Driving Sustainable Food Choices: How to Craft an Effective Sustainability Labeling System

Paul E. Stillman[1*]

Treeny Ahmed[1]

Ravi Dhar[1]

[1]Yale School of Management

*Address correspondence to: Paul Stillman, 165 Whitney Ave, New Haven, CT 06511, or by email at paul.stillman@yale.edu

UNDER 2nd ROUND REVIEW

JOURNAL OF THE ASSOCIATION FOR CONSUMER RESEARCH

Abstract

An important step in averting climate change is shifting consumers' diets to contain less meat. While preliminary work suggests sustainability labels can shift consumers' preferences, there is no clear guidance on what makes an effective labeling system. Across 5 experiments (N = 6001), we find that multi-icon systems (traffic-light) are the most effective in reducing the carbon impact of consumers' choices, but also generated the most negative attitudes. We further find that single-icon systems (e.g., labeling only sustainable options) to be effective at shifting consumer choices, particularly when combined with numeric information (e.g., kg of CO_2), and generally produce no negative attitudes relative to control. We replicate these results using an incentive compatible design, and show they generalize to an externally valid population (tech employees), reducing the carbon footprint of choices by 25-40%. Overall, this paper provides a systematic empirical investigation of the effectiveness of different approaches to sustainability labeling.

Word count: 8000

Climate change represents an existential threat to humanity, and consumer choices increasingly reflect a desire to live sustainably (Haws, Winterich and Naylor 2014; Prothero et al. 2011; White, Habib and Hardisty 2019; Winterich 2021). One important step in reducing global climate change is to shift diets to include less beef and lamb and more plant-based dishes (Hawken 2017). Meat consumption accounts for roughly 15% of all human emissions, with beef and lamb producing roughly 5 times as much emissions compared to pork or poultry (Gerber et al. 2013).

One barrier to making sustainable food choices is consumers' lack of clarity surrounding which foods are sustainable. Indeed, consumers desire to eat sustainably, but are unsure which foods are sustainable (Hartmann et al. 2021; Herberz, Brosch and Hahnel 2020; Horne 2009; Zepeda et al. 2013), and consistently underestimate the impact of food choices on climate (Camilleri et al. 2019; Wynes, Zhao and Donner 2020). To increase awareness and shift choices, recent research has begun to investigate the effectiveness of nudges using sustainability labels (Annunziata, Mariani and Vecchio 2019; Camilleri et al. 2019; Cho and Berry 2019; Vanclay et al. 2011; Yokessa and Marette 2019). This work has shown initial promise: consumers appear willing to pay more for foods labeled with sustainability labels (Bastounis et al. 2021), and consumers make more sustainable choices when foods are labeled with sustainability information (Vanclay et al. 2011). However, current sustainability labeling systems vary greatly (Potter et al. 2021), and there is little guidance for practitioners on (a) which labeling approaches are most effective, and (b) which are least likely to generate negative reactions from consumers. In the present paper, we answer these questions by systematically testing different approaches to sustainability labeling.

Sustainability Labels: Content and Complexity

Figures 1 and S1-S3 (Web Appendix) provide examples of labels used in research and practice. We propose that these diverse labeling approaches fundamentally vary along two dimensions: their complexity (amount of information) and their content – whether they use evaluative icons (e.g., footprint icon), numerical information (e.g., kg of CO_2), or both.

Figure 1. Examples of sustainability labels used in research and practice. These labeling approaches vary on their complexity (left to right) and their content (numeric information, evaluative icons, or both). More examples are provided in Figures S1-S3.

Past research has documented the effectiveness of evaluative icons (Macdiarmid et al. 2021; Neumayr and Moosauer 2021; Panzone et al. 2020; Vanclay et al. 2011). Such icons are generally intuitive and attention-grabbing (Cadario and Chandon 2020), and require little effort to process (i.e., they operate via System 1, Dhar and Gorlin 2013). These icons (Figure 1, bottom) can be relatively simple, single-icon systems (a label highlighting the healthy foods), or more complex, 3-icon (stoplight) or 5-icon (A-E grades) systems that label all food in order to provide a more nuanced picture of the relative sustainability. While the additional nuance provided by multi-icon approaches may help consumers, the act of labeling certain foods as 'bad' in comparison to others may also generate negative emotional reactions of annoyance or shame. To our knowledge, the difference between (less complex) single- and (more complex) multi-icon labels has yet to be tested empirically.

Another approach is to use numeric information (Figure 1, top), such as estimates of CO_2 required to produce that food. Numerical information is believed to operate through more effortful processes (System 2), which can both be more persuasive, but also require more engagement to be effective, and therefore can be easier to ignore. To address this, sometimes these numbers are translated into a more interpretable measure (e.g., how many minutes that amount of carbon would power a lightbulb, Camilleri et al., 2019). As with evaluative icons, numeric information can be represented either simply (a single CO_2 number), or more complex (e.g., numeric values for carbon, land use, water use, etc., Cho and Berry 2019). Finally, some approaches combine both numeric information with evaluative icons (Figure 1, Middle), often by representing different numeric values with different colored icons (e.g., Babakhani, Lee and Dolnicar 2020; Brunner et al. 2018).

There exist no clear guidelines as to which (if any) labeling format is most effective, and which is least likely to generate negative consumer attitudes. Here, we systematically test different approaches to identify the most effective type of label in shifting consumers' choices. In particular, we investigate the effectiveness of numeric information compared to both single- vs. multi-icon approaches, and investigate whether combining evaluative icons and numeric information provides benefits over either on their own.

Effectiveness of Nutrition Labels

While these questions have not been investigated directly in sustainability, work in the related domain of nutrition labeling may provide initial suggestions. This work aims to shift consumers' choices by including numeric calorie information and/or evaluative icons highlighting healthier food options. While labeling food with calorie information was initially promising (Bollinger, Leslie and Sorensen 2011), meta analyses of these programs suggest that they produce mixed results (Long et al. 2015; Swartz, Braxton and Viera 2011). More recent reviews and empirical work suggest that nutrition labeling systems that incorporate evaluative icons (e.g., traffic-lights), can have positive influences on consumer choice (Cecchini and Warin 2016; Hobin et al. 2017; Sinclair, Cooper and Mansfield 2014; Thorndike et al. 2014). In one field study investigating both content types, VanEpps and colleagues (2016) used either a label consisting of traffic light icons, numeric calorie information, or both, and found that all approaches effectively shifted health information, but that none outperformed the others (i.e., there were no benefits of combining evaluative icons with numeric information). Other work suggests that single-icon evaluative icons (i.e., just labeling which foods were healthy) had the potential to mislead consumers into thinking that foods were healthier than they actually were (Andrews, Burton and Kees 2011). Together, this work suggests that multi-level evaluative icons are most consistently effective at shifting consumer choice, with mixed results for including numeric information of calories, and no apparent benefit of combining different label types.

