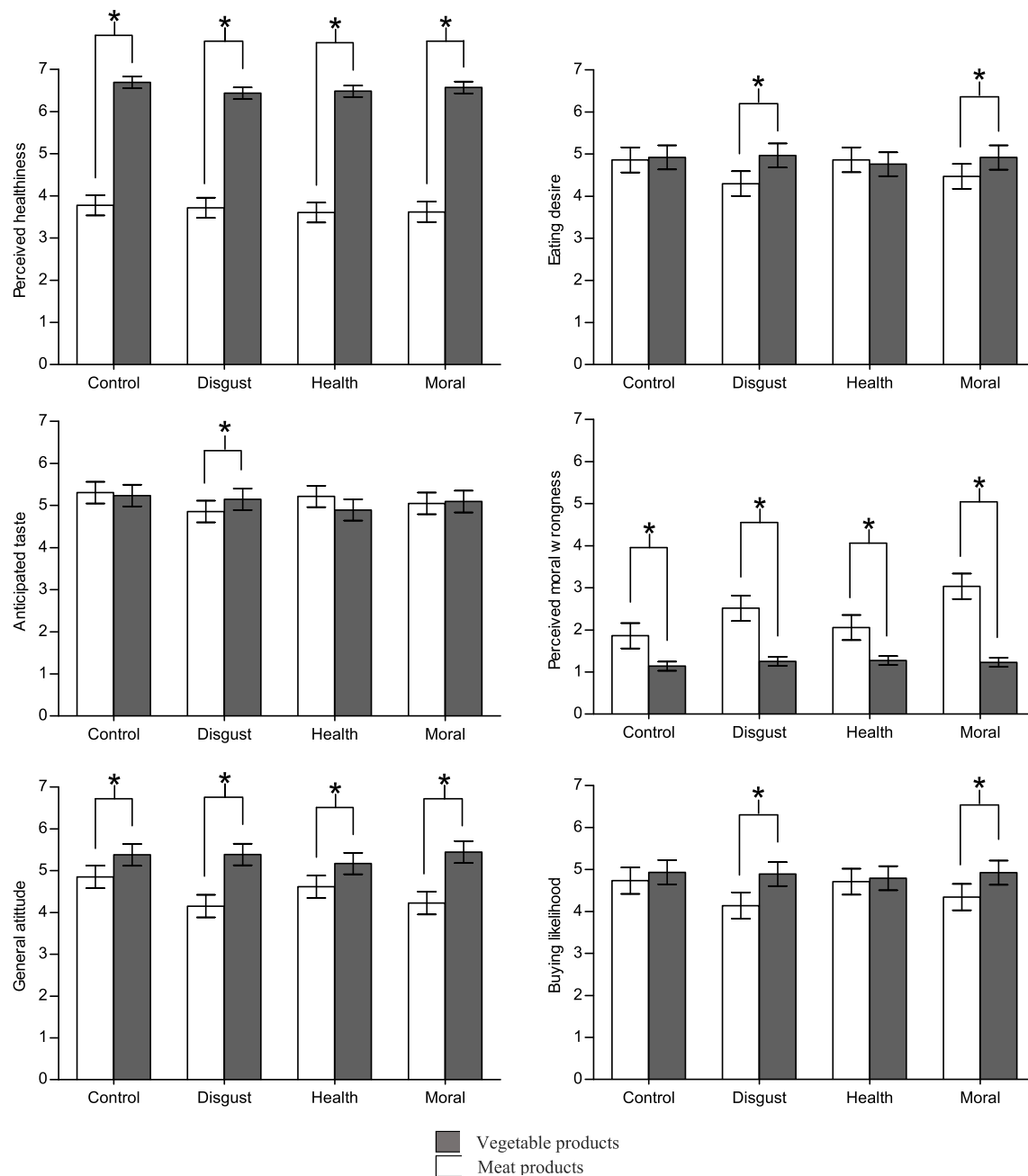


Fig. 1. Means and 95% confidence interval bars for ratings of perceived healthiness, anticipated eating enjoyment and buying likelihood of meat and vegetable products on different essay conditions in Study 1. * Indicates that the simple effect is significant at the $p < 0.05$ level.

