Influencing Dietary Choices for Sustainability: A Dining Hall Field Experiment

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Abstract

Climate change is an issue of increasing concern, and studies have shown that animal agriculture is a significant contributor. Despite this, there has been no significant change in meat consumption in the United States. Current literature suggests that information provision can have a small effect in changing consumer behavior. I have conducted a field experiment at a university dining hall where I display a sign with a fact about the sustainability of plant-based diets. Using a difference in differences technique, I show that there is no statistically significant impact of this treatment on the consumption of vegetarian and vegan dishes. Further research is needed to test various messages for efficacy and use a larger sample to produce more precise estimates.

Introduction/Literature Review

In recent years, climate change has become a problem of increasing concern. Since the United Nations published Livestock's Long Shadow in 2006, it has been clear that animal agriculture is a huge contributor of greenhouse gas emissions, as well as various other forms of environmental damage. Perhaps the most impactful finding is that animal agriculture is responsible for 18% of total greenhouse gas emissions, more than the transportation sector. It seems that many individuals are making attempts to lessen their environmental impact, yet there is no clear downward trend in meat consumption in recent years. In 2018 it is forecast that Americans consumed 218.4 pounds of red meat and poultry per capita, up from 216.8 pounds in 2017. There is not even a reduction in the consumption of beef, which is most notorious for its environmental impact—Americans are projected to consume 56.9 pounds of beef per capita in 2018, which is no change from 2017 (USDA[1]). Overall, as shown in Figures 1 & 2, meat and specifically beef consumption have been fairly constant over recent years, with a small dip around the Great Recession but no lasting change. Thus, there is sizable opportunity for mitigating environmental damage through reducing the consumption of animal products, an area receiving less attention in the discussion of climate change.

[1] https://www.ers.usda.gov/publications/pub-details/?pubid=91254 Livestock, Dairy, and Poultry Outlook: February 2019

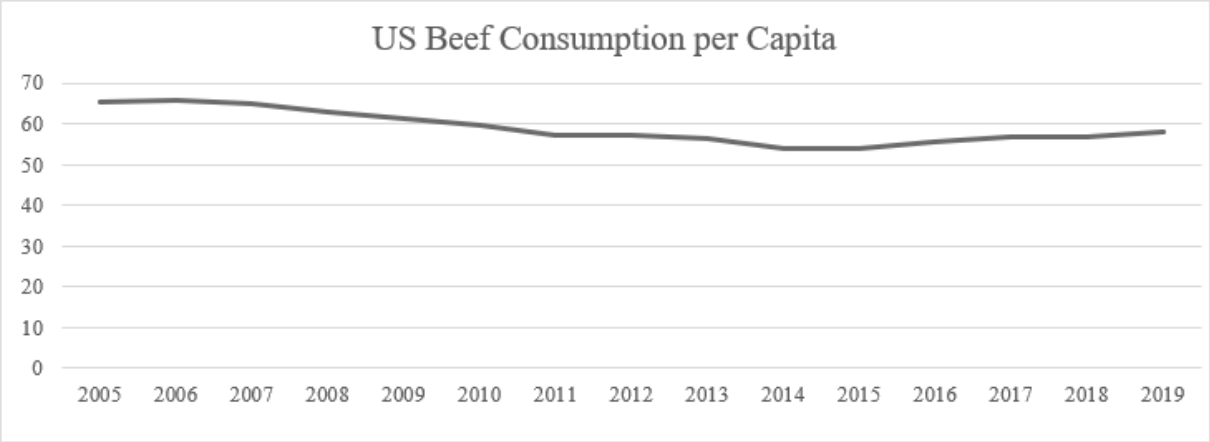

Figure 1 (Data Source: USDA, 2018 & 2019 are forecast)