While this is suggestive, several differences between health and sustainability make direct extension of these conclusions premature. First, consumers often lack even a basic understanding of which foods are vs. are not sustainable (Camilleri et al. 2019), and while health estimates are by no means accurate, consumers do have a rough (though imperfect) idea of what is vs. is not healthy. This suggests that even relatively small amounts of sustainability information (e.g., a single-icon) may be relatively more impactful. Second, compared to the health domain in which differences in calories between healthy and unhealthy foods tends to be relatively modest (e.g., a 960-calorie turkey club with chips has 2.5 times the calories of a 370-calorie turkey sandwich), differences in carbon emissions are more dramatic. For instance, beef contributes roughly 5 times the carbon emissions of chicken, and 50 times the emissions of a veggie burger (World Resources Institute 2016). This difference in magnitude may make numeric information more persuasive in the sustainability domain.

It thus remains an open question as to how effective different sustainability labeling systems are. In the present research, we seek to systematically investigate the different approaches to presenting sustainability system – namely, looking at less (single-icon) and more (multi-icon) complex evaluative icons, plus the interactive effect of including numeric information – in order to provide nuanced recommendations for restaurant or store operators interested in communicating sustainability information to their customers.

While investigating these questions, we attempt to center the constraints of restaurant operators in developing our interventions.[1] One barrier to voluntary adoption of such labels is fears of consumer backlash – as such, we also measure consumer attitudes to test which labeling systems will generate negative attitudes. Finally, we investigate if these labels will be effective for incentive compatible choices and for externally valid participants.

[1] One of the goals of this research was developing a labeling system to be used within the cafeterias of a technology company. For this reason, we opted not to investigate two labeling strategies: first, as more complex numeric information (e.g., amount of water used) can be challenging to calculate, we only investigate the presence or absence of simple numeric information (kg of CO2), rather than more complex numeric representations. Second, while work on nutrition has found that single-icon 'stop signs' that highlight unhealthy food can be effective (Andrews et al. 2021), we reasoned most operators would not want to include labels that solely highlighted certain foods as 'bad.' We leave investigation of these labeling approaches to future research.

The Present Studies

To investigate these questions, we conducted five online experiments that systematically varied the content and complexity of sustainability labels. Study 1 tested whether the complexity of evaluative icons (i.e., single-icon vs. multi-icon) influenced label effectiveness. Study 2 tested the effectiveness of numeric information versus (single) evaluative icons, as well as whether combining them outperformed either alone. Study 3 investigated the interactive effects of single- and multi-icon labels with numeric information. Finally, Study 4 replicated these effects using an incentive compatible design, and Study 5 constituted a large-scale replication using a sample of technology employees. Across many of our studies, we investigated attitudes toward the restaurant in order to test negative backlash produced by the addition of a labeling system.

Figure 2. Choices for appetizer (top) and main (bottom) in the (higher complexity) multi-icon traffic-light (top) and (lower complexity) single-icon (bottom) condition. Condition was manipulated between subjects, and each subject saw all the same labels (or no labels at all in the control condition).

Study 1

Study 1 investigated the differential impact of label complexity, testing how a single-icon system (highlighting only the sustainable option) compared to a multi-icon system (e.g., a traffic-light) for choices and attitudes towards the restaurant.

Participants. We recruited 1,054 participants (56% female, mean age = 37) not following a strict vegan or vegetarian diet from Amazon's Mechanical Turk to participate in exchange for $0.30.

Procedure. We presented participants with 5 appetizer and 5 main dish options with pictures and names, and participants chose one of each (see Figure 2). In the control condition, participants simply made their choice, and in the critical conditions we explained the evaluative icons before participants made their choice. To compare (more complex) multi-icons with (less complex) single-icons, participants either saw (a) a single-icon system where we only include a green footprint on the most sustainable choices (the seafood and vegetarian options), with the other food choices having no label, or (b) a multi-icon system where every food had a label that corresponded to low/medium/high emissions (e.g., green for vegetarian/seafood, yellow for chicken, red for beef). We tested several different color schemes for the multi-icon systems (Figure S4): a traffic light, black/grey/green, a "medal" condition (bronze/silver/gold), and two "fill" conditions ("fill-black" and "fill-white").

After making their food choices, participants responded to a series of questions assessing attitudes towards the cafe: "This cafe cares about offering tasty food options", "I would return to this cafe in the future", "I was satisfied by the options served at the cafe" (all rated: 1 = strongly disagree, 7 = strongly agree), and "What is your overall opinion of the cafe?" (1 = dislike a great deal, 7 = like a great deal). These measures were highly correlated ($\alpha = .88$) and collapsed into a composite measure.

Results

We analyzed whether participants selected one of the three seafood or vegetarian options and conducted a generalized logistic mixed effects model with random effects for participant predicting choice (1 = chose seafood or vegetarian, 0 = other) from dummy variables corresponding to our critical conditions.

There were no significant differences between the different multi-icon conditions ($ps > .18$) and so we report results collapsing across these conditions (individual condition results given in the Web Appendix). Relative to control, in which 49% of participants chose sustainable options, we see a significant increase in sustainable choice for both multi-icon systems, in which 63% chose sustainable ($b = .70$, $SE = .17$, $Z = 4.22$, $p < .001$), and single-icon systems, in which 63.5% chose sustainable ($b = .72$, $SE = .20$, $Z = 3.62$, $p < .001$), with no difference between single- and multi-icon (*b* = .02, *SE* = .17, *Z* = .12, *p* = .90), suggesting single-icon systems may be as effective as multi-icon systems.

Confirming the risk of negative consumer attitudes, participants who were shown a multi-icon labeling system had significantly more negative attitudes towards the restaurant compared to control, *b* = -.18, *SE* = .09, *t*(1051) = -1.97, *p* = .049. The single-icon system, in contrast, was not significantly different from control, *b* = -.05, *SE* = .12, *t*(1051) = -.46, *p* = .649.

Discussion

Study 1 found a less complex single-icon system (i.e., highlighting only the most sustainable option) to be as effective as more complex multi-icon systems (e.g., traffic-light). Notably, multi-icon systems generated negative attitudes towards the restaurant, but the single-icon system did not.

Study 2

Study 2 investigated the effect of label content (evaluative icons vs. numeric information) on consumers' choices. Participants saw single-icons, numeric information (kg of CO_2), or both. We further received feedback from cafeteria operators that indicated they did not want to have a foot prominently displayed near their food. We thus switched from the single green footprint to a single green and blue globe (see Figure 3; supplemental studies 1a-1b confirmed that globe icons were preferred to footprints by both consumers and managers).

Participants. We recruited 1,514 participants (50% female, mean age = 42) not following a strict vegan or vegetarian diet from Amazon's Mechanical Turk in exchange for $0.50.

Procedure. Participants were asked to imagine visiting a build-your-own-burger restaurant where you could select the components of your burger. We presented participants with several choices for each of the following: bun, sauce, patty, cheese, and condiments. The critical dependent variable was the choice of patty. Participants had five options: 100% beef patty (3.93 kg of CO_2), 50%-blended beef and mushroom patty (1.97 kg of CO_2), turkey patty (.53 kg of CO_2), chicken breast (.53 kg of CO_2), and vegan patty (.05 kg of CO_2, see Figure 3). In the control condition, participants simply saw no labels or numbers when making their choice.

