BEHAVIORAL NUTRITION: TASTING WITH YOUR EYES, DRINKING WITH YOUR HEART ON YOUR STRAW, AND CHOOSING MINDLESSLY WITH YOUR GUT

By

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ABSTRACT OF THE DISSERTATION

Behavioral Nutrition: Tasting With Your Eyes, Drinking With Your Heart on Your Straw, and Choosing Mindlessly With Your Gut

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Interdisciplinary Research is imperative to finding a creative solution to complex problems. The body of research presented in this dissertation harnesses the interdisciplinary model and illuminates the field of behavioral nutrition. The four studies draw on Behavioral Economics in the use of choice architecture or nudges to encourage the decision maker to choose healthier or pro social options while still preserving freedom to choose any option. *Putting the Healthy Item First* reports a field study that used a subtle nudge, a manipulation of the order in which ingredients appeared on a sandwich order slip, to test the effect of a cue to healthy eating in a college dining take-out facility. This study adds to the body of research on effective use of menu position to encourage healthier choices at the ingredient level. In *Tasting with your Eyes*, a labeling manipulation was used to determine the effect the label had on willingness to try and taste preference of a food item above and beyond the taste of the food itself. This study showed that a “locally sourced” or “organic” food label can affect taste and preference of a food item, holding constant the actual content of the food itself, and can be used as a
nudge to promote a certain food. The *America Runs on Nudges* study used an explicit nudge to prompt customers to select a lower fat, lower calorie beverage choice at Dunkin’ Donuts. This study showed that a behavioral nudge could alter the ordering practices of the Dunkin’ Donuts customer. *Drinking with Your Heart on Your Straw* compared the effects of two specific types of nudges on beverage choice. The effect of a nutrition (self-interest) motive, charity (pro-social) and combination of nutrition and charity motive on beverage choice was studied in a field setting at an Italian franchise on a university campus. The nutrition and combination nudge was effective in promoting beverage choice of water but the charity nudge was not. The results of the four studies presented in this dissertation illustrate how we can harness the use of nudges to entice people to choose the healthy option.
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CHAPTER ONE
INTRODUCTION

Traditional research models were built on the belief that “excellence in science meant disciplinary excellence” (Metzger & Zare, 1999). Based on the success of the US research program, there has been resistance towards changing this template for research success. However, the tides are turning, and there is a shift in the research paradigm towards an interdisciplinary approach. Interdisciplinary research can be challenging as researchers across disciplines think differently. Not only are diverse modes of data used to draw conclusions (e.g., quantitative versus qualitative), assumptions, concepts, methods of recognizing and reporting outcomes pose a problem as differences of the mind are uncovered (Strober, 2011). The culture of the discipline comes into play, and there may be a conflict on how to ascertain scientific results. Despite the burden of having interdisciplinary conversations, there are strong motivators to pursue this approach to research. Research outcomes reported out of one discipline may limit data interpretation by providing too narrow a view of the study results (Strober, 2011). There is strong belief that collaboration within and between disciplines is imperative to finding a creative solution to complex problems. Cognitive diversity enhances creative thought, and this progressive thinking moves forward solutions to problems at a faster pace than with a single disciplinary approach (Strober, 2011). Interdisciplinary conversations have drawn the attention of major research institutions with many having interdisciplinary research in their strategic plan (Brint, 2005). Developing a culture of interdisciplinary research has economic benefits for these institutions as well. Since 2000, many government agencies and foundations have included interdisciplinary research as part of
a grant application. In 2003, the National Institute of Medicine made a case for more interdisciplinary teams, especially between the basic and behavioral/social sciences (Strober, 2011). The National Research Council and Institute of Medicine (2003) argued that “some parts of the scientific frontier require the mobilization of interdisciplinary research teams. Increasingly, investigators will need to integrate knowledge and greater prominence must be given to research in the behavioral and social sciences.” (National Research Council & Institute of Medicine, 2003, p.51-52; Strober, 2011, p. 5-6) More than a decade later, the academic debate and dialogue continues on how best to practice the interdisciplinary philosophy.

The body of research presented in this dissertation harnesses the interdisciplinary model. The four research studies presented underscore the value of interdisciplinary research by illuminating the new field of behavioral nutrition. This area of inquiry explores the underlying psychological and environmental factors that affect food choices and, ultimately, health outcomes of socio-economic importance, including obesity, diabetes and all types of chronic diet-related diseases. This research draws on behavioral economics in the use of choice architecture or nudges to encourage the decision maker to choose healthier or pro social options while still preserving freedom to choose any option (Thaler, Sunstein, & Balz, 2014). Preserving freedom of choice is important in consumer behavior and decision-making. According to the Reactance Theory, people become aroused to a motivational state called psychological reactance when they feel their freedom has been taken away or threatened (Brehm, 1989). Psychological Reactance can manifest in two ways: actions taken by the consumer to restore freedom and/or the lost or threatened option has an increased perceived attractiveness (Brehm, 1989). Either of
these manifestations of reactance may also ignite the implication principle causing consumers to question if other freedoms will be relinquished following the initial loss of freedom. Brehm points out that Psychological Reactance occurs even if the consumer did not plan on using all the products or services presented; any alteration in freedom of choice will be countered by a tendency to desire what is taken away.

Nudges do not take away freedom of choice, thus do not induce Psychological Reactance and are a low cost and effective method of behavior change. Changing the dining environment can reduce an individual’s overconsumption of food and is often a more feasible intervention than constantly reminding an individual to monitor their food intake (Wansink, 2004; Lowe, 1993).

A key question addressed by the current studies is: what types of nudge interventions have the greatest effect on changing food or beverage choice? Explicit promotion of healthy options is not always effective in moderating overall calorie consumption. For example, labeling foods with calorie content or key adjectives to define healthiness may elicit an unfavorable outcome. Consumers claim they want healthy options added to menus, but frequently they do not actually purchase them (Fitzgerald, Kannan, Sheldon, & Eagle, 2004). In fact, the presence of healthy options on a menu may even push people towards more indulgent selections (Wilcox, Vallen, Block, & Fitzsimons, 2009). Thus, interventions are needed that go beyond education and offering healthier alternatives. Altering the food environment through nudges is likely to be a more effective means of food choice control.