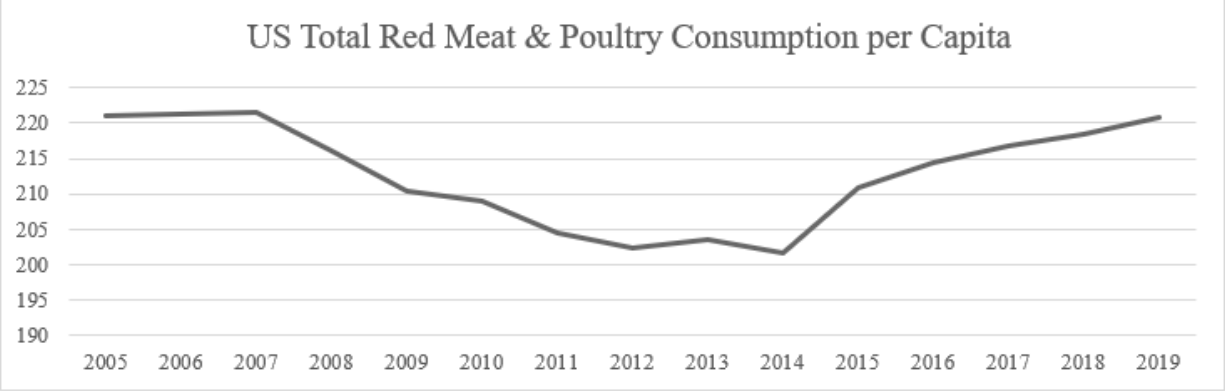

Figure 2 (Data Source: USDA, 2018 & 2019 are forecast)

In this paper, I present the results of an experiment in a university dining hall wherin I provide information on the environmental impact of animal agriculture. This approach was chosen because food can be delicate topic, as people often feel that their freedom is being challenged if one tries to influence dietary choices. Thus, I simply inform consumers of the environmental impact, without imploring them to act one way or another. This approach might be classified as libertarian paternalism, which has been shown to be an effective method to guide individuals to better outcomes without restricting their freedom to choose (Thaler and Sunstein 2003). It is inspired by literature which suggests that provision of information may be an effective way to influence more sustainable grocery purchases. I hope to measure whether this can be extended to

a dining hall setting, and if it still applies when the information points towards plant-based options.

The study was conducted at a dining hall at a large university in Southern California. Each observation consists of a meal period at that dining hall, which is either lunch or late night, a smaller after-dinner opening. I collect 15 observations over the course of two weeks, with an average of 733 diners at late night, and 1897 diners at lunch. For each observation I have the aggregated data for all the diners at one station of the dining area, "The Grill," where hamburgers, sandwiches, and fries are served. Reinforcing the sentiment above that meat consumption is an area ripe for improvement, I find that at a typical meal, around 10 times as many meat burgers were served as veggie burgers. On the last two days (3 observations), I implemented an intervention where I displayed a sign with an environmental fact about plant-based food choices at this station. The results show that this had no significant effect on the dishes that were chosen by subjects.

The current literature suggests that environmental labels can be effective in influencing food choices, and this depends on the label design and consumer values. In a computer-based experiment, Grankvist et al (2004), find that consumers can be affected by environmental labels as long as they already have in interest in environmental protection. We see that this is actualized in sales data and real consumer behavior as well. Vanclay et al (2011) find that labelling grocery products as green, yellow, or black depending on the level of carbon emissions, causes individuals to purchase more sustainable products and fewer unsustainable products. Harris (2007), in an analysis of food products and sales data, finds that there is a consumer demand for products that have a sustainability label. It is worth noting that in general there is a high

substitutability for "sustainable" products and conventional ones. For example, organically grown lettuce tastes the same as conventional lettuce, so the only cost of switching is the slightly higher price or perhaps the inconvenience of choosing a nonstandard option. However, in my experiment the more sustainable alternative that is implied is not entirely comparable to the meat-based option.

On another note, Americans are eating out more often. According to Nielsen[2], the at-home share of food expenditure is declining to just under 50% in 2016. So, in thinking about food purchases it is important to consider both restaurant and grocery store expenditures and behavior. But, the application of the above studies to a restaurant setting warrants care because at the grocery store, individuals are planning what they will eat in the future. This means that they are generally less susceptible to present-biased preferences, although Milkman et al (2010) do find some evidence that they are still at work in their study of online grocery orders. It is still likely that since patrons at a restaurant are deciding what they will eat at that moment, they are thus more susceptible to present-biased preferences. That is, they will be less concerned with the long-term effects of their choice and more focused on the immediate benefits such as palate pleasure and convenience.

Thus, I now turn to the literature on information provision in a restaurant setting. Almost all of this literature is related to health and nutrition concerns. The calorie-labeling laws for chain restaurants in New York provided an auspicious opportunity for such research. Bassett et al (2008) find that customers who reported seeing calorie information purchased 52 fewer calories.