In the critical conditions, we added a labeling system to the patty options (see Figure 3). Before making any choices, participants saw an explanation of the labels. In the single-icon condition we labeled the vegan patty with a globe plus a message that read “sustainable choice!” In the numeric information condition, we labeled each patty option with the estimated kg of CO_2 emitted to produce that choice. In single-icon + numeric condition, participants saw both the globe symbol and the numerical information. Finally, we exploratorily tested a version of numeric information that also included a picture of a car with the distance required to produce equivalent carbon emissions (e.g., the beef patty corresponded to 17.4 miles, whereas the vegan patty correspond to .22 miles), calculated using the Greenhouse Gas Equivalencies Calculator on the Environmental Protection Agency website. After making their selection, participants evaluated the restaurant, though for this and the following studies we shortened this to a single item question, “What is your overall opinion of the cafe?” (1 = dislike a great deal, 7 = like a great deal).

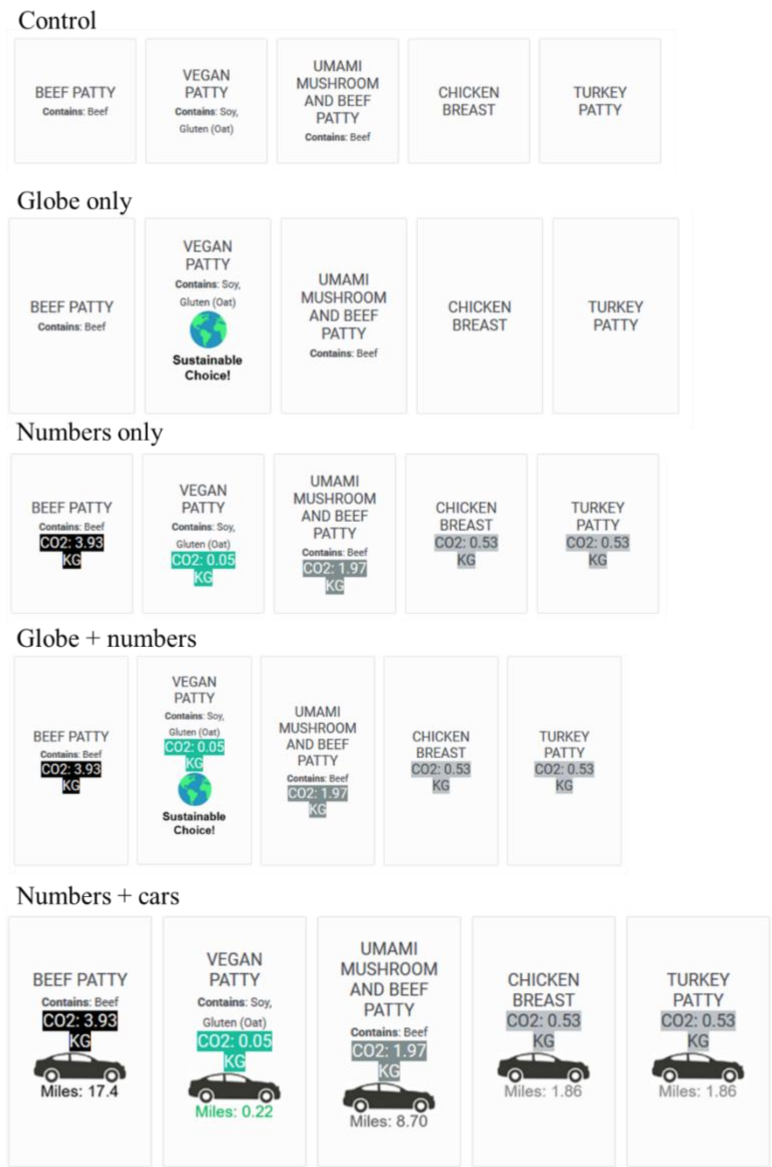

Figure 3. Conditions for Study 2.

Results

We analyzed the data in three ways: (1) proportion of participants selecting the vegan patty, (2) proportion of participants selecting the 100% beef patty, and (3) the average carbon footprint (in kg of CO_2) of each condition. Replicating Study 1, all four of our critical conditions significantly increased choice share of the vegan patty compared to control. In control, 10.4% of participants chose the vegan patty compared to 23.3% for the single-icon (b = .97, SE = .23, Z = 4.14, p < .001), 21.0% for the single-icon + numeric (b = .83, SE = .24, Z = 3.51, p < .001), 16%

for numeric information only ($b = .50$, $SE = .24$, $Z = 2.07$, $p = .039$), and 21.3% for numeric information + car-miles ($b = .85$, $SE = .23$, $Z = 3.64$, $p < .001$). Further, the single-icon alone significantly outperformed numeric information alone ($b = -.47$, $SE = .21$, $Z = -2.25$, $p = .024$). None of the other conditions were significantly different from one another.

Notably, when we investigate the choice share of the 100% beef patty, as well as the carbon footprint for each condition, we see a more nuanced picture. As before, all conditions had a lower choice share of beef and a lower carbon footprint compared to control (51.3% selecting beef, $M_{carbon} = 2.39$ kg CO2, with comparison summarized in Table 1): single-icon: 40.4% selecting beef ($b = -.44$, $SE = .17$, $Z = -2.66$, $p = .008$), $M_{carbon} = 1.98$ ($b = -.41$, $SE = .14$, $t(1509) = -3.03$, $p = .003$), single-icon + numeric: 30.9% selecting beef ($b = -.86$, $SE = .17$, $Z = -5.02$, $p < .001$), $M_{carbon} = 1.67$ ($b = -.72$, $SE = .13$, $t(1509) = -5.34$, $p < .001$), numeric information only: 38.7% selecting beef ($b = -.51$, $SE = .16$, $Z = -3.17$, $p = .002$), $M_{carbon} = 1.98$ ($b = -.42$, $SE = .13$, $t(1509) = -3.16$, $p = .002$), numeric information + car-miles: 30.0% selecting beef ($b = -.90$, $SE = .17$, $Z = -5.34$, $p < .001$), $M_{carbon} = 1.60$ ($b = -.80$, $SE = .13$, $t(1509) = -6.01$, $p < .001$). Further, in contrast with the results looking solely at vegan patty choice share, we see that both the single-icon and numeric-only conditions were significantly less effective than both the single-icon + numeric and numeric + cars conditions (*ps* < .05). In other words, our control condition is least effective for shifting choices, and both (a) our single-icon + numeric information and (b) numeric information + cars conditions outperformed both (c) single-icon and (d) numeric information on their own (see Table 1). Finally, evaluations of the restaurant did not differ significantly across conditions (*ps* > .10).

Table 1. Average Beef choice share, veggie choice share, carbon footprint, and evaluations of the restaurant for each condition in Study 2.