The four research studies presented in this dissertation test the effects of nudges that can be used in the foodservice environment to engage customers in healthy eating
practices that prevent (or reverse the increase of) unhealthy nutrition behaviors. The four studies use nudges to influence customers; however, the nudges vary in how explicit or intrusive they are. Three of the four studies involved field settings. These field experiments involve research in a real consumer setting with tight experimental manipulations and access to individual-level data from customers who do not know that they are part of a study and behave in a real-world setting. The interventions tested could easily be implemented in real world dining venues.

*Putting the Healthy Item First* reports a field study that used a subtle nudge, a manipulation of the order in which ingredients appeared on a sandwich order slip, to test the effect of a cue to healthy eating in a college dining take-out facility. The order of ingredients on a submarine sandwich order form was manipulated such that in the experimental condition the healthiest ingredients were placed first in the listings in each sandwich category (bread, fillings and condiments) and were highlighted with a star. Previous research (Downs, Loewenstein, & Wisdom, 2009) has shown that order of food items in a menu affects customer choice. This study, however, adds to the body of research on effective use of menu position to encourage healthier choices but at the ingredient level rather than the main dish level. Ingredient bars are becoming a popular restaurant trend (Jacobson & Hurley, 2002), and nudges that make choosing certain ingredients more effortless can be used to promote healthy ingredient choices.

The *Tasting with your Eyes* study was the only non-field experiment of the four studies in the dissertation. However, unlike a typical lab study, the data were collected in a university dining hall to mimic the feel of a field study. In this study, a labeling manipulation was used to determine the effect the label had on willingness to try and
taste preference of a food item above and beyond the taste of the food itself. Foods are routinely judged for their taste profile, based on bottom-up processing. The results of this study showed that a “locally sourced” or “organic” food label can affect taste and preference of a food item, holding constant the actual content of the food itself, and can be used as a nudge towards increasing selection of dairy, fruits, and vegetables. A low-fat label does not have the same effect and may actually impart a negative connotation for a food product. Thus, it should be used prudently with foods we wish to promote for their nutritional benefits. Food labels have their effect by way of “top down” processing (i.e. priming expectations about the food) rather than “bottom up processing” (i.e., evaluating the actual flavor profile of a food).

America Runs on Nudges appears to be a true statement as indicated by the results from the field study reported in Chapter 3. This study used an explicit nudge to prompt customers to select a lower fat, lower calorie beverage choice at a recognized franchise. During the study period, customers who ordered a Latte at a university-run Dunkin’ Donuts were prompted by a verbal cue, asking if they would like to make their order a Lite Latte. Latte Lite orders increased from 18.9% of all lattes ordered during baseline to 51.5% of all latte orders during the intervention period. Not only was the verbal nudge effective during the intervention phase, during a 20-day follow up period, 50.5% of latte orders were Lite. A Latte Lite entails a total Calorie savings of 60 kcals and 9 grams of fat saved per medium Latte compared to a regular latte. This study showed that a behavioral nudge could alter the ordering practices of the Dunkin’ Donuts customer. Dunkin’ Donuts sells 2.7 million cups of coffee a day in the United States. A reduction of
calories and fat for customers who frequently visit Dunkin’ Donuts could have an enormous national impact on weight control.

*Drinking with Your Heart on Your Straw.* The results of the first three studies indicate that nudges are an effective means to change dietary behavior, while still allowing customers the freedom of choice. This fourth study compared the effects of two specific types of nudges on beverage choice. The effect of a nutrition (self-interest) motive, charity (pro-social) and combination of nutrition and charity motive on beverage choice was studied in a field setting at an Italian franchise on a university campus. The research explored which of the nudges would be most effective in having students choose water instead of a sugar sweetened beverage with their meal. Sugar sweetened beverage (SSB) intake is often cited as a major contributor to the obesity epidemic. Government legislation towards controlling beverage choice has not been received as a favorable approach. A nudge would be a novel approach towards reducing SSB intake without government intervention and still allowing freedom of choice. Based on results from a pilot study and preliminary study of the intervention posters, we hypothesized that the charity nudge would be most effective in swaying beverage choice. However, this was not the case. A nudge was effective in promoting beverage choice of water but it was the nutrition (self-interest) nudge that was found to be most effective, not the charity (pro-social) nudge.

The four studies presented in this dissertation combine decision-making research from Psychology with behavior change research from Nutrition to shed new light on determinates of healthy choice. The Interdisciplinary Research paradigm that is highlighted in university strategic plans and required in various grant proposals is
exemplified in the burgeoning field of behavioral nutrition—a field that may hold some of the answers needed to address the complex problem of obesity. The current results illustrate how we can harness the use of nudges to entice people to choose the healthy option.
CHAPTER TWO

PUTTING THE HEALTHY ITEM FIRST

Abstract

The objective of the study was to examine the effects of an order form intervention on choice of healthy ingredients among college students ordering submarine sandwiches (subs) at a dining hall. The research design included a randomized experiment conducted in a university dining hall take-out section over a period of eight weekly sub nights. Participants were college students who submitted 9,765 sub orders during an eight week study period. We manipulated the format of the order form on which students indicated their selected sub ingredients, making the healthier selections more salient in one condition. The main outcome measures were the selection of sub ingredients on the order forms. Logistic regression and ANOVA was used to examine the effect of experimental conditions on selection of individual sub ingredients. The health-salient order form increased selection of healthier ingredients and decreased selection of unhealthy ingredients. The manipulation increased fiber and decreased sodium of the subs served but did not impact calorie or fat levels. This study adds to the body of research on effective use of menu position effects to encourage healthier choices but at the ingredient level rather than the main dish level. Contextual changes that highlight social norms are effective in influencing ingredient choice but have modest effects on nutritional intake.
Introduction

Current levels of obesity have heightened researchers' interest in the design of environments that foster healthy eating. Subtle factors such as size of plates or serving dishes, portion size, and variety of offerings affect the amount consumed (Wansink, 2004). In addition, partitions in a multi-serving food package (Geier, Wansink, & Rozin, 2012), or placing diners physically farther from an attractive food (Wansink & Payne, 2008) can decrease consumption of indulgent foods. Each of these manipulations likely has its effect on eating behavior by suggesting consumption norms (Wansink, 2004).