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[2] https://www.nielsen.com/content/dam/corporate/us/en/reports-downloads/2018-reports/merging-tables-and-aisles.pdf Merging Tables & Aisles: Understanding Shifts in U.S. Total Food and Beverage Demand

This effect is only seen at one of the restaurants studied, where calorie information was displayed at the point of purchase. Especially in restaurant settings, providing information at the point of purchase is the most popular method as it can inform patrons of a new fact, a learning effect, or remind them of it and bring those concerns to the forefront of their mind while they are choosing what to eat, a salience effect. Moreover, it make the information easily accessible, and consumers do not have to go out of their way to obtain the information. Bollinger et al (2011) find evidence for both a learning and salience effect after a calorie labelling law was enacted in a restaurant, leading to fewer calories purchased overall. Downs et al (2009) also analyze the purchasing patterns at various restaurants. They find that calorie information had an impact at some restaurants but not all. They propose that the reason for this is that sometimes the calorie information is a negative shock, but other times, it makes consumers realize that they had been overestimating the calories in an item. Then, the information is a pleasant surprise that increases purchases, but only when there is such an overestimation.

The study most similar to this paper is one done by Campbell-Arvai et al (2014). They conducted an experiment testing different menus to see if they could increase the popularity of vegetarian dishes. To the best of my knowledge, this is the only other study that combines the provision of environmental information with restaurant behavior. Moreover, this is notable because their environmental information corresponded to vegetarian options rather than just a "sustainable" version of what the diner might choose in the first place. They found that implementing a treatment of providing information on sustainability did not have a statistically significant effect. However, their information treatment was to add a leaf symbol next to vegetarian and vegan menu items. Then, at the bottom of the menu there was a short explanation that read, "This symbol on the menu identifies a meat-free meal option. Recent scientific studies have suggested

that consuming less meat can help to reduce our environmental impact." It is quite possible that subjects could not be bothered to read the footnote or that they thought it was a weak statement and did not give heed to it. Moreover, their data is obtained through a survey and not actual consumption. My main contribution is to show that a highly visible nudge, making it very explicit that choosing a non-meat option is beneficial for climate change, does not have a strong effect on patrons' preferences in a restaurant setting, which is evidenced through actual consumption behavior.

This paper will examine the effect of providing environmental information on the consumption of prepared foods in a dining hall. Thus, I am examining both, consumer response to environmental information and response to food related information in a buffet style restaurant setting. As noted above this intersection is an area with little existing research. But the answer to this question has broad implications. Provision of information is generally a low-cost method, which can be implemented very easily. Moreover, it can be modified for different situations without much effort. For example, if we want consumers to be more mindful of their choice to consume dairy products, we can display a fact about the environmental impacts of cow's milk versus a more sustainable alternative. Similarly, the provision of information can be implemented in different food service contexts without much need for modification. A sign near an item at a buffet can be put up just as easily as one at a fast food counter or on a restaurant menu. This is one way in which information may be preferable to a different kind of "nudge" approach, such as manipulating defaults or convenience, which the literature suggests is the most impactful. A nudge is a slight change in the choice environment which exploits biases to encourage better choices.

Moreover, looking at a university setting is important in itself. Most students at a university are young adults who are forming life-long habits. If we can influence their dietary choices, then there will be lasting effects and benefits that would continue to manifest even years after the initial treatment.

Background and Experimental Design

This experiment took place in one of the four dining halls of University of California, Santa Barbara (UCSB). This dining hall was chosen because it is one of the largest at the school, with an average of 1897 diners at lunch, and the take rate data is the most accurate. Take rates are the measure of consumption in the dining halls, similar to sales data. The dining commons have a buffet style set up, where an individual pays or swipes their student ID to get in. Once inside, they can eat whatever they want. The staff measures the consumption of dishes by tracking take rates, the count of each dish taken. So, for each meal period, they obtain an aggregate count for the total number of each item taken.

The dining hall is organized into various stations based on the types of cuisine. My experiment is focused on "The Grill," which is the station that typically serves hamburgers, fries, and either a hot sandwich or a hot dog. The dining hall is open for various meal periods every day, each one lasting around 3 hours. I am only looking at lunch and late-night, since those are the meals that during which this station is open.

The intervention I implemented was to display a sign that informed patrons about the sustainability of plant-based diets. The sign, shown in the appendix, reads "Choosing a plant-based option for your meal today will reduce your greenhouse gas, acidifying, and eutrophying

emissions up to 73% - Science magazine." Consumers would see this sign as they are choosing which dish to take, since it is placed right at the station. The dishes are already labelled with small cards which have a small "(V)" to indicate vegetarian dishes and "(VGN)" to indicate vegan dishes. So, it is clear to consumers which dishes to choose if they want to take a plant-based option.

