



Promoting plant-based food choices: Findings from a field experiment with over 150,000 consumer decisions[☆]

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ABSTRACT

Plant-based foods offer great promise for ensuring environmental sustainability. However, encouraging people to replace meat-based meals with plant-based meals is a difficult feat, as people often perceive meat consumption as socially normal, evolutionarily natural, and satisfying in taste. In the current research, we tested a subtle strategy for changing eating behavior. Through a 10-week field experiment, we investigated how different frames for vegetarian and vegan menu items influence consumer behavior in a real-world setting. We randomly varied whether vegetarian and vegan items on a restaurant's menu were referred to as "vegetarian" and "vegan" vs. "plant-based." Throughout the experiment, we tracked 167,637 consumer decisions. Items were 24% more likely to sell when they were marketed as vegetarian/vegan than when they were marketed as plant-based. These findings highlight the potential for frames to promote plant-based food choices, offering a subtle strategy for changing consumer behavior and supporting sustainability efforts.

Eating a plant-based diet is one of the most effective steps someone can take toward reducing their carbon footprint (Wynes & Nicholas, 2017). Compared to the production of animal-based foods, the production of plant-based foods uses water more efficiently, is more protective against biodiversity loss, and yields lower greenhouse gas emissions (Clark et al., 2019; Meier & Christen, 2013; Willett et al., 2019). For example, cutting meat out of one's diet is four times more effective at curbing emissions than is comprehensive recycling (Wynes & Nicholas, 2017). Nevertheless, encouraging people to replace meat-based meals with plant-based meals is a difficult feat, as many people feel psychologically attached to meat (Graça et al., 2015) and perceive meat consumption as too socially normal, evolutionarily natural, and hedonically pleasurable to give up (Piazza et al., 2015).

One simple, time-efficient, and cost-effective strategy for increasing people's consumption of plant-based foods may be to use frames: to optimize what those foods are called. In many contexts, such foods are referred to as "plant-based," whereas in other contexts, the same foods are called "vegetarian" or "vegan." From our experience, these two types of labels seem to be the two dominant descriptors used in marketing and

food-service settings. That the same food can be described in a variety of ways (as *plant-based*, *vegetarian*, *vegan*) invites important questions about framing effects, as different frames may have different effects on decision-making and behavior among consumers who eat meat.

Prospect theory (Kahneman & Tversky, 1979) suggests that people value gains and losses to different degrees and are inclined to show loss aversion: to perceive the loss of some good as more impactful than the gain of an equivalent good. The terms, "vegetarian" and "vegan," are frames defined by loss—by what is lacking. To call a food "vegetarian" is to clarify that it lacks meat; to call it "vegan" is to say that it lacks any animal products. We posit that referring to a food as "plant-based," meanwhile, draws attention to what consumers *gain* from it: plants. Meta-analytic evidence points toward gain frames as more effective than are loss frames at encouraging prevention behaviors in particular, such as healthy eating (Gallagher & Updegraff, 2012). Accordingly, prospect theory and findings from it suggest that meat-eaters likely feel more favorably toward foods framed as "plant-based" over foods framed as "vegetarian" or "vegan," providing a testable hypothesis for the present research.

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Of note, some recent research has examined other types of framing effects to promote meat-reduction intentions, providing several useful insights into how subtle strategies may be effective at shifting consumer intentions. Studies have found that encouraging people to eat more plant-based meals works better than encouraging people to eat fewer meat-based meals (Carvalho et al., 2021); gain frames work better than loss frames when discussing health outcomes (Carfora et al., 2021); and, when displaying vegetarian dishes in a separate menu section, pro-environmental or social frames of this section work better than a conventional vegetarian frame (Krpan & Houtsmma, 2020). More generally, making plant-based dishes more visible in food environments and including a wider variety of plant-based dishes are promising strategies for decreasing meat consumption (Kwasny et al., 2022).