	Control	Single-Icon	Numeric Information	Numeric Information + Cars	Single-Icon + Numeric Information
Beef Choice Share	51.3%[a]	40.4%[b]	38.7%[b]	30.0%[c]	30.9%[c]
Veggie Choice Share	10.4%[a]	23.3%[b]	16%[b]	21%[b]	21.3%[b]
Carbon Footprint (kg of CO_2)	2.39[a]	1.98[b]	1.98[b]	1.60[c]	1.67[c]

Note. Within each row, values with different superscripts are significantly different from one another (superscripts between rows are not comparable).

Discussion

Study 2 found that combining numeric information with an (less complex) evaluative icon (i.e., a sustainable globe) was more successful than using either approach in isolation. We similarly see benefits of translating numeric information to an easy-to-comprehend metric (car miles). Finally, none of these approaches induced negative attitudes.

Study 3

Study 1 suggested that less complex single-icons were as effective as more complex multi-icons, and Study 2 showed that introducing numeric information had an additive effect with single-icons. Study 3 investigated the interactive effects of (less vs. more complex) evaluative icons and numeric information in a 3 (evaluative icons: none, single-icon globe, multi-icon traffic-light) × 2 (numeric information: absent vs. present) design.

Participants. We recruited 1,804 participants (47% female, mean age = 38) not following a strict vegan or vegetarian diet from Prolific in exchange for $0.50.

Procedure. Study 3 closely resembled Study 2: participants completed the same hypothetical "build your own burger" task. In the control condition (no evaluative icons and numeric information absent), participants simply selected which patty option they preferred. For all levels that included numeric information, the kg of CO_2 was presented for each option (Figure 4, bottom, with numbers slightly different than Study 2 due to changing our source to the World Resources Institute, 2016). For the single- and multi-icon conditions, we included respectively (a) a globe on the vegan burger, or (b) green, yellow, or red stoplight symbols on each protein option (Figure 4, top). We measured attitudes of the restaurant using the same single-item measure as Study 2. Lastly, we measured two individual difference variables of interest: "Global climate change is the most important issue of our time," (1 = strongly disagree, 7 = strongly agree) and hunger (1 = not at all hungry, 7 = very hungry), in order to test whether our effects are stronger for those who believe climate change is an important issue and weaker for those who are hungry.

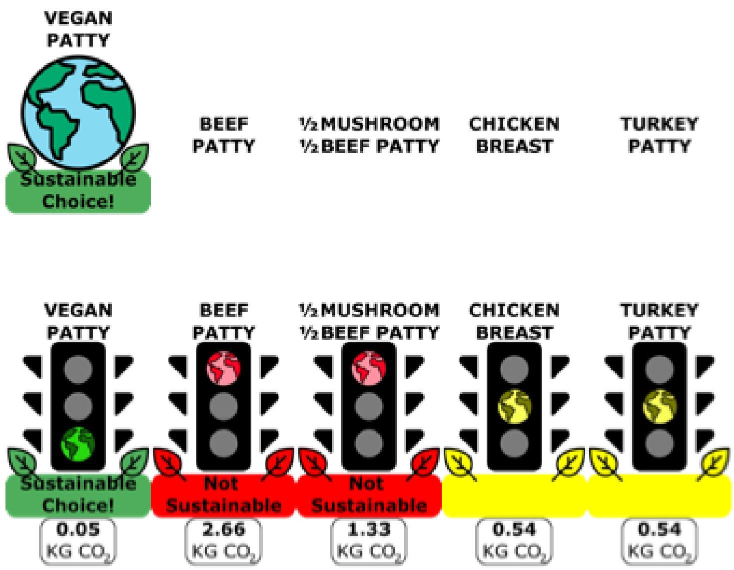

Figure 4. Examples of conditions in Study 3. Participants saw either no evaluative icons, a less complex single-icon (i.e., a globe, top), or more complex multi-icons (i.e., traffic-light, bottom). Participants also either were given numeric information (bottom), or this information was omitted (top).

Results

Choice Share – Vegan. We find that all critical conditions except for numeric information (see Table 2) significantly increased choice share of the vegan patty relative to control, in which 4.9% of participants chose a vegan patty compared to 9.0% for single-icon (b = .65, SE = .33, t(1798) = 1.96, p = .050); 6.6% for numeric information (b = .32, SE = .35, t(1798) = .92, p = .359); 12.7% for single-icon + numeric information (b = 1.04, SE = .32, t(1798) = 3.28, p = .001); 13.8% for multi-icon (b = 1.13, SE = .31, t(1798) = 3.61, p < .001); and 13.6% for multi-icon + numeric information (b = 1.11, SE = .31, t(1798) = 3.57, p < .001). Further, we see that the single-icon + numeric information, as well as both multi-icon conditions significantly outperformed numbers on their own (ps < .02).

Choice Share – Beef. Replicating Study 2, we find all critical conditions reduced choice share of the full beef patty relative to control, in which 59.8% of participants chose beef, compared to 46.3% for single-icon (b = -.54, SE = .16, t(1798) = -3.31, p < .001); 37.2% for numeric information ($b = -.92$, $SE = .17$, $t(1798) = -5.52$, $p < .001$); 37.5% for single-icon + numeric information ($b = -.91$, $SE = .17$, $t(1798) = -5.45$, $p < .001$); 34.0% for multi-icon ($b = -1.06$, $SE = .17$, $t(1798) = -6.27$, $p < .001$); and 31.9% for multi-icon + numeric information ($b = -1.16$, $SE = .17$, $t(1798) = -6.80$, $p < .001$). Further, the single-icon condition performed significantly worse than all other critical conditions ($ps < .05$).

Table 2. Average Beef choice share, veggie choice share, carbon footprint, and evaluations of the restaurant for each condition in Study 3.

	Control	Single-Icon	Numeric Information	Single-Icon + Numeric	Multi-Icon	Multi-Icon + Numeric
Beef Choice Share	59.8%[a]	46.3%[b]	37.2%[c]	37.5%[c]	34.0%[c]	31.9%[c]
Veggie Choice Share	4.9%[a]	9.0%[bc]	6.6%[ab]	12.7%[c]	13.8%[c]	13.6%[c]
Carbon Footprint (kg of CO2)	1.89[a]	1.60[b]	1.43[c]	1.39[c]	1.23[d]	1.20[d]
Evaluations	5.90[a]	5.79[a]	5.71[b]	5.70[b]	5.48[c]	5.51[c]

Note. Within each row, values with different superscripts are significantly different from one another (superscripts between rows are not comparable).

Carbon Footprint. Finally, we investigated the average emissions of choices as a function of condition. Again, we see all conditions significantly outperform control, which had an average carbon footprint of 1.89 kg CO_2 compared to 1.60 kg for single icon ($b = -.29$, $SE = .08$, $t(1798) = -3.42$, $p < .001$); 1.43 kg for numeric information ($b = -.46$, $SE = .08$, $t(1798) = -5.51$, $p < .001$); 1.39 kg for single-icon + numeric information ($b = -.50$, $SE = .08$, $t(1798) = -5.94$, $p < .001$); 1.23 kg for multi-icon ($b = -.66$, $SE = .08$, $t(1798) = -7.88$, $p < .001$); 1.20 kg for multi-icon + numeric information ($b = -.69$, $SE = .08$, $t(1798) = -8.22$, $p < .001$). We further find that the numeric information and single-icon + numeric information conditions significantly outperform single-icons alone ($ps < .05$), and that both multi-icon conditions significantly outperform all other critical conditions ($ps < .05$), but were not different from one another ($p = .752$).