The data collected spanned Monday through Friday of two consecutive weeks. However, the Monday of the second week was omitted due to a holiday. I am also missing observations for late night on Fridays, since the dining hall closes early on Friday, and for one Tuesday night since no burgers were served. The Monday through Friday of the first week and Tuesday and Wednesday of the second week were observations with no intervention, which served as a control. Then, the sign was put up for Thursday and Friday of the last week. The sign stayed up throughout this whole period, even during dinner when no data was collected.

Data

My data was obtained directly from Dining Services within Housing, Dining, and Auxiliary Enterprises of UCSB. As described above, the staff at the dining commons collects data on take rates for each dish served. I have a total of 15 observations, where each observation is a single meal period, and for each meal period I have data on the count of each dish served at The Grill. On average, 1989 items were served at The Grill per meal period, 557 of which were meat or veggie burgers. Other items that are consistently offered are fries and some kind of hot sandwich, such as a grilled cheese.

The take rate data is used to create a variable for each day of total vegetarian or vegan items served divided by all items served at The Grill. I am considering both vegetarian and vegan dishes because although "plant-based" means vegan food, it is likely that many individuals do not understand this. Otherwise, they may be willing to change their behavior only slightly, forgoing meat but still consuming dairy and eggs. Additionally, by considering the fraction over total dishes rather than just the sum of vegetarian and vegan dishes, the variable is not influenced by the number of patrons at the dining hall. That is, a meal where more diners choose to get an item from this station will not confound the variable for that observation. Moreover, this fraction allows me to account for both a reduction in meat dishes as well as an increase in meat-free dishes, two plausible effects of the sign.

Since the dataset is quite small, this does not allow for many variables to be controlled without overfitting. One such variable is the specific types of burgers. Unlike restaurants with menus that are fairly constant, the dining hall has a different menu for every meal period, that only repeats once every four weeks. This is one way in which noise is introduced. There are various burger, sandwich, and veggie burger offerings. So, the popularity of these dishes could have more to do with which ones are offered. For example, the meat burger on one day could be more popular simply because the offering that day is a cheeseburger rather than a hamburger.

Dining Services was unable to provide me with demographic information, but it is clear that almost all of the patrons are students at UCSB, and most of them are freshmen living in the nearby dorms. Thus, young college students are the primary demographic, which is not representative of the overall population. My sample population is further restricted to those who take an item at The Grill, which is only a subset of the diners at lunch. On the other hand, at late-

night, The Grill is the only station that is open. Although I do not have data on other stations, there are a total of 6 food stations plus the dessert area, so we can see that The Grill does not completely capture all diners. This could lead to a self-selection bias. The options at The Grill are generally not the healthiest, so individuals who choose those items are likely basing their decisions on familiarity or taste rather than other considerations such as health or sustainability. Moreover, it is likely that diners who come to this station do so because they have already decided that they want to eat a burger for their meal. That is, they have a preference for red meat, which could indicate a disregard for environmental concerns.

Methodology

The main method I will use in my analysis is a difference in differences technique. This was chosen because I anticipated that there may be fixed effects for each day of the week and that the week itself could have an effect. For example, people may be more mindful of their food choices at the beginning of the week and may experience ego depletion as the week goes by. Additionally, it is becoming more common for individuals to have a “cheat day” or “cheat meal” once a week, and this generally falls on a Friday. If this were to happen, then the take rates for foods like burgers and fries should be higher on that day. It is also reasonable to believe that one week may be slightly different than the next. There are various reasons for this. Since this study was done at the beginning of the year, specifically early January/ late February, New Year’s resolutions could have an effect. Namely, as we get further away in time from New Year’s, individuals begin to give up on or forget their resolutions, which could involve healthy eating or sustainable habits. It is worth noting that these two habits often intersect, as healthier foods tend to be less processed and more plant-based, which are better for the environment. Secondly, the

second week of the study was also during the start of midterms season, and some subjects may have been worrying about tests or busy studying for them. Then, this could lead to ego depletion and they would exercise less self-control. They would also have more on their mind and be less likely to pay attention to a sign or be willing to learn a new fact.

