UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Carbon Footprint Information Promotes Sustainable Food Choices

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Course: PSYC 421

Themes: Food, Climate, Procurement

Date: April 14, 2020

Executive Summary

We chose to explore the environmental impact of plant-based diets. Specifically, we wanted to know whether we could influence people's dietary decisions with a simple nudge. Knowing that plant-based meals are more environmentally sustainable than meat[6], we explored the relative differences in carbon footprint. We partnered with *Grub Grab*, a meal subscription service that offers both plant-based and meat-based options on campus. We calculated the respective carbon footprints of each meal they offer and implemented this data on their website. The website previously included metrics on each meal for fats, protein, carbs and calories. Our nudge was the addition of carbon footprint information, which demonstrated some environmental disparity between the plant-based and meat-based options. Our study compared the meal preferences of participants with and without the carbon footprint information. We wanted to know how implementing a nudge campaign using carbon footprint information would affects people's meal choices. We hypothesized that there will be increased selection for items with low carbon footprint and decreased selection for items with high carbon footprint. Our results supported this hypothesis.

Keywords: Carbon footprint, plant-based foods, plant-based diet, nudge

Introduction

Throughout decades plant-based diets have been shown to have substantial health benefits such as protection against chronic diseases such as cardiovascular disease[1], diabetes[2], obesity[3] and certain cancers[4]. There are also several protective effects and beneficial nutrients contained in these plant-based foods, including mono- and polyunsaturated fatty acids, minerals, phytochemicals, fiber, n-3 fatty acids, antioxidant vitamins and plant protein[5]. Beyond personal health benefits, an adoption of a diet with less meat can play a significant role in climate change mitigation[6]. Compared to plant-based diets, meat-based diets are less sustainable as they require more land, water and energy[7]. A study published by The University of Oxford presents one of the most comprehensive analysis into the effects farming can have on the environment, it included data from 40,000 farms in 119 countries. The results show that meat and dairy production is responsible for 60 percent of the agriculture greenhouse gas emissions[8]. Despite the evident benefits, in several places around the world, there is an overconsumption of animal protein[10]. The average adult requires 50 grams of protein per day[10]. Recent statistics show that the average adult in Canada consumes more than 90 grams of protein per day, way beyond the dietary requirements[9]. A plant-based diet can meet current nutritional recommendations being significantly better for the environment[10].

The psychological insight this paper will be focusing on are nudges. There has been a growing literature on employing nudge strategies to promote better food choices[11]. Nudges have been used to promote a shift in people's behavior towards better food choices through the presentation health[12], through hedonic enhancements[14], use of descriptive social norms[14], and use of normative messaging[15]. A more recent and less researched development is that of carbon footprint labels, which inform consumers about the greenhouse gas emissions caused by different products. Carbon food labels have mostly been applied and studied in the grocery sector. For example, one group of researchers examined consumer reactions to a color-coded carbon label introduced to several product categories in a grocery store[16]. In all studies consumers showed more climate friendly behavior due to the label[16]. Furthermore, they labeled two out of four daily dishes in a canteen as "climate-friendly choices" and found that sales of the labeled options increased by over 20% [16]. However, we found a gap in the literature when it came to presenting carbon footprint information on menus.

A literature review revealed very few studies that have explored the use of carbon footprint nudges for dishes on a menu. Within the context of plant-based diets, defined as a diet consisting of fruits, vegetables, grains, legumes, nuts, and seeds[17], we sought to explore: How does implementing a nudge campaign using carbon footprint information affect people's meal choices? We hypothesized that when presented with carbon footprint information there will be increased selection for items with a low carbon footprint and that there will be decreased selection for items with high carbon footprint.

Methods

Participants

We had originally intended to run our study with Grubgrab customers but due to Covid-19 shutdowns we transitioned to a survey. The survey was designed by our research team on

UBC Qualtrics and distributed through social media groups primarily made up of undergraduate students at the University of British Columbia. Although our original sample consisted of *N*=105 responses, 56 were excluded due to failure to complete the entire survey leaving us with a final sample of *N*=49 responses (12 male, 36 female, 1 non-binary).

Conditions

The survey presented respondents with a choice of two dishes per question and asked them to choose one of them. There were six dishes in total (Figure 1) and the order of presentation was determined using a Latin Square design which resulted in each dish being presented 6 times and each pairing being presented twice (reversed order the second time). The survey thus consisted of a total of 36 questions in which the first 18 did not have carbon footprint information while the subsequent 18 did (Figure 2). Our manipulation was the presentation of carbon footprint information alongside the nutritional information already presented earlier in the survey. We then proceeded to measure individuals' choices.