Study 2 aimed to untangle these two pieces of information.

5. Study 2

5.1. Materials and methods

5.1.1. Participants

A sample of four-hundred-thirty-nine American participants (53.1% males; $M_{age} = 36.3$ years, $SD_{age} = 10.7$ years) were recruited through MTurk. Fifty-six were excluded because they indicated they were vegetarians or could not eat meats due to health or religious reasons. Thus, the final sample was 383 participants.

5.1.2. Procedure and design

The study followed similar procedures as Study 1, but the

environmental essay was replaced with separate animal welfare ($n = 79$) and environmental degradation ($n = 77$) essays. Based on the results of two pilot studies, a few minor changes were made on the neutral ($n = 82$), health ($n = 72$) and disgust essay ($n = 73$) conditions, and the number of DV questions regarding meat and vegetable products was reduced from six to three (supplemental materials, [Appendix 3 and 5](#)). We also improved the quality of the images of the meats and vegetables used in Study 1 (supplemental materials, [Appendix 4](#)). Further, manipulation checks and attention checks were added. As in Study 1, meat and vegetable indexes showed adequate reliability (perceived healthiness: $\alpha_{meat} = 0.90$; $\alpha_{vegetables} = 0.86$; anticipated eating enjoyment: $\alpha_{meat} = 0.87$; $\alpha_{vegetables} = 0.81$; buying likelihood: $\alpha_{meat} = 0.88$; $\alpha_{vegetables} = 0.81$). Overall, the percentage of correct answers to the attentional questions was high (supplemental materials, [Appendix 6](#)). Similarly, manipulation checks indicated that the essays had the

expected effects. In particular, reported physical disgust varied across conditions, $F(4, 378) = 55.97, p < .001, \eta_p^2 = .37$. Those in the disgust condition, $M = 4.22, SD = 1.85$, reported more disgust than did participants in the environmental, health, and control conditions (all p 's $< .001$), but not the animal welfare condition ($M = 4.36, SD = 1.82; p = .83$). Reported worry about health also varied across conditions, $F(4, 378) = 40.53, p < .001, \eta_p^2 = .30$, with participants in the health condition ($M = 4.36, SD = 1.68$) reporting being more worried about their health than participants in all other conditions (all $p < .001$) except the disgust condition ($M = 4.05, SD = 1.82; p = .25$). Worry about animal welfare also varied across conditions, $F(4, 378) = 65.48, p < .001, \eta_p^2 = .40$, with participants in the animal welfare condition ($M = 5.51, SD = 1.61$) indicating being more worried about animal welfare than those in all the other conditions (all p 's $< .001$). Finally, reported worry about the environment varied across conditions, $F(4, 378) = 59.05, p < .001, \eta_p^2 = .38$, with participants in the environmental condition ($M = 5.14, SD = 1.83$) scoring higher than participants in all the remaining conditions (all p 's $< .001$).

5.2. Results

Following the same analytic strategy used in the Study 1, a 2 (food type: meat versus vegetable product ratings – within-subjects) \times 3 (rating: perceived healthiness, anticipated eating enjoyment and buying likelihood – within-subjects) \times 4 (essay condition – between subjects) \times 2 (sex – between subjects) mixed MANOVA was carried out to test whether the essays differentially affected meats and vegetables ratings.

Analysis showed a significant interaction between food type and essay conditions, $F(4, 373) = 3.14, p = .01$; Wilk's $\Lambda = 0.96, \eta_p^2 = .033$. This interaction was not moderated by rating type, $F(8, 744) = 1.38, p = .19$; Wilk's $\Lambda = 0.97, \eta_p^2 = .015$, so we collapsed over ratings in analyzing the differences between meats and vegetables across essay conditions. As illustrated in Fig. 2, ratings of meats and vegetables differed significantly in the health, $t(71) = -4.16, p < .001, d = -0.70$, animal welfare, $t(78) = -4.55, p < .001, d = -0.71$, and disgust conditions, $t(72) = -4.18, p < .001, d = -0.65$, with meats being rated lower than vegetables. Analysis did not show differences between meats and vegetables in control, $t(81) = -1.53, p = .12, d = -0.22$, and environmental degradation conditions, $t(76) = -1.47, p = .14, d = -0.21$. Importantly, interaction contrasts indicated that the difference in meats and vegetables ratings differed from the control condition only in the disgust condition, $p = .03$, and in the animal welfare condition, $p = .04$.