Normative cues which signal the appropriate behavior in a given context can have a strong influence on eating behavior, for example influencing intentions to make healthy food choices (Croker, Whitaker, Cooke, & Wardle, 2009). A cue can describe a descriptive norm, for example a message that "80% of people in Britain try to eat at least 5 portions of fruit and vegetables a day" (Croker et al., 2009). Alternatively, a cue can highlight a recommended behavior. For example, Thorndike and colleagues (Thorndike, Sonnenberg, Riis, Barraclough, & Levy, 2012) found that color-coded tags on foods (green for healthy, red for unhealthy) in a hospital cafeteria, coupled with a rearrangement of the food items to make the healthier ones more visible, increased sales of zero-calorie beverages. Normative cues need not be as overt as a green recommendation sticker: menu items at the top of the list tend to be chosen more, and so menus that order selections from healthiest to least healthy result in people making healthier choices (Dayan & Bar-Hillel, 2011). A study by Downs and colleagues (Downs, Loewenstein, & Wisdom, 2009) found that customers were more likely to choose lower calorie sandwiches when these were listed or pictured in the front of the
menu rather than at the middle or back. In addition, moving the healthier selections to a more accessible and salient location in a salad bar causes them to be consumed in higher quantities (Rozin, Scott, & Dingley, 2011). Cues that make choosing certain options more effortless can subtly indicate what choice behavior is expected (McKenzie, Liersch, & Finkelstein, 2006).

In the current study, we examined the effect of a cue to healthy eating in a college dining take-out facility. We examined the effect of menu cues on food choice at the ingredient level rather than at the dish or entrée level as has been previously studied (Downs et al., 2009). It is important to test this type of manipulation at the ingredient level because ingredient bars and choice of toppings are becoming increasingly popular in restaurants that serve pizza, omelets, burgers and low-fat yogurt. This type of menu manipulation may produce a smaller effect when consumers make choices about individual ingredients, because of the opportunity to compensate for healthy choices with an unhealthy choice. In contrast, a single menu item (e.g., sandwich) entails a single choice and may therefore be easier to manipulate. The purpose of the current study was to examine whether menu position and salience would affect food choice in the more challenging setting of individual ingredient selection.

We conducted an eight-week randomized experiment, manipulating the order, and saliency of options (starred and larger, bolder font on healthier items), on an order form, a cue that indicates the choices that were expected or encouraged. We predicted that diners would choose healthier food options when using the order form that highlighted those options.
Methods

Setting: This field study was carried out in the take-out line of a university dining facility. The dining hall offers both a sit-down buffet-style dining hall and a take-out line. The take-out line has a different menu each night of the week and offers submarine sandwiches (subs) on one night per week. On these nights, diners who come to the take-out line stand in line in a hallway and fill out an order form to select the ingredients for their sub.

The order form includes different ingredient options in the categories of bread, spreads, cheeses, meats, vegetables, and additional condiments (Figure 1). Diners are able to choose as many items on the order form as they would like, except for type of bread, of which they must choose only one. Typically, the order forms are discarded after the orders are prepared, however, during the study period, the dining staff retained the forms for data analysis.

Participants: The participants in the study were university students who had purchased meal plans and patronized the sub take-out line. The students were not aware of their participation in the study. The study was approved by the Institutional Review Board at the university where the study was conducted. The study took place over eight weekly sub nights, during which time a total of 9,765 order forms were collected for the study. The length of the study (eight weeks) was chosen to provide multiple days within each experimental condition. We did not set a target number of order forms to be collected for the study, but wished to avoid confounds between experimental condition and specific calendar day or events (e.g., weather).
Procedure: During the weekly sub night on four of the eight nights, diners used the standard order form (control condition) typically used by this dining hall. On the other nights, diners used a modified “health-salient” order form. This order form highlighted the healthier ingredients by listing them first within each ingredient category (spreads, cheeses, meats, vegetables, and additional condiments) printing them in bolded, slightly larger font, and designating them with a star symbol (Figure 1). Healthier ingredients were defined as lower in calories, fat, or sodium and, for some ingredient categories, higher in fiber than other ingredients in the same category. Nutritional analysis of the items on the sub order slip was performed using the Food Processor SQL-version 9.8 data analysis program. All of the diners on a given night received the same order form condition. The order of the two order form conditions was randomized for the first four weeks of the study, and again for the second four weeks.

Results

Dependent variables were participants’ choices of the 29 individual ingredients in the six ingredient categories. We ran logistic regressions with choice of an individual ingredient as the dichotomous dependent measure. The independent variables were order form (control or health-salient), ingredient category (bread, spreads, meats, cheeses, vegetables, and condiments), and health status of the ingredient (whether the ingredient was starred, had larger font and was bolded [i.e. designated as healthy] on the health-salient order form). The latter two variables were within-subject. Table 2 shows the results of the logistic regression based on 9,765 observations.

The logistic regression revealed an influence of order form condition.
Specifically, it showed an interaction between order form and ingredient status, $\chi^2(1)$
13.67, \( p < .0001 \), indicating that use of the health-salient order form increased choice of the healthy ingredients and decreased choice of the unhealthy ingredients. In addition, there was a 3-way interaction among order form, ingredient status, and ingredient category, \( \chi^2(4) = 31.66, \ p < .0001 \), indicating that the effect of the health-salient order form increased choice of the healthy ingredients and decreased choice of the unhealthy ingredients for some categories more than others. Separate logistic regressions for each ingredient category showed that the interaction between order form and ingredient status was individually significant for the bread, meat, and condiment categories.

We also computed individual chi-squares for each of the 29 ingredients to test the effect of order form condition on each. Figure 2 illustrates which ingredients showed an effect: ingredients represented with a green bar are those that were designated healthy (starred), and those represented with a red bar are those that were designated as unhealthy (not starred). We predicted that, compared to the control order form, the health-salient order form would increase choice of the green ingredients, represented by a bar to the right, and decrease choice of the red ingredients, represented by a move to the left. Eleven of 29 ingredients showed a statistically significant effect in the predicted direction (see Table 3 for the percentages of participants who chose each ingredient under each condition). One additional ingredient (mayonnaise) showed a surprising reverse effect – that is, choice of mayonnaise was higher with the health-salient order form than with the standard order form. The health salient form increased choice of spreads in general, as reflected in an increase in both mayonnaise and mustard.