Measures

We had hypothesized that the presentation of carbon footprint information would result in increased selection of items with low carbon footprint and a decrease in selection for items with high carbon footprint. We therefore measured participants responses on which dishes they selected. We first measured their choices when nutritional information was presented but carbon footprint was not and subsequently measured their choices for the same dishes and paring when carbon footprint information was presented alongside the nutritional information (Figure 2).

Procedure

The survey was distributed via several social media groups on March 24th and we continued to collect data until March 28th at which point data collection was halted. The first page of the survey instructed participants to suppose they have won a competition from a meal plan service and that they must pick which meals they would like to receive. It further told them that each meal would contain a description and nutritional information for the meals. At the beginning of the second part of the survey, participants received a similar message that also included the fact that there is now carbon footprint information alongside the nutritional information. In order avoid any confound regarding participant knowledge, they were provided with a definition of carbon footprint as well. Further detail for both sets of instructions are provided in Figure 3. After completing the first two parts, participant completed a third demographic portion. After completion of the demographic portion, all participants were debriefed.

Results

We first looked at the mean selection for each item with and without the carbon footprint information and found a general trend supporting our hypothesis (Figure 4). To test for significance, we then conducted a paired samples t-test with a Bonferroni adjusted alpha level of $\alpha = .008$. We obtained significant results for 4 of the 6 items (Table 1). As demonstrated in Figure 5, we saw a decrease in selection for the Butter Chicken ($t(48) = 5.46$, $p < 0.001$, $d = 0.78$) and

Chana Masala ($t(48) = 3.618$, $p < 0.001$, $d = 0.52$) and increase in selection for the Falafel Salad Bowl ($t(48) = -4.22$, $p < 0.001$, $d = -0.603$) and Baja Chicken Salad Bowl ($t(48) = -2.797$, $p = 0.007$, $d = -0.40$). Due to our small sample size, we conducted a post-hoc power analysis using G-Power. The results indicated $\beta = 0.99$ for Butter Chicken, $\beta = 0.80$ for Chana Masala, $\beta = 0.92$ for Falafel Salad Bowl, and $\beta = 0.51$ for the Baja Chicken Salad Bowl. Next, we looked at each individual question in both parts of the survey (without CO_2 and with CO_2) to see if participants chose the more sustainable option. Participant responses were coded with 1 to indicate that they had chosen the more sustainable option and with a 0 to indicate that they had not. We then conducted a paired samples T-test in order to analyze if there was a significant difference. Once again, we used a Bonferroni correction to set an alpha level of $\alpha = 0.0028$. The results revealed a significant difference ($t(17) = -6.078$, $p < 0.001$, $d = -1.43$) when comparing all pairs, showing that individuals selected the sustainable option more often when presented with carbon footprint information (Figure 6). Finally, we looked at individual questions where a plant-based food was presented alongside a meat-based food. Here we found a significant result ($t(48) = -5.619$, $p < 0.001$, $d = -0.80$) indicating the participants chose the plant-based options, which were the sustainable option (lower carbon footprint), more often when presented with carbon footprint information (Figure 7).

Discussion

Our results revealed that when the carbon footprint nudge was implemented into GrubGrab's menu, participants generally chose the menu item with lower carbon footprint. We saw that there was a significant increase in participants choosing the Falafel Salad Bowl (which had the lowest carbon footprint) and a significant decrease in participants choosing Butter Chicken (which had the highest carbon footprint). These results indicate that changes are specifically sensitive at the extremes. These results were consistent in previous work done in similar study. Specifically, that a nudge may be an effective way to steer individuals into choosing a certain meal option[18]. Furthermore, we investigated the likelihood of participants choosing the more sustainable option among each pair of menu items before and after being presented with the carbon footprint information. We found that participants were often more likely to choose a less carbon footprint heavy option when the designated information was shown. This suggests that individuals tend to make more sustainable choices when presented with carbon footprint information.