Interactive Effect. For both the beef choice share and the carbon impact of choices, we find a significant evaluative icon × numeric information interaction, beef choice share: $F(2, 1798) = 7.02$, $p < .001$; carbon footprint: $F(2, 1798) = 6.76$, $p = .001$ (there was no significant interaction for choice share of vegan patty, $F(2, 1798) = .63$, $p = .532$). Probing these interactions, it appears that adding numeric information significantly reduces beef choice share and carbon footprint for both single-icon (beef choice share: $Z = -2.19$, $p = .028$; carbon footprint: $t = -2.48$, $p = .013$) and no-icon conditions (beef choice share: $Z = -5.52$, $p < .001$; carbon footprint: $t = -5.69$, $p < .001$), but not for stoplight conditions (beef choice share: $Z = -.55$, $p = .583$; carbon footprint: $t = -.30$, $p = .762$). In other words, adding numeric information is helpful both on its own, and in conjunction with single-icons, but not in conjunction with multi-icons.

Evaluations. As in Study 1, we find that participants in either the multi-icon ($M_{multi\text{-}icon}$ = 5.48) or multi-icon + numeric information ($M_{multi\text{-}icon+numeric}$ = 5.51) conditions held significantly less positive attitudes towards the restaurant than in any other condition (*ps* < .05, with the two conditions not significantly different from one another, $p = .702$). Unlike in Study 1, compared to control ($M_{control}$ = 5.90), we also see slightly more negative attitudes for numeric information ($M_{numeric}$ = 5.71, $b = -.19$, $SE = .09$, $t(1798) = -2.16$, $p = .031$), and for single-icon + numeric information ($M_{single\text{-}icon+numeric}$ = 5.70, $b = -.20$, $SE = .09$, $t(1798) = -2.30$, $p = .022$), but not for single-icon alone (5.79), $b = -.10$, $SE = .09$, $t(1798) = -1.16$, $p = .240$ (there were no significant differences between these 3 conditions).

Individual Differences. We next look at whether our individual difference measure of the importance of climate change impacted the effectiveness of our manipulations on the carbon footprint of choices. We find a significant climate importance × condition (0 = control, 1 = labeled) interaction ($b = -.12$, $SE = .03$, $t(1800) = -3.38$, $p < .001$), such that labeling was more effective for those who endorsed that climate change was the most important issue of our time (+1 SD = 6.66, $b = -.73$, $SE = .09$, $t(1800) = -8.14$, $p < .001$) than those who did not (-1 SD = 3.02, $b = -.30$, $SE = .09$, $t(1800) = -3.44$, $p < .001$) though we note that labels were still highly effective for both groups. We do not find evidence for higher order interactions, suggesting that labels are more effective for those who believe climate change is important, but no labels perform particularly well for these individuals. Finally, we find a much weaker hunger × condition interaction ($b = .07$, $SE = .04$, $t(1800) = 1.96$, $p = .049$), suggesting labeling systems are less effective for those who are hungry (+1 SD = 5.99, $b = -.39$, $SE = .09$, $t(1800) = -4.17$, $p < .001$), than those who are not (-1 SD = 2.46, $b = -.65$, $SE = .09$, $t(1800) = -6.99$, $p < .001$), though again labeling systems were highly effective for both groups.

Discussion

Study 3 provided a more systematic investigation of (single and multi) evaluative icons and numeric information. Replicating Study 2, we find that combining numeric information with less complex single-icons (i.e., a globe and numbers) was more effective than either just single-icons (for decreasing choice share of the beef patty) or just numerical information (for increasing choice share of the vegan patty). Second, unlike single-icons, there appears to be no benefit of including numeric information with multi-icons (i.e., there were no differences between multi-icons with vs. without numeric information). Third, when analyzing the average CO_2 emissions of choices, multi-icon approaches significantly outperformed all other conditions, suggesting they may be the most effective overall. The greater effectiveness of these labels, however, was qualified by the fact that they also appeared to generate significantly more negative attitudes compared to all other conditions. Finally, we find that sustainability labels are most effective for those who view climate change as an important issue and for those who are not exceedingly hungry.

Study 4

Study 4 aimed to see whether sustainability labels would be similarly effective using an incentive compatible design. While hypothetical studies often produce similar results to incentive compatible designs (e.g., Hascher, Desai and Krajbich 2021), there exist systematic ways in which hypothetical designs do not reflect real behavior (Camerer and Mobbs 2017), and participants often select less healthier options when the choice is not hypothetical (Herziger and Hoelzl 2017). In Study 4, we presented participants with meals adapted from a meal-delivery service and tested the effectiveness of both (less complex) single-icon and (more complex) multi-icon evaluative information (both combined with numeric information) on participants' meal selections. Participants were instructed that one person would be selected at random and have their meal choice shipped to them.

Participants. We recruited 903 participants (47% female, mean age = 38) not following a strict vegan or vegetarian diet from Prolific in exchange for $0.50.

Procedure. Participants were told they would make a meal selection from a food delivery service, and were presented with six different food options and pictures taken from the Blue Apron website: creamy tomato fettuccine (vegetarian, .15 kg CO_2), pasta Bolognese (beef, 7.54 kg CO_2), rosemary garlic ribeye steak (beef, 15.08 kg CO_2), Mediterranean turkey stuffed peppers (poultry, 1.53 kg CO_2), spicy soy-glazed tofu (vegetarian, .20 kg CO_2), and oven-baked chicken & romesco couscous (poultry, 1.88 kg CO_2). Participants were instructed that each meal was of equivalent price, took roughly 30 minutes to prepare, and made two servings.

Participants were randomly assigned to one of three conditions: control, (less complex) single-icon + numeric information, and (more complex) multi-icon + numeric information (both identical to the corresponding conditions from Study 3).

Results and Discussion

As before, we analyze (a) choice share of the sustainable options (i.e., the vegetarian options), (b) choice share of the beef options, and (c) carbon footprint of choices. We find a consistent effect such that both single- and multi-icons outperformed control, but were not significantly different from each other. In the control condition, 5% of participants chose a vegetarian option, compared to 14.8% for single-icon + numeric information (b = 1.05, SE = .31, Z = 3.71, p < .001) and 13.8% for multi-icon + numeric information (b = 1.13, SE = .30, Z = 3.42, p < .001). Similarly, in the control condition, 51.5% of participants chose a beef option, compared to 29.3% for single-icon + numeric information (b = -94, SE = .17, Z = -5.47, p < .001) and 29.5% for multi-icon + numeric information (b = -.93, SE = .17, Z = -5.46, p < .001). Finally, the average carbon footprint for the control condition was 6.93 kg, compared to 4.14 kg for single-icon + numeric information (b = -2.80, SE = .50, $t(900)$ = -5.61, p < .001) and 4.50 kg for multi-icon + numeric information (b = -2.44, SE = .50, $t(900)$ = -4.93, p < .001). Across all three dependent variables, the two critical conditions did not differ (ps > .472).