A difference in differences was also chosen because a randomized controlled trial (RCT) would not have been practical in this situation. I was only able to obtain two consecutive weeks of data, which turned out to be 15 observations. The small sample makes the data quite noisy, and a difference in differences controls for the underlying differences between the treated and control days. Moreover, if I had implemented an RCT, I would have had to wait for a period in between interventions for consumers to forget the previous intervention, so that observations would be closer to independent. This is because there is a great deal of overlap between subjects in one experiment and another. It is generally the same group of people who frequent the dining hall, as they are the ones who live in the nearby dorms. So, a sign put up on one day, could affect a following day when there would be some of the same diners who remember the sign from the previous day.

Model

I am using a difference in differences model with the first week being untreated and the second week being treated. The post period is the end of the week (Thursday and Friday). Thus, I estimate the following regression:

$$Veg_i = \beta_0 + \beta_1 post_i + \beta_2 treated_i + \beta_3 post_i * treated_i + \epsilon_i$$

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where *Veg* is the fraction of vegetarian and vegan dishes over meat dishes, *post* is a dummy equal to one if the observation is on a Thursday or Friday, and *treated* is a dummy equal to 1 if the observation is during week 2. I also add in fixed effects for the day of the week and the meal time to see if this improves the estimates.

Results

My results show that there is no effect of providing environmental information on the popularity of vegan and vegetarian dishes. No coefficients of interest in the model are statistically significant. This is likely due to a small sample size.

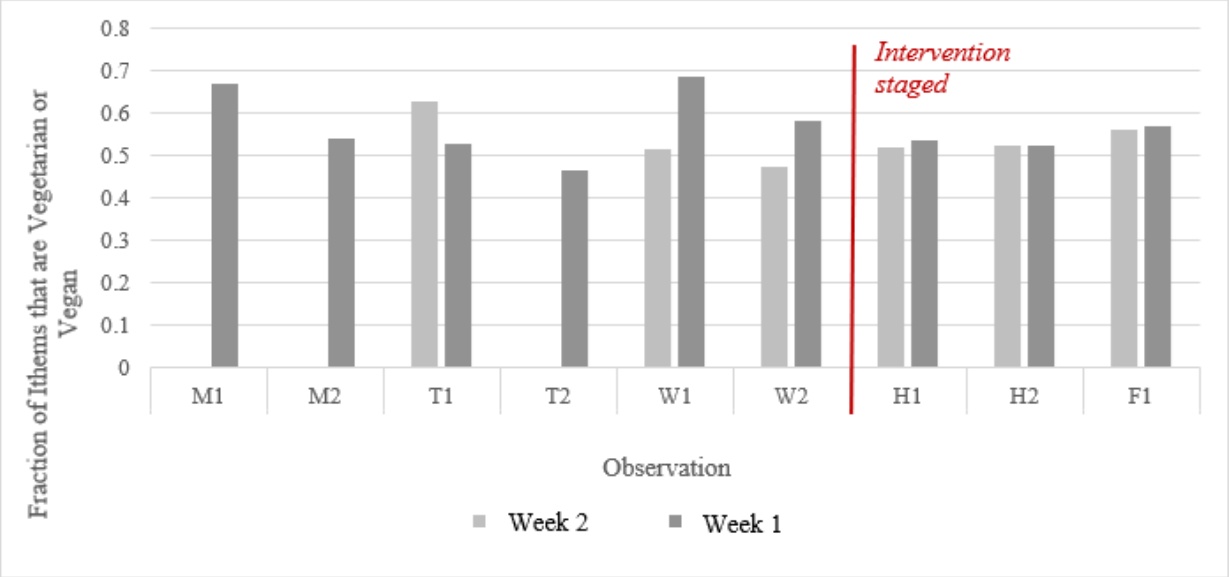

Figure 3 Proportion of meat-free options in control and treatment

Notes: Each letter stands for the day of the week and the number indicates the meal period: 1 for lunch, 2 for late night. A red line has been added to indicate the time of the intervention, which was implemented on the second week.

In Figure 3, I have the proportion of vegan and vegetarian options (i.e. the *Veg* variable) for each observation. The mean of this value is 0.559 for the control observations and 0.536 for those that were treated. The reason this proportion is seemingly high is that fries are an incredibly popular

(vegan) item. However, as mentioned above, diners consumed on average 10 times as many meat burgers as veggie burgers. Initially looking at the data, I see no striking trends to suggest fixed effects or a treatment effect, except a slight decrease in the proportion of meat-free options during the second meal, late night. Regression analysis confirms these initial observations.