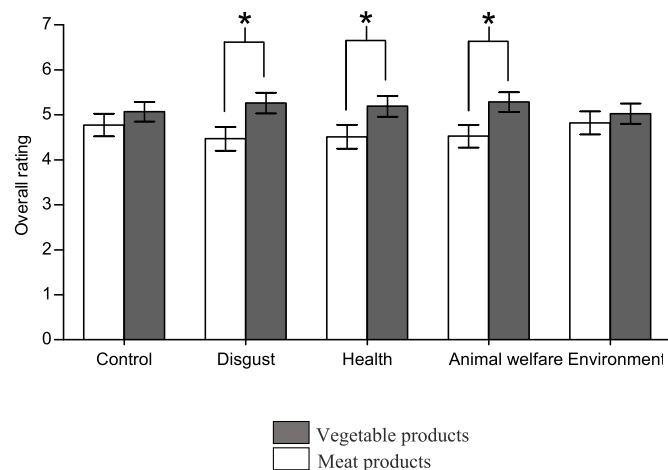


Fig. 2. Means and 95% confidence interval bars for overall ratings of meat and vegetable products on different essay conditions in Study 2. * Indicates that the simple effect is significant at the $p < 0.05$ level.

5.3. Discussion

Study 2 aimed to explore further the effects of the moral condition found in Study 1 by disentangling effects of animal welfare information versus environmental harm information. Results revealed that, compared with the control condition, the animal welfare essay reduced meats' advantage in ratings, whereas the environmental degradation essay did not. In other words, the effects seen in the moral condition of Study 1 are likely to be derived from the animal welfare information associated with the essay instead of information about the environmental harm produced by meat industry.

Study 3 aimed to replicate the strongest effects of Study 2 (derived from the disgust, and animal welfare essays) using supplementary visual information, and test whether these effects flow from different processes or reactions to the essays. In other words, Study 3 explored the mediational role of feelings of nausea (which often coincides with disgust) and empathy towards animals in the relationship between the disgust and animal welfare conditions and meat attitudes.

6. Study 3

6.1. Materials and methods

6.1.1. Participants

Four-hundred-sixty-seven American participants were recruited through Mturk (54.6% male; $M_{age} = 34.8$ years, $SD_{age} = 10.6$ years). Sixty participants were excluded because they were vegetarians or did not eat meats due to health or religion reasons. Thus, the final sample was 407 participants.

6.1.2. Procedure and design

The study followed the same procedure as Study 2 with two modifications. First, instead of using the four types of information (health, disgust, environmentalism, animal welfare) used in Study 2, the present study used only the two that had shown the strongest effects in the earlier studies (disgust, $n = 137$, and animal welfare, $n = 135$) and a control condition ($n = 135$). Second, instead of essays, the present study used slideshows that included images and short paragraphs of either disgust or animal welfare concerns related to meat or a neutral slideshow regarding the 1980 Winter Olympics (supplemental materials, Appendix 7). These changes were made to test whether effects in the previous studies could be increased by including visual information. Also, as noted earlier in the discussion of Study 2, some of the statements presented in the animal welfare essay might have increased participants' feelings of disgust rather than concerns for animal treatment in meat industry. Therefore, the use of slideshows in the present study allowed us to have more control over what participants imagined when presented with the manipulation.