Omnibus measures: We examined whether the experimental manipulations had an effect on total calories, total grams of fat, total mg of sodium, or total grams of fiber in
the sub ordered. We computed each of these measures for each sub order using specifications of sandwich construction (i.e. serving sizemeasurements of each category ingredient) supplied by the University Dining Service (see Appendix). Data from 13 sub orders was excluded from this analysis because no bread was selected on those orders.

Measures of calories, fat, sodium, and fiber were each subjected to a t-test comparing the two order form conditions. Order form condition had a marginal effect on sodium, \( t(9750)=1.87, \) Cohen’s \( d=0.04, p=.06, \) and a significant effect on fiber, \( t(9750)=2.87, \) Cohen’s \( d=0.06, p=.004 \) (Table 4). Use of the health-salient order form, however, did not decrease calories, \( t(9750)=0.07, p=.94, \) or fat, \( t(9750)=0.59, p=.55, \) of the order. This may be because, as discussed above, use of the health-salient order form paradoxically increased use of mayonnaise, which is a major contributor of calories and fat.

To test this idea, we repeated the analyses statistically controlling for whether mayonnaise was selected on the order. Mayonnaise selection was strongly related to both calories, \( F(1,9747)=3896, \) \( \eta^2=.29, p<.0001, \) and fat, \( F(1,9747)=5573, \) \( \eta^2=.36, p<.0001. \) Controlling for mayonnaise selection did not alter the effects of experimental condition on sodium or fiber. However, after controlling for mayonnaise selection, order form condition was related to calories, \( F(1,9749)=5.20, \) \( \eta^2=.0004, p=.02, \) and marginally related to fat, \( F(1,9749)=3.53, \) \( \eta^2=.0002, p=.06. \) Table 3 shows the least squared means which indicate that, after controlling for mayonnaise, the health-salient order form resulted in a decrease of 13 calories and 1 gram of fat. In other words, had not the health-salient order form elicited increased mayonnaise selection; it would have reduced the total calories and fat of the subs ordered by a very small but statistically significant
amount. Given that it did have this paradoxical mayonnaise effect, the order form manipulation was calorie neutral. This is, the effect that the health-salient order form had on selection of other ingredients balanced out the effect that it had on increased mayonnaise selection.

Because we had no way to match up order forms that the same person submitted on separate weeks, in the forgoing analyses, we treated each of the 9,765 order form as if it corresponded to a separate person, even though it is likely that many individuals handed in multiple forms over the course of the eight week study. This approach inflates the degrees of freedom relative to analyses that could take into account the repeat customers. In order to address this limitation, we conducted a simulation in which the sub orders from one week were randomly linked to those from the other weeks, creating hypothetical repeat customers. By doing so, we maximized the potential within-subjects nature of the data. That is, instead of assuming that there were 9,765 unique individual placing orders, we assumed that there were 1,359 individuals placing multiple orders across the eight weeks. Analyses of these simulated data yielded conclusions that were identical to those from our main analysis. Specifically, choice of ingredients showed an interaction between order form and ingredient status, $\chi^2(1) = 34.55, p < .0001$, indicating that use of the health-salient order form increased choice of the healthy ingredients and decreased choice of the unhealthy ingredients. In addition, a 3-way interaction among order form, ingredient status, and ingredient category, $\chi^2(1) = 31.16, p < .0001$, indicated that the interaction between order form and ingredient status was present for the bread, meat, and condiment categories but not for the other categories. Finally, analyses of total
calories, fat, sodium, and fiber using the within-subject simulation yielded results identical to those from the main analysis.

**Discussion**

The current study demonstrated that diners selected healthier ingredients when using the health-salient order form than when using the control form. The layout differences between the two versions of the order form were subtle but nevertheless affected diners' real-world behavior. The use of the word *healthy food* on the experimental order form was more of an explicit cue. The behavior change was modest in size and occurred for some but not all ingredients: use of the health-salient order form affected choice in the predicted direction for 11 of the 29 ingredients by one to five percentage points. However, small changes in daily eating behavior could add up to important consequences in terms of maintaining a healthy weight and managing risk of chronic diseases. An alternate research design would have been to test the effect of ordering of ingredients separately from the effect of starring the healthy items and printing them in larger, bolder font, to see which manipulation had the greater effect on behavior. However, because the effect of our combined health salient form manipulation was modest, we expect that the individual effects of each component of the manipulation could be quite minimal. Another research design would have been to use a more subtle cue instead of the star and *healthy food* denotation. A study by Wagner, Howald and Mann (2015) found that subjects (especially women) were more likely to choose a healthy snack when it was labeled with a subtle cue, such as a red heart with a white checkmark, compared to when it was labeled explicitly with the word *healthy*. 
Although the order form condition had an effect in the predicted direction for a number of ingredients, it had a counter-predicted effect for one: the health-salient order form unexpectedly increased the selection of mayonnaise. We considered the possibility that the selection of mayonnaise was triggered by selecting healthier meats. Specifically, use of the health-salient order forms increased choice of turkey by 3 percentage points, and selection of turkey was associated with choice of mayonnaise (53% of order forms that selected turkey also selected mayonnaise, as compared to only 45% of order forms with no selection of turkey.). However, mayonnaise choice was affected by the order form condition even after statistically controlling for selection of turkey (lnOR = 0.070, \( p = .0005 \) before and lnOR= 0.067, \( p = .001 \) after controlling for mayonnaise). Indeed, the size of the association between order form condition and mayonnaise selection remaining largely unchanged even after statistically controlling for all other ingredient selections (lnOR = 0.091, \( p = .0001 \) after controlling for all other ingredients). This reverse effect of order form condition on mayonnaise selection may therefore represent the health halo effect, where just having the word healthy on the order slip may have led diners to believe they have taken steps to be healthy, including choosing mayonnaise (Chandon and Wansink, 2007, Wilcox, Vallen, Block, & Fitzsimons, 2009). Alternatively, the mayonnaise effect could be explained by moral licensing where diners may have felt justified in choosing mayonnaise as a result of choosing other, healthy options (Schuldt & Schwarz, 2010). For example, if a diner were to choose turkey over pepperoni and decline the addition of cheese and salt on the sandwich, he or she might feel justified in adding mayonnaise. Finally, the health halo effect could be an antecedent to moral licensing (Wagner, 2015). As discussed earlier, as a result of the reverse effect of order
form condition on mayonnaise selection, the order form manipulation had no net effect on calorie or fat totals.