Table 1 Ordinary Least Squares Regression Summary

Notes: Post is a dummy equal to one if the observation is on a Thursday or Friday, and treated is a dummy equal to 1 if the observation is during week 2

Dependent Variable: Vegan and Vegetarian dishes Over All Dishes				
	(1)	(2)	(3)	(4)
treated		-0.040	-0.052	-0.047
		(0.049)	(0.042)	(0.051)
post	-0.022	-0.035	-0.047	-0.072
	(0.045)	(0.049)	(0.042)	(0.073)
post*treated	-0.007	0.033	0.045	0.040
	(0.056)	(0.075)	(0.064)	(0.074)
Meal FE			0.070*	0.074*
			(0.032)	(0.037)
Day of Week FE				Yes
Observations	15	15	15	15
R-squared	0.040	0.096	0.394	0.485

Standard errors in parentheses
*** Significant at 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

Table 1 shows the results of several regressions. We see that using the difference in differences estimation and various controls, there is a slight, but not statistically significant increase in the proportion of meat-free options chosen when the sign was in place. This effect, however, is much smaller but negative when I use a different method and do not control for the week (column 1).

I focus on the regression in column (3), which includes meal fixed effects, but not day of week fixed effects. The regression results show that meal effects are significant, but day of week effects are not. In particular, the results show that a higher fraction vegetarian and vegan options are served at lunch than late night. This could be due to subjects having more self-control earlier in the day, as mentioned above. Additionally, it could be that the different physical set-up or menu offerings at late night create an environment that promotes more meat-based dishes. On the other hand, there is no strong indication of day of week fixed effects. Thus, I drop the controls for that, since it adds unnecessary variables to my regression and the small sample size is susceptible to overfitting.

In this regression, we cannot reject the null hypothesis that the treatment had zero effect since the p-value for the *post*treated* interaction term is .502. Using randomization inference with 2000 draws yields a p-value of 0.329 for the interaction term, which confirms the result that I am unable to reject the null hypothesis. Using the regression results, I can however construct a 95% confidence interval for the magnitude of the effect. I find that we can be 95% confident that having the sign displayed had an effect somewhere between decreasing the proportion of meatless dishes by 0.081 or increasing it by 0.171. Since the control mean for the dependent variable is 0.559, we can put this in terms of percent change i.e. we are 95% confident that the treatment effect on the proportion of meatless dishes served was somewhere between a 14.5%

decrease or a 30.5% increase. So, we can be quite sure that there is no significant negative impact of displaying the sign. Likewise, there is no impressive increase in the proportion of vegan and vegetarian dishes served.

Other studies generally do not look at a proportion of a class of products or items over all items, so it is difficult to compare the results directly. But, it is still worthwhile to compare the magnitude of the effect. Vanclay et al (2011) find that the sales for products labelled unsustainable decreased by 6% and the sales of products labelled as sustainable increased by 4%. Bollinger et al (2011) find that calorie labelling laws decrease calories purchased per transaction by 6%. Thus, we have that a small change of behavior in the expected direction is shown to be statistically significant in the literature, which is consistent with the confidence interval I have constructed.

Conclusion

In this paper I have attempted to answer the question of whether we can influence diners to consume more vegetarian and vegan options by posting a sign that informs them about the sustainability of plant-based food. This is distinct from current literature in that I examine both environmental labels and actual restaurant behavior. The data show that the effect of this treatment is not significantly different from zero.

Due to a small sample size, I was unable to produce conclusive regressions estimates. Further research with a larger sample is needed to reduce the standard errors and produce more precise estimates. The failure to reject a zero effect could also be due to the experiment design. It is possible that the sign was not visible enough, or that it was not powerful enough. It is uncertain

how many subjects during treated meal periods saw the sign, and a survey component could account for this in the future. For those who did see the sign, it is possible that they were unaffected by the message because the learning and salience effects were too weak. That is, subjects already knew the information that was displayed or that the message was not powerful enough, perhaps due to the wording. A good approach would be to first use surveys to test different signs and messages and select the most powerful one for the field experiment. There is also a question of whether having the sign up for a longer period of time could have a cumulative effect and increase effectiveness or have a diminishing effect due to information fatigue. So an area for additional research would be to test treatments with different sign durations. My study shows that there is no great risk involved in displaying environmental information at the point of purchase of a dining hall, and it is a low-cost method that may or may not have a beneficial effect on the items consumed.


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