Together, these results suggest that sustainability labels can be effective even for real choices, although here we find no evidence that systems using multi-icons are more effective than single-icons. We return to this discrepancy in the discussion.

Study 5

Study 5 sought to replicate the effectiveness of combining less complex evaluative icons with numerical information in a study using a novel population: corporate employees at a large American tech firm.

Power Analysis and Participants. A power analysis suggested a target sample size of 680 total (340 per cell) to achieve 95% power to detect a difference of 14% (e.g., a difference of beef choice share of 50% vs. 36%) via a Fisher's exact test. Overall, we recruited 964 (58% female, average age of 34) employees via email and internal advertisement at newsletters and a digital announcements platform, and all gave informed consent and participated in the research study. Approximately, 25% of our volunteers reported following a strict vegetarian, vegan, or pescatarian diet, and as such these volunteers were excluded from our analysis (results were unchanged when using the entire sample). This resulted in a sample size of 726 participants.

Procedure

Made-to-order burger. Participants first completed the same hypothetical "build-your-own-burger" scenario as Studies 2-3. Participants were assigned to one of two conditions (between subjects): control or single-icon + numeric information, the latter of which was similar to Studies 2-4 (see Figure S5). Participants then provided their overall opinion of the restaurant (1 = dislike a great deal, 7 = like a great deal).

Stew choice. To test another food concept, we asked participants to select their preferred source of protein for a menu option called Jamaican Brown Stew ("a stew packed with Caribbean flavors and spices"). The protein options were beef (2.66 kg of CO_2), tofu (.05 kg of CO_2), pork (.58 kg of CO_2), fish (cod, .35 kg of CO_2), chicken (.54 kg of CO_2), and seasonal veggies (.05 kg of CO_2). For those in the single-icon + numeric condition, the globe label was affixed to the "seasonal veggies" and "tofu" choices, and these participants further saw the kg of CO_2 information for all protein options. Participants were assigned to the same condition as they were for the burger scenario. Participants then provided their overall opinion of the restaurant (1 = dislike a great deal, 7 = like a great deal).

Results

Made-to-order burger. As before, our primary outcomes of interest were the choice share of the beef patty, the choice share of the veggie patty, and the average emissions of their choices (Table 3). Replicating our prior studies, we see a significant reduction in the choice share of the beef patty: 30% of control participants chose the beef patty, compared to 18% for single-icon + numeric information (30%, ($b = .67$, $SE = .18$, $Z = 3.73$, $p < .001$). We similarly see a significant increase in the choice share of the vegan patty when presented with the single-icon + numeric information compared to the control, increasing to 22% from 13% ($b = -.57$, $SE = .20$, Z

= -2.88, *p* = .004). Finally, we see a significant decrease in average emissions, with control condition choices producing on average 1.33 kg compared to 1.01 kg for the single-icon + numeric information condition (b = .32, SE = .07, t(722) = 4.58, p < .001).

Table 3. Choice share in Study 4 as a function of condition.

BURGER

	Beef (2.66)	Veggie (.05)	Umami Mushroom and Beef (1.33)	Chicken Breast (.54)	Turkey (.54)	Average CO_2 of Choice
Control	.30	.13	.28	.20	.09	1.33
Single-Icon + Numeric	.18	.22	.25	.25	.10	1.01
Significance Test	p < .001***	p = .004**	p = .373	p = .060†	p = .697	p < .001***

STEW

	Beef (2.66)	Seasonal Veggies (.05)	Tofu (.05)	Fish (.35)	Pork (.58)	Chicken (.54)	Average CO_2 of Choice
Control	.16	.11	.12	.15	.07	.40	.75
Single-Icon + Numeric	.06	.18	.14	.23	.06	.33	.46
Significance Test	p < .001***	p = .007**	p = .304	p = .006**	p = .553	p = .076†	p < .001***

Note. Choice share values for the burger (top) and stew (bottom) decisions in Study 5. Choice share values (i.e., Beef, Veggie, …, Turkey Patty) correspond to the proportion of participants in that condition choosing that option (e.g., for the burger choice, 30% of participants chose the beef patty in the control condition). Values in parentheses correspond to the CO_2 emissions of that particular choice. Average CO_2 of choice corresponds to the average emissions of choices for that condition (higher values equals more emissions). ***p < .001, **p < .01, *p < .05, †p < .10.

Jamaican stew. We next investigated the impacts of our label on choice within the stew context, results of which are given in Table 3. Consistent with the above results, including the single-icon + numeric information significantly reduced beef choice share to 6% from 16% in the control condition (16%, b = 1.14, SE = .27, Z = 4.23, p < .001). To examine the impact of our label on the choice share of the most sustainable option, we tested (a) the combined choice share of the seasonal veggies plus the tofu (i.e., the two options labeled with the Globe icon), and (b) the choice share of tofu and seasonal veggies separately. When looking at the combined choice share, we see a significant increase in the single-icon + numeric information condition 33% compared to 23% for control (*b* = -.49, *SE* = .17, *Z* = -2.92, *p* = .004). This effect appeared to be driven primarily by an increase in choice share of seasonal veggies (18% in the critical condition vs. 11% in control, *b* = -.58, *SE* = .22, *Z* = -2.70, *p* = .007); the pattern for tofu was consistent but not significant (14% in the critical condition vs 12% in control, 12%, *b* = -.23, *SE* = .22, *Z* = -1.03, *p* = .304). Finally, we again found that our label intervention reduced the carbon footprint of choices from .75 kg of CO_2 in control to .46 kg (*b* = .28, *SE* = .06, *t*(719) = 5.11, *p* < .001). As with the burger restaurant, attitudes of the restaurant did not differ as a function of the label condition (*b* = -.05, *t*(722.02) = -.64, *p* = .525).

Discussion

Study 5 demonstrated the effectiveness of using a less complex single-icon sustainability label that highlighted the most sustainable option(s) and provided numeric information on the CO_2 emissions. Using a more externally valid population of corporate employees, we found that, across multiple restaurant concepts, including these sustainability labels decreased the carbon emission of choices by approximately 0.3 kg of CO_2 on average per person. In percentage terms, this amounts to a decrease of between 25% (burger) and 40% (stew) of emissions. To put this number in perspective, if the true effect size of this in the field were one third the size as this effect (i.e., 0.1 kg of CO_2 per person per meal, roughly 10% per meal), it would translate to a reduction of roughly 180 kg of CO_2 per person per year, equivalent to driving a car over 450 miles. These results thus further demonstrated the robustness of sustainability labels, and suggested the results to be effective beyond Mechanical Turk participants.