After viewing the slideshow, participants were asked to complete the same single-item measures used in Study 2 regarding perceived healthiness ($\alpha_{meat} = 0.87$; $\alpha_{vegetables} = 0.86$), anticipated eating enjoyment ($\alpha_{meat} = 0.84$; $\alpha_{vegetables} = 0.79$) and buying likelihood ($\alpha_{meat} = 0.82$; $\alpha_{vegetables} = 0.79$) of meats and vegetables, and to answer two items (also rated on a 7-point scale; 1 = *Not at all*; 7 = *A great deal*) regarding the extent to which the slideshow made them feel (1) nauseous and (2) empathy towards animals. This addition was meant to allow us investigate the mechanism through which the manipulation works. Overall, the percentage of correct answers to attentional questions was high (supplemental materials, Appendix 8).

6.2. Results

Following the same procedure used in Studies 1 and 2, a 2 (food type: meat versus vegetable product ratings – within-subjects) \times 3 (rating: perceived healthiness, anticipated eating enjoyment and buying likelihood – within-subjects) \times 3 (slideshow condition – between

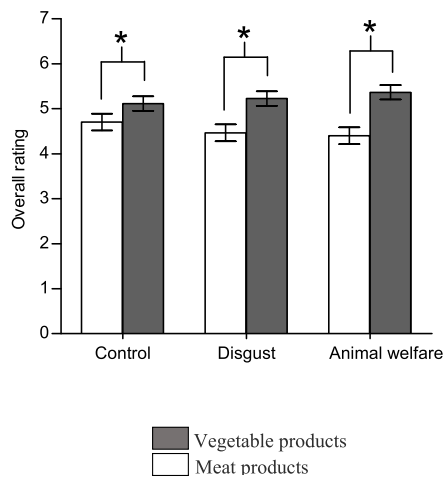


Fig. 3. Means and 95% confidence interval bars for overall ratings of meat and vegetable products on different essay conditions in Study 3. * Indicates that the simple effect is significant at the $p < 0.05$ level.

subjects) \times 2 (sex – between subjects) mixed MANOVA was carried out to test whether slideshows differentially affected ratings of meats and vegetables.

The analysis showed a significant interaction between food type and slideshow conditions, $F(2, 401) = 5.06$, $p = .007$; Wilk's $\Lambda = 0.97$, $\eta_p^2 = .025$. This effect was not moderated by rating type, $F(4, 800) = 1.77$, $p = .13$; Wilk's $\Lambda = 0.98$, $\eta_p^2 = .009$, so we proceeded to analyze data by collapsing over ratings. Participants' meat ratings were lower than vegetable ratings across the three conditions, *control condition*: $t(134) = -3.29$, $p = .001$, $d = -0.39$; *animal welfare condition*: $t(134) = -6.81$, $p < .001$, $d = -0.80$; *disgust condition*: $t(136) = -7.47$, $p < .001$, $d = -0.83$. Interaction contrasts revealed that the differences in both the disgust condition ($p = .003$) and the animal welfare condition ($p = .01$) were significantly different from those in the control condition (Fig. 3).

Finally, the slideshows indeed affected empathy and nausea. Empathy differed significantly across the three conditions, $F(2, 404) = 143.62$, $p < .001$, $\eta_p^2 = .42$, with participants in the animal welfare condition reported higher levels of empathy ($M = 5.77$, $SE = 0.15$) than in the disgust ($M = 4.83$, $SE = 0.14$, $p < .001$) and control ($M = 2.39$, $SE = 0.15$, $p < .001$) conditions. Similarly, disgust (specifically, feelings of nausea) also differed significantly across the conditions, $F(2, 404) = 59.60$, $p < .001$, $\eta_p^2 = .23$, with participants in disgust condition scoring higher ($M = 3.99$, $SE = 0.15$) than participants in the animal welfare ($M = 3.00$, $SE = 0.15$, $p < .001$) and control ($M = 1.65$, $SE = 0.15$, $p < .001$) conditions.