Nevertheless, within the current empirical literature, it remains unknown which common descriptor for plant-based foods—calling them *plant-based* or *vegetarian/vegan*—is optimal for encouraging consumer uptake. We addressed this knowledge gap in the present research. We note that whereas *vegetarian* and *vegan* have fairly clear definitions, it seems that multiple definitions of *plant-based* exist without a clear consensus, despite how ubiquitous the use of this term has become in culinary spaces. Our focus in the current research was on how consumers subjectively perceive this term: whether it makes them more or less interested in consuming a food labeled as such, compared to a food labeled as *vegetarian* or *vegan*. Identifying whether calling foods *vegetarian/vegan* or *plant-based* maximizes consumer uptake could ultimately guide other framing efforts to design the most impactful behavior change interventions, providing efficient guidelines for marketers and practitioners.

Beyond unknowns about whether to call foods *vegetarian/vegan* or *plant-based*, there is also a shortage of studies examining how this type of consumer behavior changes in response to different frames in natural settings, outside of the laboratory. Understanding how framing effects influence behavior change in ecologically valid, natural settings can provide information vital to changing consumers' actual everyday behaviors and thus to reducing the environmental impacts of diet. The vast majority of existing studies on plant-based consumption have assessed effects of frames on dietary attitudes or behavioral intentions. While self-reported attitudes and intentions are useful for understanding how consumers feel toward plant-based eating and how open they are to changing their behavior, these self-reports are limited in that they often misalign with consumers' actual subsequent behaviors; meta-analytic evidence suggests that intentions, on average, explain only 28% of the variance in people's future behavior (Sheeran, 2002).

In the current research, accordingly, we conducted a field experiment to compare how two common frames for vegetarian and vegan menu items (*plant-based* vs. *vegetarian/vegan*) influence consumer behavior toward these items in a real-world setting. Throughout the experiment, which lasted 10 weeks in duration, we tracked over 150,000 consumer decisions. We hypothesized that referring to vegetarian and vegan menu items as "plant-based" would make them more likely to sell, compared to referring to them as either "vegetarian" or "vegan."

1. Method

This study was preregistered at https://osf.io/h92de/?view_only=c182e6c745c4b42900787006de56edb.

2. Materials and procedure

Through a field experiment, we tracked sales of menu items in a restaurant located on the campus of a large public university in the United States throughout the fall quarter of 2021. Items on the menu were organized by relevant headings (e.g., Vegetarian Options, Asian Specials, Sides). We selected menu items and headings with the terms "vegetarian" or "vegan" in their names as targets to be manipulated. We

randomly counterbalanced whether menu items and headings were labeled as vegetarian/vegan vs. plant-based for the first five weeks of the fall quarter vs. the second five weeks; in any menu items with detailed descriptions mentioning "vegetarian" or "vegan," these words were also changed in order to remain consistent with the menu item's label. For example, one sample item on the menu was originally called "Vegan BBQ Chicken Quesadilla" (Fig. 1 displays how this item appeared on the menu available to students). For our experiment, this menu item was randomly chosen to be marketed as "Plant-Based BBQ Chicken Quesadilla" for the first five weeks of the quarter but then marketed as "Vegan BBQ Chicken Quesadilla" for the second five weeks. Because we counterbalanced our label manipulation across menu items, the restaurant's menu at any given time during the study period had a fairly equal number of items labeled as "plant-based" and as "vegetarian"/"vegan."

The restaurant menu was available to patrons digitally on the university's dining website and in-person through menu boards at the restaurant. Although the naming of items changed, all items are tagged online and at the point of service with small icons identifying them as vegetarian or vegan. This characteristic strengthened the impact of our framing manipulation by ensuring that students were aware that items labeled as plant-based were devoid of meat and/or animal products. All other factors beyond our framing manipulation remained constant across study conditions.

Approximately 90% of patrons of this restaurant are first-year, first-year transfer, and second-year undergraduate students at the university, which helped to strengthen the internal validity of our framing manipulation. Notably, due to the COVID-19 pandemic, this restaurant was closed for the 2020–2021 academic year. Consequently, ~90% of the patrons who dined at the restaurant during our study period had no previous experience with it. This characteristic reduced concerns about potential familiarity effects in our experiment; because patrons were new to the restaurant, presumably they did not have any memory of the restaurant's original menu prior to our experiment.

Because this was a field experiment, with patrons frequenting the restaurant naturally at their own will, we could not determine our sample size *a priori*. Instead, we preregistered a time course of the study: The study took place for the entirety of instruction during the university's fall quarter of 2021, which was 10 weeks in duration and a time during which all classes were held in-person on campus. Each study condition thus lasted five weeks. Throughout the study, a total of 167,637 menu items were sold.