General Discussion

Leveraging carbon emission information to promote more sustainable consumption is an exciting new frontier in sustainable decision-making, relevant to public health, economics, marketing, and sustainability science. Notably, however, there exist many possible ways to convey this information to consumers. Until now, there has been minimal guidance for how to construct sustainability labeling systems, and their potential for producing negative attitudes amongst consumers has not been extensively investigated. Across five experiments, we demonstrated that identifying sustainable food options with a label consistently led to more sustainable choices by consumers. Study 1 found that less complex single-icons (i.e., exclusively highlighting which options are sustainable) were as effective as more complex multi-icons, such as a traffic-light. Notably, these multi-icons (but not single-icons) produced negative attitudes compared to control. Study 2 found that combining a less complex single-icon with numeric information outperformed either alone. Study 3 (a) replicated that combining numeric information with the single-icon increased sustainable behavior more than either on their own, but also found (b) that (in contrast to Study 1) using more complex multi-icons (either with or without numeric information) were the most effective. Notably, however, as in Study 1, introducing multi-icon traffic-lights generated less favorable attitudes toward the restaurant. Study 3 further found impacts of individual differences, such that sustainability labels are most effective for those who believe climate change is important, and for those who are not overly hungry. Study 4 used an incentive compatible design and again found that combining numeric information with both single- or multi-icons shifted behavior, and Study 5 demonstrated that sustainability labeling systems combining single-icons with numeric information similarly influence choices in a more externally valid population: employees at a large technology firm.

Recommendations for Implementation

The present research provides evidence, using hypothetical and incentive compatible food choices, that sustainability labels can lead to non-trivial reductions in the carbon emissions of food choices. Indeed, our studies consistently find that sustainability labels reduce carbon emissions of food choices by approximately 25-40%, consistent with past work using real behavior – for instance, Camilleri and colleagues (2019) found a 35% decrease in purchase of beef soup compared to control. Our work suggests that providing numeric information on carbon emissions, coupled with either a less complex single-icon system highlighting the most sustainable options, or an illustration of what the carbon numbers mean in terms that are clear to participants (e.g., minutes of powering a lightbulb, miles driven in the average car, etc.), are effective approaches to shifting consumer choices without generating negative attitudes.

Recommendations surrounding whether or not to use a more complex multi-icon system such as a traffic-light are less straightforward. In Study 3, we found that these labels outperformed single-icons (there was also no benefit of adding numeric information to traffic-lights). However, we did not find an advantage of multi-icons in either Study 1 or Study 4, suggesting that multi-icons may not be robustly advantaged compared to single-icons. Further, using traffic-light icons must be balanced against the relatively greater likelihood of generating negative attitudes compared to other labeling approaches. Taken together, these results suggest that (a) any label is better than nothing (all labeling conditions significantly outperformed control across all studies), (b) less complex single-icons combined with numeric information may be the "safest" approach to maximize effectiveness while minimizing risk of negative attitudes amongst consumers, and (c) if negative consumer attitudes are not of a concern, then stoplight evaluative icons may be most desirable given the possibility for relatively higher effectiveness.

Limitations and Future Directions

A limitation of the present work is that it relies solely on online food choices, and only Study 4 used an incentive compatible design. We believe that the robustness of our effects suggest that these results will hold under conditions of real choice (even if the true effect size is ultimately smaller), but clearly this warrants future research. Additionally, while we have demonstrated our effect is robust across multiple presentations, it remains to be seen whether such labels may eventually weaken once their novelty wears off.

Conclusion

Combating global climate change requires massive change across multiple different domains. One way that we as individuals can help reduce climate change is by being more mindful of the climate impact of our food choices. A major obstacle, however, remains outsized uncertainty regarding which options are more sustainable, as well as understanding relatively how much more sustainable one option is than another. In the present research, we demonstrate that labeling systems that take advantage of numeric information combined with relatively simple symbols that highlight which options are most sustainable reliably influence consumers' choices to be more environmentally friendly. Sustainability labels thus constitute an impactful, cost-effective and scalable tool for food organizations looking to decrease their carbon footprint and help forestall major climate change.

References

Andrews, J. Craig, Scot Burton, and Jeremy Kees (2011), "Is Simpler Always Better? Consumer Evaluations of Front-of-Package Nutrition Symbols," *Journal of Public Policy & Marketing*, 30(2), 175–90.

Andrews, J. Craig, Richard Netemeyer, Scot Burton, and Jeremy Kees (2021), "What Consumers Actually Know: The Role of Objective Nutrition Knowledge in Processing Stop Sign and Traffic Light Front-of-Pack Nutrition Labels," *Journal of Business Research*, 128, 140–55.

Annunziata, Azzurra, Angela Mariani, and Riccardo Vecchio (2019), "Effectiveness of Sustainability Labels in Guiding Food Choices: Analysis of Visibility and Understanding among Young Adults," *Sustainable Production and Consumption*, 17, 108–15.

Babakhani, Nazila, Andy Lee, and Sara Dolnicar (2020), "Carbon Labels on Restaurant Menus: Do People Pay Attention to Them?," *Journal of Sustainable Tourism*, 28(1), 51–68.

Bastounis, Anastasios, John Buckell, Jamie Hartmann-Boyce, Brian Cook, Sarah King, Christina Potter, Filippo Bianchi, Mike Rayner, and Susan A. Jebb (2021), "The Impact of Environmental Sustainability Labels on Willingness-to-Pay for Foods: A Systematic Review and Meta-Analysis of Discrete Choice Experiments," *Nutrients*, 13(8), 2677.

Bollinger, Bryan, Phillip Leslie, and Alan Sorensen (2011), "Calorie Posting in Chain Restaurants," *American Economic Journal: Economic Policy*, 3(1), 91–128.

Brunner, Florentine, Verena Kurz, David Bryngelsson, and Fredrik Hedenus (2018), "Carbon Label at a University Restaurant – Label Implementation and Evaluation," *Ecological Economics*, 146, 658–67.

Cadario, Romain and Pierre Chandon (2020), "Which Healthy Eating Nudges Work Best? A Meta-Analysis of Field Experiments," *Marketing Science*, 39(3), 465–86.

Camerer, Colin and Dean Mobbs (2017), "Differences in Behavior and Brain Activity during Hypothetical and Real Choices," *Trends in Cognitive Sciences*, 21(1), 46–56.

Camilleri, Adrian R., Richard P. Larrick, Shajuti Hossain, and Dalia Patino-Echeverri (2019), "Consumers Underestimate the Emissions Associated with Food but Are Aided by Labels," *Nature Climate Change*, 9(1), 53–58.

Cecchini, M. and L. Warin (2016), "Impact of Food Labelling Systems on Food Choices and Eating Behaviours: A Systematic Review and Meta-Analysis of Randomized Studies," *Obesity Reviews*, 17(3), 201–10.

Cho, Yoon-Na and Christopher Berry (2019), "Understanding the Effects of Retailer- and Manufacturer-Provided Sustainability Labels on Product Evaluations and Purchase-Related Outcomes," *Journal of Business Research*, 100, 73–85.