A key strength of the current study is that it was a field study that used an experimental manipulation in a real-world setting. In addition, participants were unaware that their behavior was being observed as part of a research study, thus avoiding demand effects. Compared to previous studies, this study also set a higher bar to detect effects of the menu manipulations as they were implemented at the ingredient level rather than the main dish or entrée level. Despite the opportunity to compensate for a healthy choice for one ingredient by choosing a few other unhealthy ingredients, we still found a significant effect on healthy ingredient choices of using the health salient sub form. The study also had some limitations. Although we know what students ordered, we did not have a measure of actual consumption (e.g., students may not have eaten the entire sub or may have saved half of it for a future meal). In addition, as discussed above, we could not track the repeated orders from a given individual from week to week, which limited the type of statistical analyses we could perform.

**Implications for Research and Practice**

Dietary behavior is a leading contributor to health conditions including obesity, diabetes, and heart disease. Changes in dietary behavior can have profound effects on morbidity and mortality, yet changing dietary behavior is extraordinarily difficult. One strategy for altering eating behavior is to restructure the "choice architecture" (Thaler & Sunstein, 2008), or the way in which dietary choices are presented, so as to nudge diners toward healthier options. The current study demonstrates one such technique. Ordering menu selections so that the healthier options are at the top of the category (Dayan & Bar-
Hillel, 2011) and indicating recommended options with a symbol (Thorndike et al., 2012)—two techniques that were combined in the current study—increase diners’ selection of the healthier options. Such a change in menu presentation is easy to enact in many dining establishments such as restaurants and cafeterias. This type of technique does not require explicit education of diners but instead relies on the social norms that are subtly communicated by changes in the dining environment. This manipulation, however, had only small effects on the total sodium and fiber in the sub orders and no effect on total calories and fat. The potential for such dining environment changes to produce compensation effects (such as the effect on mayonnaise observed here) warrants further research. Nevertheless, this type of choice architecture may hold promise for use as part of a total diet approach in that small changes in dietary intake over a period of time could lead to significant changes in body mass index, without the consumer having to make a conscious effort to restrict calories.
Appendix

The calculation of the total calories, fat, sodium, and fiber in each sub order were based on the following facts about how dining hall staff construct the subs. Each sub on a multi-grain or plain roll contains 10 ounces of meat and cheese, while subs prepared with a wrap contain 8 ounces. If the sub contains both meat and cheese, the cheese makes up 2 ounces and the meat the remainder. If multiple meats are selected, then they make up equal proportions of the meat weight. Thus, for example, a turkey, ham, and Swiss sub on a roll would contain 4 ounces of turkey, 4 ounces of ham, and 2 ounces of Swiss cheese. The serving size for mayonnaise is 4 tablespoons on a sub roll and 1 tablespoon on a wrap. The serving size for mustard is one tablespoon on a sub roll and one teaspoon on a wrap. The serving size for all other ingredients is the unit shown in Table 1. Table 1 also shows the number of Calories, grams of fat, mg of sodium, and grams of fiber per unit for each ingredient. A nutritional value for the ingredients in each category was obtained from a nutrition software program (Food Processor SQL) which is interfaced with the university ingredient database.
Table 1. Nutrient Composition of Each Ingredient.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Unit</th>
<th>Calories</th>
<th>Fat (g)</th>
<th>Sodium (mg)</th>
<th>Fiber (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi Grain Roll</td>
<td>1</td>
<td>319</td>
<td>5.6</td>
<td>574</td>
<td>9.0</td>
</tr>
<tr>
<td>(12&quot;)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plain Roll (12&quot;)</td>
<td>1</td>
<td>504</td>
<td>10.1</td>
<td>861</td>
<td>4.7</td>
</tr>
<tr>
<td>Wrap</td>
<td>1</td>
<td>300</td>
<td>8.0</td>
<td>610</td>
<td>3.0</td>
</tr>
<tr>
<td>Mustard</td>
<td>1 teaspoon</td>
<td>5</td>
<td>0.4</td>
<td>77</td>
<td>0.1</td>
</tr>
<tr>
<td>Hummus</td>
<td>4 oz</td>
<td>132</td>
<td>2.0</td>
<td>969</td>
<td>6.0</td>
</tr>
<tr>
<td>Mayo</td>
<td>1 tablespoon</td>
<td>100</td>
<td>11.0</td>
<td>80</td>
<td>0.0</td>
</tr>
<tr>
<td>Vegan Deli Meat</td>
<td>1 oz</td>
<td>40</td>
<td>1.3</td>
<td>240</td>
<td>0.0</td>
</tr>
<tr>
<td>Turkey</td>
<td>1 oz</td>
<td>25</td>
<td>0.3</td>
<td>340</td>
<td>0.0</td>
</tr>
<tr>
<td>Ham</td>
<td>1 oz</td>
<td>27</td>
<td>1.1</td>
<td>369</td>
<td>0.0</td>
</tr>
<tr>
<td>Roast Beef</td>
<td>1 oz</td>
<td>51</td>
<td>2.7</td>
<td>14</td>
<td>0.0</td>
</tr>
<tr>
<td>Capicola</td>
<td>1 oz</td>
<td>30</td>
<td>0.8</td>
<td>378</td>
<td>0.3</td>
</tr>
<tr>
<td>Tuna</td>
<td>1 oz</td>
<td>44</td>
<td>4.7</td>
<td>39</td>
<td>0.1</td>
</tr>
<tr>
<td>Genoa Salami</td>
<td>1 oz</td>
<td>105</td>
<td>9.5</td>
<td>515</td>
<td>0.0</td>
</tr>
<tr>
<td>Bologna</td>
<td>1 oz</td>
<td>91</td>
<td>8.1</td>
<td>314</td>
<td>0.0</td>
</tr>
<tr>
<td>Pepperoni</td>
<td>1 oz</td>
<td>132</td>
<td>11.4</td>
<td>507</td>
<td>0.4</td>
</tr>
<tr>
<td>American</td>
<td>1 oz</td>
<td>105</td>
<td>8.8</td>
<td>417</td>
<td>0.0</td>
</tr>
<tr>
<td>Provolone</td>
<td>1 oz</td>
<td>100</td>
<td>7.6</td>
<td>249</td>
<td>0.0</td>
</tr>
<tr>
<td>Swiss</td>
<td>1 oz</td>
<td>108</td>
<td>7.9</td>
<td>55</td>
<td>0.0</td>
</tr>
<tr>
<td>Tomato</td>
<td>3 slices</td>
<td>21</td>
<td>0.2</td>
<td>15</td>
<td>0.5</td>
</tr>
<tr>
<td>Onion</td>
<td>1 oz</td>
<td>11</td>
<td>0.0</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>Hot Peppers</td>
<td>1 oz</td>
<td>24</td>
<td>1.9</td>
<td>19</td>
<td>1.0</td>
</tr>
<tr>
<td>Lettuce</td>
<td>2 oz</td>
<td>8</td>
<td>0.0</td>
<td>6</td>
<td>0.6</td>
</tr>
<tr>
<td>Pickles</td>
<td>2 oz</td>
<td>36</td>
<td>0.4</td>
<td>2562</td>
<td>2.4</td>
</tr>
<tr>
<td>Black Olives</td>
<td>1 oz</td>
<td>33</td>
<td>3.0</td>
<td>247</td>
<td>0.9</td>
</tr>
<tr>
<td>Pepper</td>
<td>1 dash</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Oregano</td>
<td>1 dash</td>
<td>5</td>
<td>0.0</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Vinegar</td>
<td>1 oz</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Oil</td>
<td>1 oz</td>
<td>60</td>
<td>7.0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Salt</td>
<td>1/4tsp</td>
<td>0</td>
<td>0.0</td>
<td>500</td>
<td>0.0</td>
</tr>
</tbody>
</table>
★ Indicates healthy food item on health salient sub form.