3. Results

3.1. *Data and analysis scripts are available at https://osf.io/69dmz/?view_only=cd1e1e352dc54d91a0c9008c8d34e467*

We conducted three two-proportions *z*-tests to test whether the likelihood of menu items selling differed depending on whether they

Vegan BBQ Chicken Quesadilla

Vegan Chicken Strips, BBQ Sauce, Red Onions, and shredded Vegan Cheese in a Wheat Tortilla, topped with Guacamole. Served with Mexican Rice and Refried Beans.

\$8.00     

Plant-Based BBQ Chicken Quesadilla

Plant-Based Chicken Strips, BBQ Sauce, Red Onions, and shredded Plant-Based Cheese in a Wheat Tortilla, topped with Guacamole. Served with Mexican Rice and Refried Beans.

\$8.00     

Fig. 1. Two frames of an example menu item. This item appeared as the top image (vegan label) for one half of the study period and as the bottom image (plant-based label) for the other half.

were labeled as vegetarian/vegan or plant-based. Our main test analyzed sales of all vegetarian and vegan items grouped together. In two additional tests, to provide more nuanced insight into consumer behavior, we compared plant-based labeling to (1) vegetarian and (2) vegan labels separately. In each test, proportions in each condition included the total number of selected menu items sold as the numerator and the total number of purchases in the restaurant as the denominator, over the course of the 10-week field experiment period.

Our first analysis revealed that menu items were 24% more likely to sell when they were labeled as either vegetarian or vegan (accounting for 1.10% of all purchases) than when they were labeled as plant-based (0.89% of all purchases), $\chi^2(1) = 37.81, p < .001$, 95% CI of difference [0.14%, 0.28%].

Second, we compared proportions for only the vegetarian menu items (excluding vegan items). Menu items were 23% more likely to sell when they were labeled as vegetarian (0.86% of all purchases) than when they were labeled as plant-based (0.70% of all purchases), $\chi^2(1) = 29.10, p < .001$, 95% CI of difference [0.10%, 0.22%].

Third, we compared proportions for only the vegan menu items (excluding vegetarian items). Menu items were 24% more likely to sell when they were labeled as vegan (0.24% of all purchases) than when they were labeled as plant-based (0.19% of all purchases), $\chi^2(1) = 8.58, p = .003$, 95% CI of difference [0.02%, 0.08%].

4. Discussion

Increased consumption of plant-based foods can promote sustainability by reducing the impacts of food production on water usage, greenhouse gas emissions, and biodiversity loss (Clark et al., 2019; Meier & Christen, 2013; Willett et al., 2019). Nevertheless, many consumers who eat meat are reluctant to replace meat with plants (Graça et al., 2015; Macdiarmid et al., 2016; Piazza et al., 2015; Rosenfeld & Tomiyama, 2020).

To persuade meat-eaters that plant-based foods confer ethical, health, and/or environmental benefits is a difficult, time-intensive, and resource-intensive feat. Such persuasion is even more laborious as moral disengagement and dissonance processes motivate meat-eaters to reject plant-based diets and maintain meat consumption (Graça et al., 2016; Rothgerber & Rosenfeld, 2021). These barriers reiterate the value of subtle framing strategies, which offer efficient and effective means of changing consumer behavior.

Results of the current research suggest that framing a plant-based menu item as either “vegetarian” or “vegan” is more effective at encouraging consumers to purchase it than is framing it as “plant-based.” The difference between vegetarian/vegan and plant-based frames, moreover, appears to be of substantial practical significance, with “vegetarian” and “vegan” labels increasing the likelihood of a menu item selling by more than 20% compared to a “plant-based” label. Marketing plant-based products as “vegetarian” or “vegan” thus presents a promising strategy for increasing consumer uptake of these more sustainable options.