Dhar, Ravi and Margarita Gorlin (2013), "A Dual-System Framework to Understand Preference Construction Processes in Choice," *Journal of Consumer Psychology*, 23(4), 528–42.

Gerber, P. J., H. Steinfeld, B. Henderson, A. Mottet, C. Opio, J. Dijkman, A. Falcucci, and G. Tempio (2013), "Tackling Climate Change through Livestock: A Global Assessment of Emissions and Mitigation Opportunities.," *Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities.*, https://www.cabdirect.org/cabdirect/abstract/20133417883?q=(bn%3A%229789251079201%22).

Hartmann, Christina, Gianna Lazzarini, Angela Funk, and Michael Siegrist (2021), "Measuring Consumers' Knowledge of the Environmental Impact of Foods," *Appetite*, 167, 105622.

Hascher, Joshua, Nitisha Desai, and Ian Krajbich (2021), "Incentivized and Non-Incentivized Liking Ratings Outperform Willingness-to-Pay in Predicting Choice," *Judgment and Decision Making*, 16(6), 1464–84.

Hawken, Paul (2017), *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*, Penguin.

Haws, Kelly L., Karen Page Winterich, and Rebecca Walker Naylor (2014), "Seeing the World through GREEN-Tinted Glasses: Green Consumption Values and Responses to Environmentally Friendly Products," *Journal of Consumer Psychology*, 24(3), 336–54.

Herberz, Mario, Tobias Brosch, and Ulf Hahnel (2020), "Kilo What? Default Units Increase Value Sensitivity in Joint Evaluations of Energy Efficiency," *Judgment and Decision Making*, 15(6), 972.

Herziger, Atar and Erik Hoelzl (2017), "Underestimated Habits: Hypothetical Choice Design in Consumer Research," *Journal of the Association for Consumer Research*, 2(3), 359–70.

Hobin, Erin, Bryan Bollinger, Jocelyn Sacco, Eli Liebman, Lana Vanderlee, Fei Zuo, Laura Rosella, Mary L'abbe, Heather Manson, and David Hammond (2017), "Consumers' Response to an On-Shelf Nutrition Labelling System in Supermarkets: Evidence to Inform Policy and Practice," *The Milbank Quarterly*, 95(3), 494–534.

Horne, Ralph E. (2009), "Limits to Labels: The Role of Eco-Labels in the Assessment of Product Sustainability and Routes to Sustainable Consumption," *International Journal of Consumer Studies*, 33(2), 175–82.

Long, Michael W., Deirdre K. Tobias, Angie L. Cradock, Holly Batchelder, and Steven L. Gortmaker (2015), "Systematic Review and Meta-Analysis of the Impact of Restaurant Menu Calorie Labeling," *American Journal of Public Health*, 105(5), e11–24.

Macdiarmid, Jennie I., Simone Cerroni, Dimitrios Kalentakis, and Christian Reynolds (2021), "How Important Is Healthiness, Carbon Footprint and Meat Content When Purchasing a Ready Meal? Evidence from a Non-Hypothetical Discrete Choice Experiment," *Journal of Cleaner Production*, 282, 124510.

Neumayr, Lambert and Christoph Moosauer (2021), "How to Induce Sales of Sustainable and Organic Food: The Case of a Traffic Light Eco-Label in Online Grocery Shopping," *Journal of Cleaner Production*, 328, 129584.

Panzone, Luca A., Falko F. Sniehotta, Rob Comber, and Fred Lemke (2020), "The Effect of Traffic-Light Labels and Time Pressure on Estimating Kilocalories and Carbon Footprint of Food," *Appetite*, 155, 104794.

Potter, Christina, Anastasios Bastounis, Jamie Hartmann-Boyce, Cristina Stewart, Kerstin Frie, Kate Tudor, Filippo Bianchi, Emma Cartwright, Brian Cook, Mike Rayner, and Susan A. Jebb (2021), "The Effects of Environmental Sustainability Labels on Selection, Purchase, and Consumption of Food and Drink Products: A Systematic Review," *Environment and Behavior*, 53(8), 891–925.

Prothero, Andrea, Susan Dobscha, Jim Freund, William E. Kilbourne, Michael G. Luchs, Lucie K. Ozanne, and John Thøgersen (2011), "Sustainable Consumption: Opportunities for Consumer Research and Public Policy," *Journal of Public Policy & Marketing*, 30(1), 31–38.

Sinclair, Susan E., Marcia Cooper, and Elizabeth D. Mansfield (2014), "The Influence of Menu Labeling on Calories Selected or Consumed: A Systematic Review and Meta-Analysis," *Journal of the Academy of Nutrition and Dietetics*, 114(9), 1375-1388.e15.

Swartz, Jonas J., Danielle Braxton, and Anthony J. Viera (2011), "Calorie Menu Labeling on Quick-Service Restaurant Menus: An Updated Systematic Review of the Literature," *International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 135.

Thorndike, Anne N., Jason Riis, Lillian M. Sonnenberg, and Douglas E. Levy (2014), "Traffic-Light Labels and Choice Architecture Promoting Healthy Food Choices," *American journal of preventive medicine*, 46(2), 143–49.

Vanclay, Jerome K., John Shortiss, Scott Aulsebrook, Angus M. Gillespie, Ben C. Howell, Rhoda Johanni, Michael J. Maher, Kelly M. Mitchell, Mark D. Stewart, and Jim Yates (2011), "Customer Response to Carbon Labelling of Groceries," *Journal of Consumer Policy*, 34(1), 153–60.

VanEpps, Eric M., Julie S. Downs, and George Loewenstein (2016), "Calorie Label Formats: Using Numeric and Traffic Light Calorie Labels to Reduce Lunch Calories," *Journal of Public Policy & Marketing*, 35(1), 26–36.

White, Katherine, Rishad Habib, and David J. Hardisty (2019), "How to SHIFT Consumer Behaviors to Be More Sustainable: A Literature Review and Guiding Framework," *Journal of Marketing*, 83(3), 22–49.

Winterich, Karen Page (2021), "Three Ways to Engage Consumers for Sustainable Consumption," *Impact at JMR*, https://www.ama.org/2021/09/23/ three-ways-to-engage-consumers-for-sustainable-consumption/.

World Resources Institute (2016), "Protein Scorecard," *World Resources Institute*, https://www.wri.org/data/protein-scorecard.

Wynes, Seth, Jiaying Zhao, and Simon D. Donner (2020), "How Well Do People Understand the Climate Impact of Individual Actions?," *Climatic Change*, 162(3), 1521–34.

Yokessa, Maïmouna and Stephan Marette (2019), "A Review of Eco-Labels and Their Economic Impact," *International Review of Environmental and Resource Economics*, 13(1–2), 119.

Zepeda, Lydia, Lucie Sirieix, Ana Pizarro, François Corderre, and Francine Rodier (2013), "A Conceptual Framework for Analyzing Consumers' Food Label Preferences: An Exploratory Study of Sustainability Labels in France, Quebec, Spain and the US," *International Journal of Consumer Studies*, 37(6), 605–16.