- Multi grain roll - lowest in calories, sodium and fat, highest in fiber in category
- Hummus - low in calories, moderate in sodium and highest in fiber in category
- Mustard - moderate in sodium, fat and fiber. Low in calories in category
- Vegan deli meat, turkey, ham, capicola - lowest in calories and fat in category, moderate in sodium
- Roast beef - moderate in calories, fat and sodium
- Tomato, onion, hot peppers, lettuce - lower in calories, fat, sodium, moderate in fiber
- Pepper, oregano, vinegar - lowest in calories, fat and sodium
Table 2. Main Logistic Regression Results.

<table>
<thead>
<tr>
<th>Variable</th>
<th>df</th>
<th>$\chi^2$</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingredient category</td>
<td>5</td>
<td>5025.71</td>
<td>.0001</td>
</tr>
<tr>
<td>Ingredient health status</td>
<td>1</td>
<td>351.66</td>
<td>.0001</td>
</tr>
<tr>
<td>Ingredient healthy status × ingredient category</td>
<td>4</td>
<td>4763.08</td>
<td>.0001</td>
</tr>
<tr>
<td>Order form</td>
<td>1</td>
<td>15.08</td>
<td>.0001</td>
</tr>
<tr>
<td>Order form × ingredient category</td>
<td>5</td>
<td>53.06</td>
<td>.0001</td>
</tr>
<tr>
<td>Order form × ingredient health status</td>
<td>1</td>
<td>34.67</td>
<td>.0001</td>
</tr>
<tr>
<td>Order form × ingredient health status × ingredient category</td>
<td>4</td>
<td>31.66</td>
<td>.0001</td>
</tr>
</tbody>
</table>
### Table 3. Percentage of Participants Who Selected Each Ingredient in Each of the Two Order Form Conditions.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Control Form</th>
<th>Health-Salient Form</th>
<th>Chi Square</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-Grain</td>
<td>39%</td>
<td>43%</td>
<td>19.25</td>
<td>0.000</td>
</tr>
<tr>
<td>Plain Roll</td>
<td>47%</td>
<td>44%</td>
<td>12.36</td>
<td>0.000</td>
</tr>
<tr>
<td>Wrap</td>
<td>14%</td>
<td>13%</td>
<td>1.66</td>
<td>0.199</td>
</tr>
<tr>
<td>Spreads</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td>15%</td>
<td>20%</td>
<td>37.83</td>
<td>0.000</td>
</tr>
<tr>
<td>Hummus</td>
<td>8%</td>
<td>9%</td>
<td>2.21</td>
<td>0.137</td>
</tr>
<tr>
<td>Mayo</td>
<td>48%</td>
<td>51%</td>
<td>11.95</td>
<td>0.001</td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American</td>
<td>32%</td>
<td>32%</td>
<td>0.77</td>
<td>0.381</td>
</tr>
<tr>
<td>Provolone</td>
<td>48%</td>
<td>48%</td>
<td>0.00</td>
<td>0.965</td>
</tr>
<tr>
<td>Swiss</td>
<td>16%</td>
<td>16%</td>
<td>0.42</td>
<td>0.519</td>
</tr>
<tr>
<td>Meat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegan</td>
<td>2%</td>
<td>2%</td>
<td>4.30</td>
<td>0.038</td>
</tr>
<tr>
<td>Turkey</td>
<td>54%</td>
<td>56%</td>
<td>6.32</td>
<td>0.012</td>
</tr>
<tr>
<td>Ham</td>
<td>35%</td>
<td>35%</td>
<td>0.16</td>
<td>0.690</td>
</tr>
<tr>
<td>Roast Beef</td>
<td>24%</td>
<td>24%</td>
<td>0.00</td>
<td>0.974</td>
</tr>
<tr>
<td>Capicola</td>
<td>16%</td>
<td>18%</td>
<td>2.26</td>
<td>0.132</td>
</tr>
<tr>
<td>Tuna</td>
<td>7%</td>
<td>6%</td>
<td>4.19</td>
<td>0.041</td>
</tr>
<tr>
<td>Genoa</td>
<td>29%</td>
<td>26%</td>
<td>8.31</td>
<td>0.004</td>
</tr>
<tr>
<td>Bologna</td>
<td>6%</td>
<td>5%</td>
<td>1.96</td>
<td>0.161</td>
</tr>
<tr>
<td>Pepperoni</td>
<td>27%</td>
<td>26%</td>
<td>3.15</td>
<td>0.076</td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td>54%</td>
<td>56%</td>
<td>1.52</td>
<td>0.218</td>
</tr>
<tr>
<td>Onion</td>
<td>45%</td>
<td>45%</td>
<td>0.01</td>
<td>0.912</td>
</tr>
<tr>
<td>Hot Peppers</td>
<td>24%</td>
<td>26%</td>
<td>4.21</td>
<td>0.040</td>
</tr>
<tr>
<td>Lettuce</td>
<td>87%</td>
<td>87%</td>
<td>0.02</td>
<td>0.875</td>
</tr>
<tr>
<td>Olives</td>
<td>16%</td>
<td>17%</td>
<td>0.15</td>
<td>0.698</td>
</tr>
<tr>
<td>Pickles</td>
<td>26%</td>
<td>25%</td>
<td>1.92</td>
<td>0.166</td>
</tr>
<tr>
<td>Condiments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black Pepper</td>
<td>55%</td>
<td>56%</td>
<td>0.21</td>
<td>0.651</td>
</tr>
<tr>
<td>Oregano</td>
<td>46%</td>
<td>48%</td>
<td>5.90</td>
<td>0.015</td>
</tr>
<tr>
<td>Vinegar</td>
<td>48%</td>
<td>50%</td>
<td>3.70</td>
<td>0.054</td>
</tr>
<tr>
<td>Salt</td>
<td>44%</td>
<td>40%</td>
<td>15.08</td>
<td>0.000</td>
</tr>
<tr>
<td>Oil</td>
<td>49%</td>
<td>47%</td>
<td>4.18</td>
<td>0.041</td>
</tr>
</tbody>
</table>
Table 4. Omnibus Measures for Each of the Two Order Form Conditions Before and After Statistically Controlling for Mayonnaise Orders.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Control Form</th>
<th></th>
<th>Health-Salient Form</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Raw Means</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calories</td>
<td>1225</td>
<td>326</td>
<td>1224</td>
<td>323</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>69.16</td>
<td>31.44</td>
<td>69.54</td>
<td>31.19</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>4748</td>
<td>1555</td>
<td>4689</td>
<td>1542</td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>9.55</td>
<td>3.56</td>
<td>9.76</td>
<td>3.69</td>
</tr>
<tr>
<td>LS Means Controlling for Mayonnaise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calories</td>
<td>1231</td>
<td></td>
<td>1218</td>
<td></td>
</tr>
<tr>
<td>Fat (g)</td>
<td>69.83</td>
<td></td>
<td>68.88</td>
<td></td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>4752</td>
<td></td>
<td>4686</td>
<td></td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>9.53</td>
<td></td>
<td>9.78</td>
<td></td>
</tr>
</tbody>
</table>
**Figure 1.** The two different sub order forms used in the study. The left form is the standard form. The right form is the modified, health-salient form. Note the stars indicating healthy choice options, and the order of ingredients within each category.
Figure 2. The difference in percent choice between the health-salient and standard order form conditions. Note that bars on the right indicate that the ingredient was chosen more with the health-salient order form and bars to the left indicate that the ingredient was chosen less with the health-salient order form. We predicted that healthy ingredients (shown in green) would show positive difference scores (on the right) and unhealthy ingredients (shown in red) would show negative difference scores (on the left). Note: * means a significant individual effect at $p<.05$. 
End Note