Naturally, since our sample consisted of mainly participants attending the University of British Columbia (UBC), the demographic largely consisted of people in the WEIRD (Western Educated Industrialized Rich and Democratic) population and may not be representative to the general population. More to the point, our sample consisted of individuals living in Greater Vancouver were environmentalism and environmental ideas are much more prevalent than other parts of the world. There also may have been a social desirability bias, where participants may have answered questions in a manner that is viewed to be more virtuous (choosing the lower carbon footprint options). This means we cannot be sure that their behavior would necessarily follow their responses. That said, our results indicate that exposure to carbon footprint information food products seem to be an effective nudge to steer consumers toward more sustainable choices in food. Additionally, as seen in the food options used in this study, plant-

based options are largely less environmentally taxing than meat-based options (Figure 1). This means that if individuals were to make the choice to choose more sustainable items (lower carbon footprint option), they may also be making a healthier choice as the many health benefits of a dominantly plant-based diet is already known and apparent[1,2]. Furthermore, it could be hypothesized that if individuals were to make the conscious decision to choose more sustainable foods, it may have possible carryovers in their everyday lives and encourages them to make sustainable choices more often. This could be an area of interest for future research to look at.

Generally, descriptive social norms and nudges have been moderately effective in seeing changes in consuming behavior in a workplace restaurant or school lunchroom setting[14,18]. This study applies the similar concept of nudging consumers to make healthier choices in a subscription-based food service setting at a University. That being so, we attempt to apply the already known concepts in hopes to contribute to further understand how effective nudges can be as well as what the most effective way to form a nudge is for this specific context. While our study demonstrates promising results, there were also limitations. Firstly, our sample size was quite small and future work should therefore attempt to recruit a larger sample. Next, due to Covid-19 closures we transitioned and adapted our study to a survey format. Future work should focus on replicating our results in a behavioral setting as we had originally intended. Doing so would likely yield greater ecological validity. Furthermore, it would potentially provide interesting insight regarding the relationship between reported behavior and actual behavior when it comes to nudges.

Recommendations for Client

UBC and our client have goals of both reducing meat intake and moving towards a more ecologically sustainable community. This paper proposes an inexpensive potential solution that can be implemented relatively easily. We have found that when presented with carbon information and made to pick two options, participants will have an increased likelihood to pick sustainable option. This seems to be particularly the case in the most extreme options with participants deviating most significantly in the more extreme options, as shown with the Butter Chicken and Falafel Salad Bowl (highest and lowest carbon footprint). Furthermore, our results show that participants were selecting plant-based options over meat-based options when they were presented together with carbon footprint information. This preliminary evidence suggests a desire to move away from meat-based options if a viable alternative is presented.

Our results demonstrate that a simple nudge using carbon footprint information can have significant effects on individuals' choices. We therefore recommend incentivization of applying carbon footprint information throughout meal services and restaurant on campus. This relatively cheap and easy implementation could lead to a significant reduction in food-based carbon emissions as people increasingly select plant-based foods over meat-based foods. While we are confident in our results, we also recognize the shortcomings present due Covid-19 disruptions and therefore recommend future students replicate our results in a behavioral paradigm. Doing so would be an important step in convincing the larger community of the efficacy implementing carbon footprint information. We believe our results can be used as the basis for conducting such research and promoting the necessary partnerships to do so.

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Appendix A: Tables

Paired Samples T-Test

			t	df	p	Mean Difference	SE Difference	Cohen's d
Butter Chicken	-	Butter Chicken_CO2	5.460	48	< .001	1.694	0.310	0.780
Chana Masala	-	Chana Masala_CO2	3.618	48	< .001	1.714	0.474	0.517
Falafel Salad Bowl	-	Falafel Salad Bowl_CO2	-4.219	48	< .001	-0.551	0.131	-0.603
Macro Energy Bowl	-	Macro Energy Bowl_CO2	-2.626	48	0.012	-0.714	0.272	-0.375
Mediterranean Mezze Plate	-	Mediterranean Mezze Plate_CO2	0.209	48	0.836	0.041	0.196	0.030
Baja Chicken Salad Bowl	-	Baja Chicken Salad Bowl_CO2	-2.797	48	0.007	-0.510	0.182	-0.400