6.3. Mediation analysis

To test whether the slideshows had indirect effects on the meat and vegetable difference score through increased empathy towards animals, we conducted a path analysis following Hayes and Preacher's (2014) recommendations regarding mediation models with multicategorical independent variables (Fig. 4). We used Helmert coding, meaning this that the first contrast compared the control condition to the animal welfare and disgust conditions (D1), and second contrast compared the animal welfare condition to disgust condition (D2). As observed in Fig. 4, D1 had a positive effect on nausea feelings, $b = 1.86$, $SE = 0.16$, 95% CI [1.53, 2.18], and empathy towards animals, $b = 2.93$, $SE = 0.18$, 95% CI [2.58, 3.29]. Similarly, D2 had a positive effect on feelings of nausea, $b = 0.97$, $SE = 0.24$, 95% CI [0.51, 1.44], and a negative one on empathy, $b = -0.98$, $SE = 0.19$, 95% CI [-1.36, -0.60]. Neither nausea feelings, nor empathy significantly predicted vegetables and meats ratings' difference score, though. Similarly, path

analyses did not reveal any significant relative indirect effect of our manipulation. Hence, despite that D1 showed a positive effect on ratings' difference score, such effect was not explained by the mediators.

6.4. Discussion

Results again suggested that highlighting animal welfare and disgust-eliciting aspects of the meat industry affected attitudes toward meat. In particular, ratings of meats versus vegetables differed from the control condition in both experimental treatments.

Regarding the mediation analyses, results showed that, neither feelings of nausea nor empathy towards animals mediated the relation between the essay conditions and the ratings' difference score. That said, analysis did provide support for a total effect of the disgust and animal welfare conditions, compared to control condition, on ratings' difference score. Therefore, it is likely that the mediators that explain such effect are different from those that we have measured (i.e. feelings of nausea, and empathy towards animals).

7. Meta-analysis of studies 1–3

To get a better idea of the effect sizes associated with the messages employed in Studies 1–3 – and whether they depart from zero – we conducted random effects meta-analyses on meat and vegetable evaluations (as difference scores between vegetables and meats, as well as ratings of meats and ratings of vegetables, separately). Given that results from Study 1 indicated that participants not only responded differently depending on the food type, but also depending on the what type of food evaluation they made (suggesting that each individual rating might provide unique information), we decided to analyze each rating separately (Table 1).

Only the three message types (control, disgust, moral) and three dependent measures (perceived healthiness, anticipated eating enjoyment, buying intentions) used in all three studies were included. For each study, means and standard deviations for differences scores and meat and vegetable ratings for participants in control, moral, and disgust condition were computed. Note that the moral condition in Study 1 included both environmental and animal welfare concerns regarding meat industry, whereas Study 2 explored such appeals separately, and Study 3 used only an animal welfare appeal. We treated the animal welfare condition (rather than the environmental condition) as the moral condition in Study 2.

Relative to control conditions, moral messages were associated with greater differences in participants ratings of vegetables versus meats in terms of anticipated eating enjoyment, $d = 0.19$, 95% CI [0.03, 0.35], buying intentions, $d = 0.28$, 95% CI [0.12, 0.44], and perceived healthiness, $d = 0.19$, 95% CI [0.03, 0.36]. Similarly, disgust messages were associated with greater differences in anticipated eating enjoyment, $d = 0.29$, 95% CI [0.13, 0.46], and buying intentions, $d = 0.35$, 95% CI [0.18, 0.51], but not of perceived healthiness, $d = 0.13$, 95% CI [-0.04, 0.30].

In Studies 1–3, we analyzed difference scores between meat and vegetable ratings. To test whether the messages led to more negative impressions of meats, more positive impressions of vegetables, or both, we subsequently tested message ratings on meats and vegetables separately. Regarding evaluations of meat, moral messages, relative to control messages, decreased perceived healthiness, $d = -0.23$, 95% CI [-0.39, -0.06], anticipated eating enjoyment, $d = -0.24$, 95% CI [-0.40, -0.07], and buying intentions, $d = -0.25$, 95% CI [-0.41, -0.09]. However, moral messages had no effect on vegetable ratings, d perceived healthiness = -0.03 , 95% CI [-0.20, 0.14]; d anticipated eating enjoyment = 0.09 , 95% CI [-0.07, 0.25]; d buying intentions = 0.13 , 95% CI [-0.03, 0.30]. Just as with the moral messages, disgust messages decreased anticipated eating enjoyment, $d = -0.31$, 95% CI [-0.54, -0.09], and buying intentions, $d = -0.29$, 95% CI [-0.47, -0.11], though confidence intervals for effects on health ratings included zero,