Notably, observed effects of the current study’s framing manipulation were in the opposite direction as specified in our hypothesis derived from prospect theory and its evidence (Gallagher & Updegraff, 2012; Kahneman & Tversky, 1979), which have pointed toward gain frames as optimal for encouraging preventive behavior. We expected that referring to a food as “plant-based” would highlight what consumers (especially meat-eating consumers) gain from it and thus would increase consumer uptake, whereas “vegetarian” and “vegan” would draw attention to losses and be of lower appeal. One possibility for our findings is that whereas consumers may be familiar with what it means for a food to be vegetarian or vegan, what precisely it means for a food to be plant-based may be less familiar. Humans are often skeptical of eating unfamiliar foods (Pliner & Hobden, 1992), and potential unfamiliarity with foods titled as “plant-based” may have undermined consumer interest in them. Another possible explanation for our results is that

consumers in our experiment may not have construed *vegetarian* and *vegan* as losses but rather as gains—positive features of a food that bring them social capital. Vegetarianism and veganism are social identities (Rosenfeld & Burrow, 2018), and some evidence suggests that consumers may embrace vegetarian/vegan eating behaviors to acquire socially applauded group memberships and thus to develop a more positive sense of self (Plante et al., 2019). To the extent that meat-eaters view vegetarians and vegans in a positive light, they may find “vegetarian” and “vegan” labels appealing.

Our research pitted “plant-based” and “vegetarian”/“vegan” labels against one another because these two seem to be the two dominant descriptors used in marketing and food-service settings. Still, there may be more compelling ways to describe foods without mentioning either of these labels. For example, descriptive language that makes plant-based food sound more appetizing (e.g., calling a dish “indulgent,” “artisanal,” or “crispy”) or emphasizing a dish’s origin and flavors may make it more appealing to consumers (Bacon & Krpan, 2018; Gavrieli et al., 2020; Turnwald et al., 2017). To change people’s eating behaviors most effectively, more complex experimental designs that manipulate the presence of plant-based and vegetarian/vegan descriptors along with descriptive language would be informative.

4.1. Strengths and limitations

One strength of the current study is that, as a field experiment, we observed actual behavior in a real-world setting. Thus, our study had strong ecological validity and provides insights into people’s true decision-making, in contrast to simply their dietary attitudes or behavioral intentions. This feature is critical because the environmental impact of food production is connected principally to how consumers truly behave in their dietary purchases, not just what attitudes they report having toward those purchases. A second strength of our study is its extremely high statistical power. Our data include more than 150,000 consumer decisions, enabling us to estimate effects of menu labeling changes on consumption behaviors with very high precision.

One limitation of this study is that it is difficult to determine the generalizability of observed effects. As this study took place among university students in the United States, it remains unknown how our menu framing manipulation would influence consumer behavior in other populations. Further research testing generalizability across a varied range of samples would be useful to provide more robust guidelines transferrable across intervention purposes. A second limitation is that we had no means of identifying which specific type of consumers (i.e., vegetarians/vegans or meat-eaters) were purchasing which menu items throughout our study. Thus, the extent to which our observed effects were driven by changes in meat-eaters’ behaviors remains unknown. It is possible that “vegetarian” and “vegan” labels appealed highly to vegetarian/vegan consumers in our study, which could explain our effects. This possibility would buffer against using our data to make inferences about how to reduce meat consumption. As vegetarians/vegans comprised only about 10% of the student body at the university targeted in our study, though, it seems unlikely that this consumer segment could have driven the observed 24% increase in sales of plant-based items. Nevertheless, in manipulating labels in future research, it would be useful to record whether consumers purchasing any given product self-identify as vegetarian/vegan or not.

5. Conclusion

Increasing people’s consumptions of plant-based foods is a promising strategy for promoting environmental sustainability—conserving water usage, preventing biodiversity loss, and reducing greenhouse gas emissions. However, eating behavior is notoriously difficult to change. From analyzing over 150,000 consumer decisions in a field experiment, we found that menu items were more likely to sell when referred to as “vegetarian” or “vegan” than when referred to as “plant-based.” These

findings highlight the potential for frames to promote plant-based food choices, offering a subtle strategy for changing consumer behavior and supporting sustainability efforts.

CRedit authorship contribution statement

Daniel L. Rosenfeld: Conceptualization, Formal analysis, Data curation, Writing – original draft, developed the study concept, contributed to the study design. All authors contributed to the study execution. collected and analyzed study data, drafted the manuscript. **Carole Bartolotto:** provided critical revisions. All authors approved the final version of the manuscript for submission. **A. Janet Tomiyama:** contributed to the study design. All authors contributed to the study execution. provided critical revisions. All authors approved the final version of the manuscript for submission.

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