Table 1. Paired Sample T-test

Appendix B: Figures

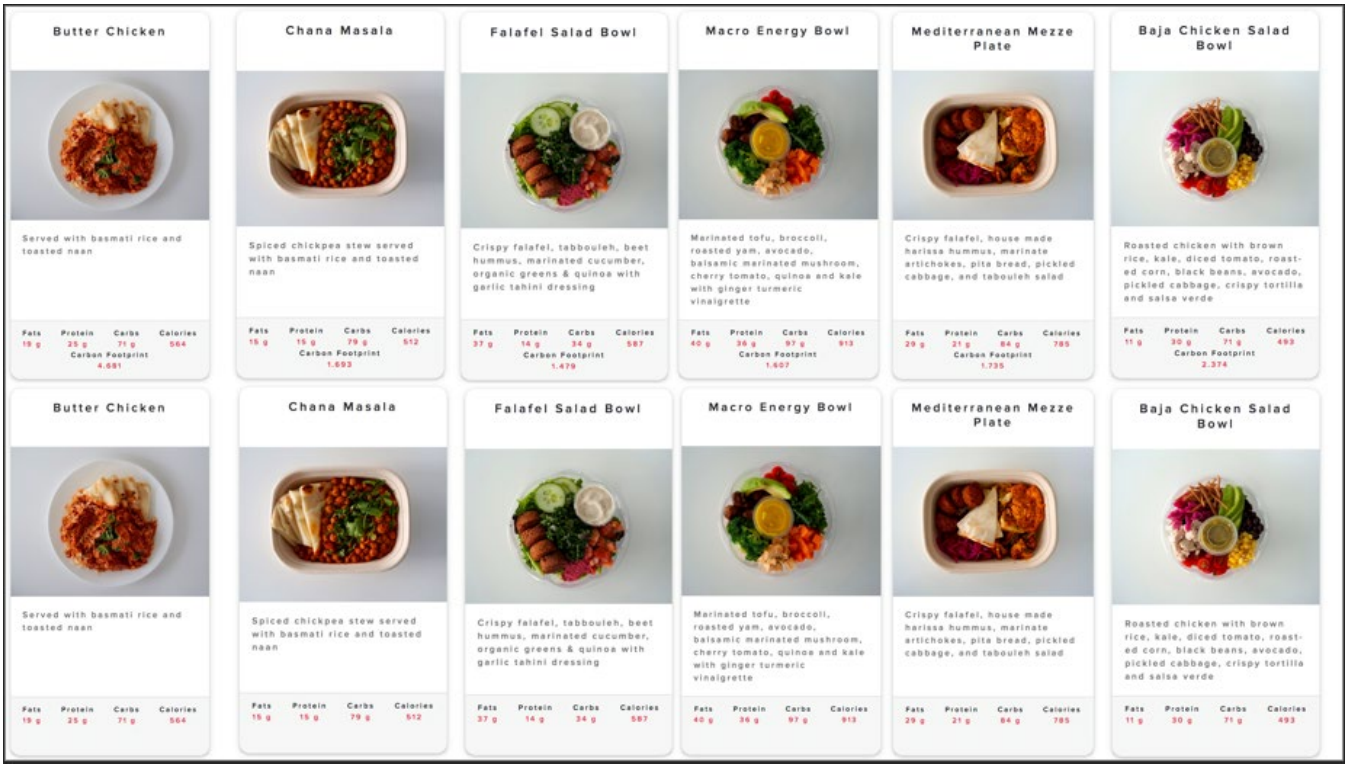

Figure 1. All the menu items presented on the survey. Top row is with carbon footprint information and bottom row is without.