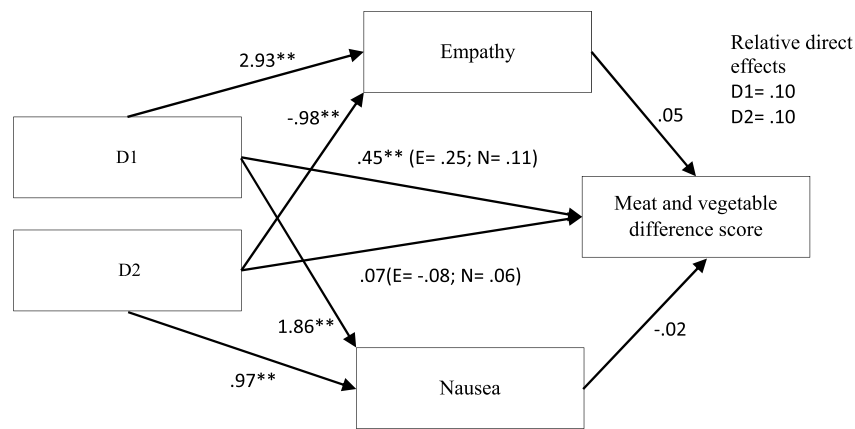


Fig. 4. Relative indirect effects of slideshow conditions on meat and vegetable ratings' difference score in Study 3.

Note: Bootstrapping fixed to 5000 re-samples, bias-corrected; ** = CI does not include zero, D1 = Control condition against Animal welfare and Disgust condition, D2 = Animal welfare against Disgust condition.

Sex was statistically controlled in the analysis.

Helmert coding used (disgust condition was set as having the ordinal highest level followed by animal welfare and control condition).

E = Relative indirect effect through empathy; N = Relative indirect effect through feelings of nausea.

$d = -0.16$, 95% CI [-0.33, 0.002]. Unlike the moral messages, though, disgust messages increased vegetables' anticipated eating enjoyment, $d = 0.17$, 95% CI [0.008, 0.33] and buying intentions, $d = 0.18$, 95% CI [0.01, 0.34] (though not perceived healthiness, $d = -0.09$, 95% CI [-0.40, 0.23]). These results suggest that disgust messages not only negatively affected anticipated eating enjoyment and buying intentions for meats; they also increased such evaluations when referred to vegetables, whereas moral appeals did not.

8. General discussion

Meat consumption is associated with health problems, and meat production imposes a large burden on environmental sustainability. To better understand how to reduce motivations to eat meat, research can study the effects of different types of persuasive messages on people's attitudes towards meat consumption.

In this paper, we compared the effectiveness of different types of persuasive information against meat consumption: two types of environmentally-related moral appeals (environmental degradation and animal welfare), health messages, and a relatively novel persuasive strategy that uses of messages designed to elicit disgust.

Overall, results indicated that disgust and animal welfare messages affected meat attitudes more strongly than did health and environmental degradation concerns. These latter results align with previous research indicating that people underestimate the meat industry's considerable environmental impact (Truelove & Parks, 2012; Vanhonacker et al., 2013) and perceive that other activities related to environmental protection have greater environmental benefits than do reductions in meat consumption (Macdiarmid et al., 2016; Tobler et al., 2011). Similarly, the lack of consistent effects of the health appeals seems aligned with literature indicating that some people weigh the (perceived) lack of protein and iron associated with a vegetarian diet more than they weigh the health threats of meat intake in their food choices (Lea & Worsley, 2001).

As mentioned above, our results suggest that both animal welfare and disgust appeals can affect meat attitudes. Indeed, existing work indicates that more positive attitude towards animal welfare are associated with choosing a vegetarian diet over a meat-reduced diet (i.e. flexitarian), as well as the choice of latter over a meat-based diet (de Backer & Hudders, 2015). Similarly, our results are aligned with research on disgust indicating that the emotion can shape aversions for foods (Rozin & Zellner, 1985; Rozin et al., 1998). The meta-analyses

Table 1
Means and standard deviations of vegetable and meat ratings' differences in study 1, 2, and 3.