1 Crossed with the order form manipulation was a second experimental manipulation: On four of the eight nights, full-length mirrors lined the hallway where students waited to place their sub orders, whereas on the other four nights, no mirrors were present. This mirror manipulation did not affect ordering behavior and so is not discussed further.

2 We used five different random matchings of sub orders from week to week and repeated with the within-subject simulation analyses for each of these five matchings. The results from the five runs were nearly identical.

3 Due to a misprint, in the order slips used in the control condition, there was no space between the breads and spreads groups as there was in the experimental order slip.
CHAPTER THREE

TASTING WITH YOUR EYES: LABELS AFFECT FOOD CHOICES

TASTE PREFERENCES

Abstract

The objective of the study was to examine whether labeling a food as local, organic, or low-fat affected perception of the food item, independent of actual food ingredients. This cross sectional study took place in four campus dining halls. Students were invited to rate their willingness to try and evaluate their taste preference of foods. The food items were labeled as: locally-sourced tomato sauce, not locally-sourced tomato sauce, organic granola, conventional granola, and low-fat and regular cottage cheese. Both food samples within each food category were identical, with the label being the only difference between the two samples. A convenience sample of 110 college-aged students participated in the study. Participants tasted and rated the tomato sauce, granola, and cottage cheese on a five point Likert scale. Order of questions was counterbalanced. One sample t-tests determined if the labels had an effect on willingness to try and preference. ANOVA was used to examine whether the size of the labeling effect differed across food category, rating type, sex, or counterbalance version. There was a labeling effect for tomato sauce (likely to try and taste preference for locally sourced) and granola (likely to try and taste preference for organic) but not the cottage cheese. There were no effects for counterbalance version and sex. The labeling effect was stronger for willingness to try ratings than for preference ratings. Food labels are effective in influencing consumer taste perception of a food item and could be used to encourage consumption of healthy foods.
Introduction

The evaluation of food is not merely influenced by bottom-up processes of sensory taste perception but is also influenced by top-down processes such as expectations of the food, many times based on how the food is labeled. Labels applied to a food can impact whether consumers choose a food and how much they enjoy it. The power of food labels can be a double edged sword. If appealing labels are applied to non-healthy, highly processed foods, they can encourage unhealthy food practices (e.g., eating organic cookies without restraint). However, if positive food labels are used on healthy foods, they can foster healthy food practices such as increased consumption of low-fat dairy, fruits, and vegetables. If food manufacturers could use food labels to increase revenue by encouraging the consumer to eat healthier foods more frequently it would be a win-win situation, benefitting both parties.

The “top down” influence of labels is illustrated in a study by Wansink, Payne, and North (2007). When customers were offered a bottle of wine with either a label stating the wine was from North Dakota or from California, the wine labeled as coming from California received higher taste expectation and experience ratings than the wine labeled as being from North Dakota. This was true even though the wine inside the two bottles was identical, such that the label, and the expectations it engendered, was the only factor that could explain the differences in taste ratings. Furthermore, the wine labels affected not only the taste experience of the wine itself but also the taste experience of the food eaten with the wine, with food eaten with the “California” wine enjoyed more.