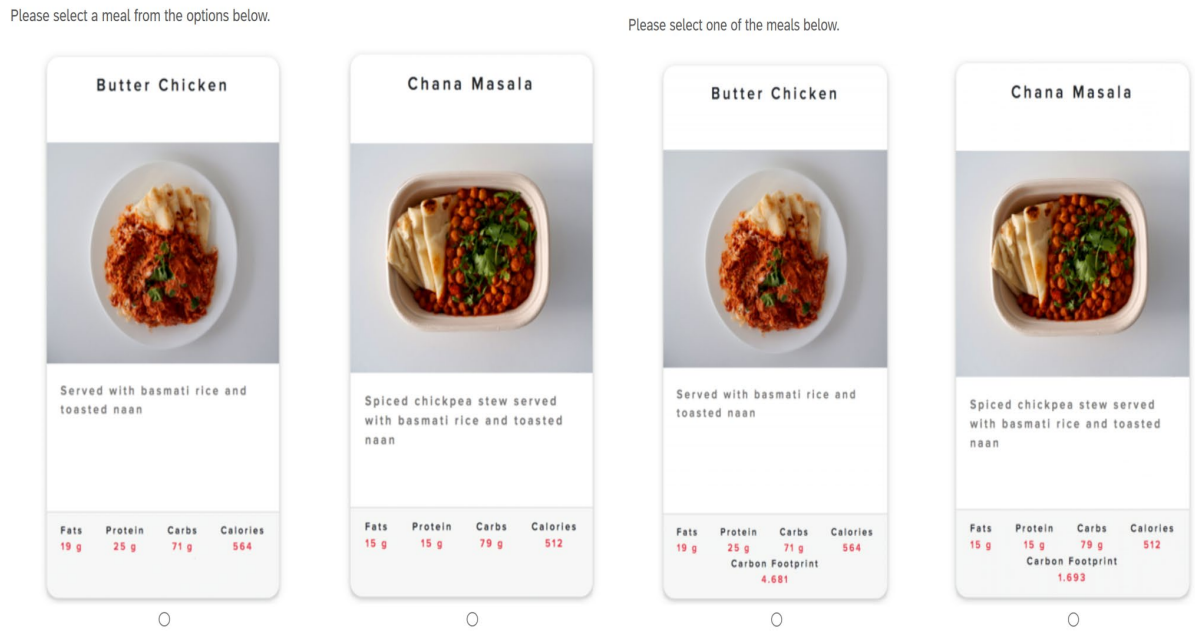

Figure 2. A single pairing as it would appear on the first and second part of the survey.

Part 1

Suppose that you have just won a competition from a company that sends you meals every week and that you must pick which meals you would like to receive. The following questions present you with two meals of which you must choose only one. Please select the meal you would be interested in having. Each meal contains a brief description and the relevant nutritional information to help guide you decision. There are three parts to this survey. You will automatically be redirected when one part has been completed. Please make sure you complete all three parts.

Part 2

The following questions present you with two meals of which you must choose only one. Please select the meal you would be most interested in having. Each meal contains a brief description, the relevant nutritional information, and the carbon footprint of the meal. Carbon footprint is the amount of greenhouse gases and specifically carbon dioxide emitted by a person, product, or (in this case) a meal. The carbon footprint values presented below are carbon dioxide emissions per kilogram (CO2e/kg).

Figure 3. The instructions participants received at the beginning of each part of the survey.