Study number	Condition	Rating											
		Perceived healthiness		Eating desire		Anticipated taste/enjoyment		Perceived moral wrongness		General attitude		Buying likelihood	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Study 1	Control	2.90	.94	.09	1.72	-.03	1.48	-.72	1.04	.55	1.33	.23	1.80
	Disgust	2.83	1.28	.89	2.10	.46	1.76	-1.34	1.38	1.43	1.86	.95	2.07
	Health	2.93	1.19	-.05	1.58	-.26	1.37	-.82	1.19	.63	1.52	.12	1.50
	Moral	2.97	1.22	.58	2.16	.17	1.88	-1.82	1.45	1.33	1.97	.72	2.13
Study 2	Control	2.15	1.30			-.94	1.86					-.49	1.90
	Disgust	2.36	1.40			-.23	1.93					.17	2.06
	Health	2.86	1.20			-.66	1.95					-.05	2.14
	Animal welfare	2.48	1.21			-.31	2.14					.17	2.14
	Environment	2.10	1.48			-.99	1.84					-.40	1.79
Study 3	Control	2.13	1.37			-.56	2.01					-.29	1.98
	Disgust	2.43	1.20			-.08	1.89					.38	1.91
	Animal welfare	2.43	1.22			-.27	1.83					.22	1.86

indicated that animal welfare appeals seem to be as effective as disgust appeals in influencing meat attitudes relative to control conditions. However, disgust appeals – but not animal welfare ones – also influenced vegetable evaluations. In particular, disgust appeals improved evaluations of eating enjoyment and buying likelihood of vegetable products. This differential results might be of interest for policy makers, and have potential practical implications, especially if we consider the health protective factor associated with an adequate consumption of vegetables (Scarborough et al., 2014).

Our studies are not exempt of limitations. First, even though we excluded vegetarians from our samples, research indicates that diet choices might be far more complex rather than just a binary distinction between people who eat meat and people who do not (e.g., pescetarian, flexitarians and low-meat eaters, among others; Dagnelie & Mariotti, 2017). In other words, individuals who moderate their meat consumption for health or environmental concerns reasons might be more easily persuaded by some types of arguments against meat consumption. Future studies could explore this issue by targeting specific types of meat eaters. A second potential limitation of our studies relates to the stimuli used. In particular, when asked to rate meats and vegetables on different domains, participants across the three studies were presented with pictures depicting raw meats. Raw meat might be more disgust-eliciting than cooked meat and therefore, future developments could test whether this is the case. That said, the stimuli presented to participants depicts how meat products actually look in supermarkets and meat-selling points. Third, although the current studies pointed to disgust and animal welfare as the most effective persuasive appeals against meat consumption, the lack of relative indirect effects seen in Study 3 did not allow us to identify the mechanisms behind such effects. Therefore, future developments should investigate further other potential mediators. Fourth, the effect size estimates gleaned from the internal meta-analysis had wide confidence intervals due to the variability in effect sizes across studies and the sample sizes within those studies. For example, the 95% confidence interval for the effect size of the disgust messages on anticipated meat eating enjoyment ranged from -0.09 to -0.54 standard deviations. Future work with larger sample sizes can better hone in on the population effect size. Future studies should build on the current results and aim to provide a more precise estimate of the actual effect size of these types of persuasive food messaging. Finally, these studies did not deploy behavioral measures. Across the three studies, only participants' attitudes towards meats were evaluated, leaving open the question of whether the effects could also be seen in the behavioral realm. Future research should aim to provide an answer to this question, as well as, to explore whether changes in meat attitudes actually predict changes in meat consumption patterns.

In sum, in this paper we investigated whether environmental, individual health, and disgust information related to the meat industry and meat consumption affect attitudes toward meat. Animal welfare and disgust appeals consistently changed attitudes towards meats, and the latter even positively affected attitudes towards vegetables. Thus, initiatives aimed at decreasing meat consumption should try to highlight these two aspects of the meat industry in order to achieve higher effectiveness.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jenvp.2018.08.002>.

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