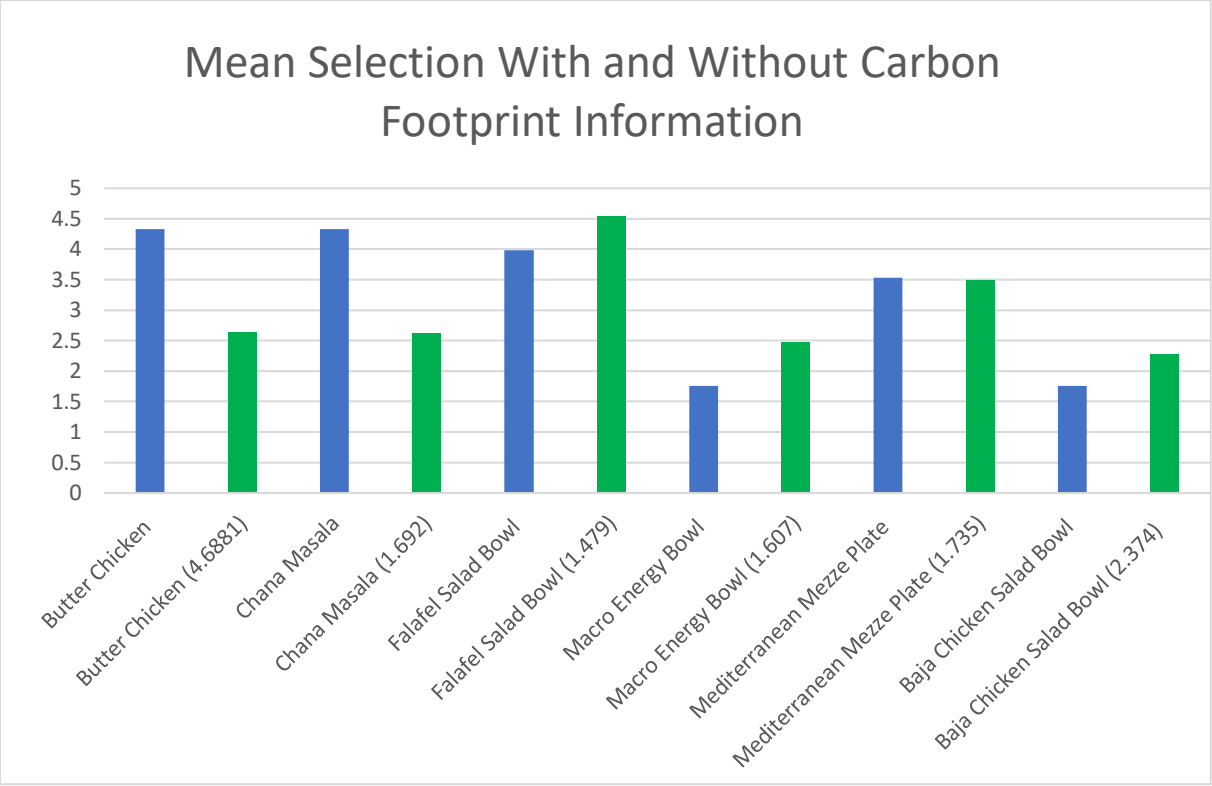

Figure 4. Mean selection for each item with and without carbon footprint information.

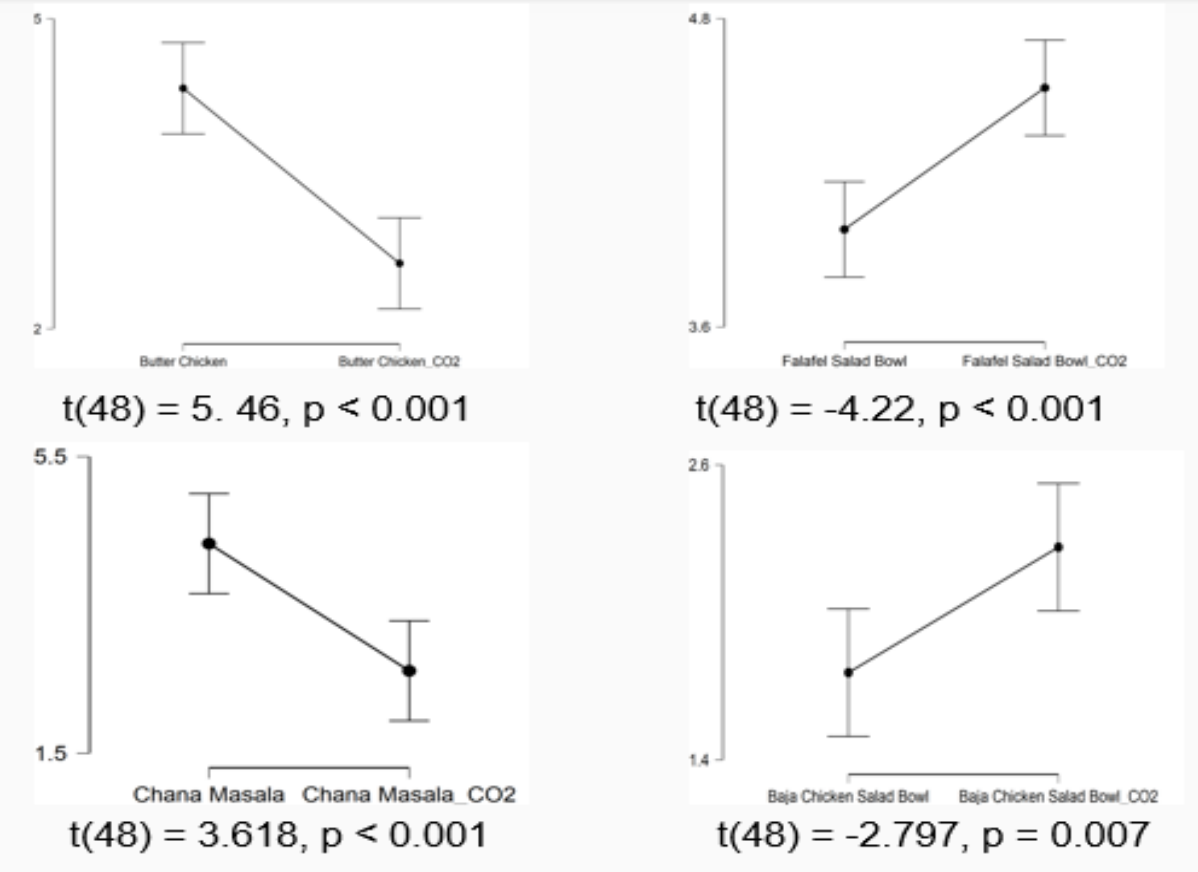

Figure 4. Four out of the six items that yielded significant results following paired samples T-test.

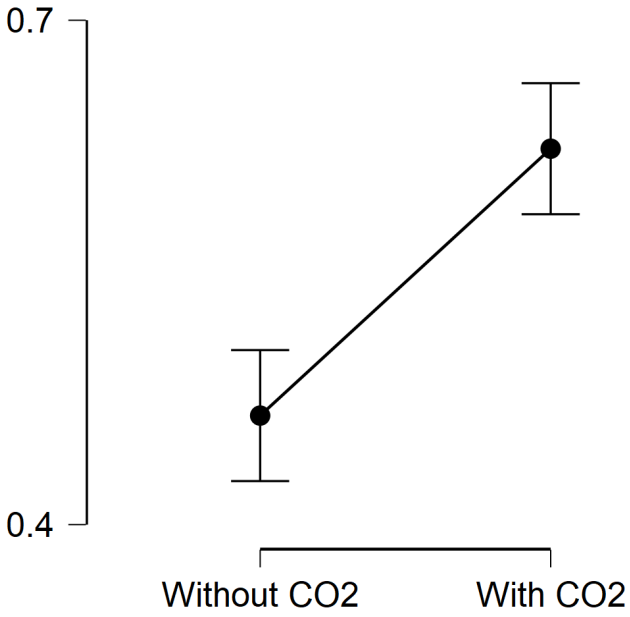

Figure 6. Graph demonstrating sustainable option selection with and without carbon footprint information.

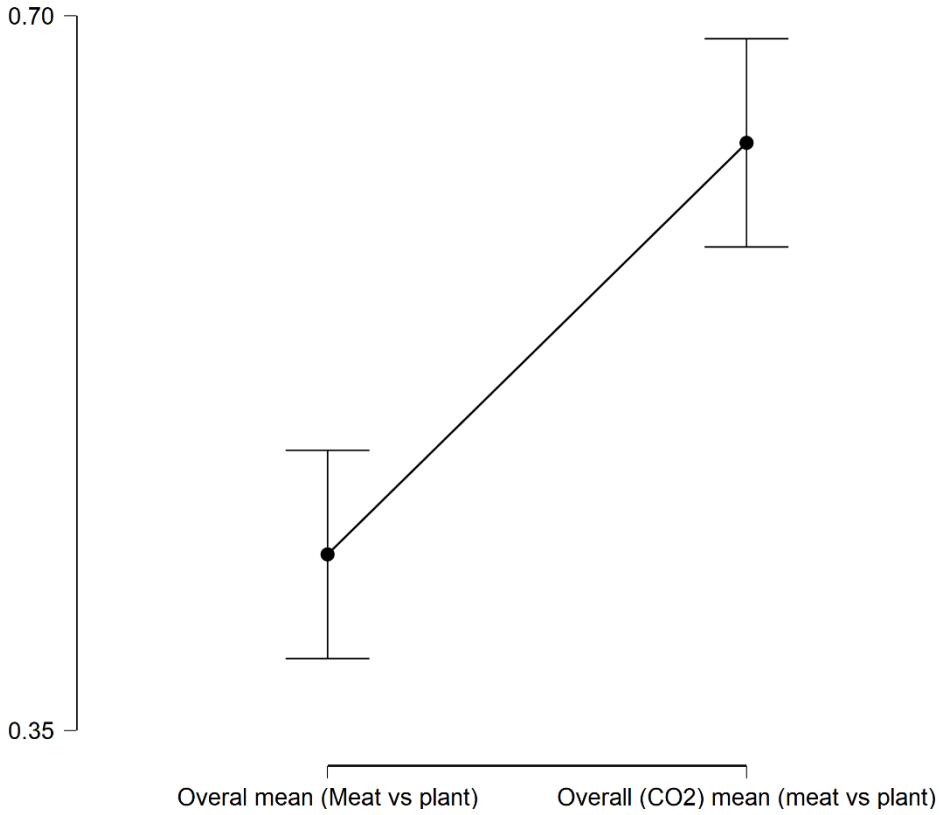

Figure 7. Graph showing selection of more sustainable option (lower carbon footprint) when a plant-based food was presented beside a meat-based food.