In a similar study, Irmak, Vallen, and Robinson (2011) found that product name has a significant effect on subjects’ perception of healthfulness and taste as well as on
actual consumption, even when the actual food product is held constant. In a lab experiment, undergraduate students evaluated jelly beans labeled either “fruit chew” or “candy chew”. Subjects (especially dieters) associated improved taste with a healthier product name. When the product name was unhealthy, dieters perceived the item to be less tasty and consumed less of it. This study showed that food labels can affect an individual’s perception and actual consumption, demonstrating the influence of top-down processing.

Food labels can affect not only perception of quality but also of quantity. Roberto, Larsen, Agnew, Baik, and Brownell (2010) labeled the same size food serving as small, medium or large and found that labels affect the quantity of food consumed. Food items of equal size were perceived as containing less when labeled “small or medium” compared to “large.” Participants given a food item labeled “medium” ate more of the item than if the item was labeled “large,” and they perceived the amount they ate from a package labeled “small” to be less than they actually consumed, perhaps thinking they had not eaten very much, a phenomenon termed “guiltless gluttony.” These results are consistent with an account that size labels communicate a social norm about appropriate serving size, such that anything labeled “small” does not contain much food, and it is acceptable to eat the entire serving. In contrast, the same serving labeled “large” would connote a lot of food or more than one serving size that perhaps should not be eaten in its entirety in one sitting.

Labels on a menu, such as traffic light color symbols, are routinely used to denote healthy versus non-healthy food items (Thorndike, Sonnenberg, Riis, Barraclough, & Levy, 2012). Such symbols can affect perceptions of the entire menu, even when the
objective contents of the menu are held constant. A study by Liu, Roberto, Liu, and Brownell (2012) tested whether calorie information presented in different formats influenced estimation of calories ordered and perceived restaurant healthfulness. Participants in the online survey were randomly assigned to one of four groups (menu without calorie information, menu with calorie information, menu with calories listed from low to high calories, and menu with rank ordered calories and the addition of red/green circles indicating higher and lower calorie choices). Participants placed hypothetical dinner orders from the menu, estimated the number of calories in the foods ordered, and rated the restaurant healthiness. Participants in the three calorie inclusion groups were more accurate than the no calorie group in estimating calories ordered. There was no significant difference in rating of perceived healthiness of the restaurant between the no calorie and calorie only menu conditions. Those in the menu group with the ranked order calories condition rated the restaurant healthiness greater than those in the calorie without ranked ordering condition, and the condition that had the addition of red or green circles rated the restaurant healthier than the other three groups despite having the same number of healthy items on the menus. Thus, merely seeing that a menu used red and green symbols to indicate less and more healthy selections increased participants’ perception of the healthiness of the entire menu.

These previous studies indicate that perceptions of food, and even the taste experience and amount consumed, can be affected by top-down processing elicited by a label, even with the actual content of the food held constant. With the exception of the Liu et al. (2012) study, none of these studies used labels that could be applied to encouraging consumers to increase consumption of healthy foods, such as fresh produce.
and low-fat dairy products, and in the Liu et al. (2012) study (which did use healthy and unhealthy labels), participants made hypothetical ratings without actually tasting the foods.

The purpose of the current study was to assess the influence of three food labels that could be used to encourage consumption of healthy foods: “local”, “organic” and “low-fat”. These labels are trendy and often used as a marketing ploy to increase purchase and consumption; however, their effect on top-down processing has not previously been tested. These labels point consumers towards foods which are perceived to be healthier and environmentally friendly. Organic, local, and low-fat labels may be used to increase consumption of foods that usually bear these labels—namely dairy products, fresh fruits and vegetables. Our study investigated whether labeling a food as local, organic or low-fat affected perception of the food item, independent of what is actually in the food item.

The literature suggests that consumers who purchase organic foods perceive items labeled as organic to be healthier and taste better than conventionally grown foods; however the findings in the scientific literature are inconclusive in terms of any nutritional benefits to eating organic over conventionally grown foods (Wunderlich, Feldman, Kane, & Hazhin, 2008). Although “local” is a trend in food labeling, it is not a regulated term. A common definition of a local food system is described in terms of the “geographical distance between production and consumption” (Martinez et al., 2010). The literature suggests that food consumed from local food systems may or may not be more nutritious than foods consumed from global food systems; however, perception is
that local products are healthier (Frith, 2007). Locavores have bought into the perception that local foods are more nutritious than their non-local counterparts.

Although it is disputable whether organic and local foods have nutritional advantages over their conventional counterparts, low-fat foods are clearly healthier than high-fat alternatives (e.g., lean vs. fatty meat), except in the case of some processed foods (e.g., low-fat baked goods where the removed fat is replaced with sugar (Rolls, Drewnowski, & Ledikwe, 2005). Labeling a food item as low-fat also influences consumers’ perception, but perception of a food item labeled low-fat is not always positive. In an older study by Aaron, Mela and Evans (1994), subjects completed a sensory evaluation of a full fat (FF) and low-fat (LF) spread, labeled as such. Subjects’ ratings of how much they liked the two spreads did not differ, nor did the amount of spread put onto bread differ between the conditions. Thus, there was no effect of label (which here signaled actual fat content). In a more recent study by Wansink and Chandon (2006), low-fat labels had an effect on consumption. Subjects ate more of the snack items (candy and granola) when they were labeled low-fat than when they were not labeled low-fat. This may be a result of altering the social norm of an appropriate serving size and/or eliciting the “guiltless gluttony” phenomenon previously discussed. Although in the case of snack foods, increased consumption of a low-fat food may be an undesirable effect (the increased serving size may counteract any benefit from the calorie reduction of the low-fat formulation), for low-fat healthier foods, increased consumption could be a benefit. For example, many individuals would benefit from increased consumption of calcium rich low-fat yogurt, especially if it was accompanied by a corresponding decrease in consumption of high fat ice cream.
In the current study we tested the hypothesis that college students would use “top down” processing elicited by organic, local, and low-fat labels when determining their food choices and taste preference for three commonly consumed products: tomato sauce, granola, and cottage cheese. We presented two food samples in each product category that were identical in terms of food composition but were labeled differently.

**Methods**

Setting: This cross sectional study took place in four campus dining halls at the same university over a three day period in the middle of the week. Students who entered the dining hall were told the dining halls were testing different food products and looking for student input from volunteers willing to taste and evaluate each product. There were three food categories (tomato sauce, granola, and cottage cheese) and two items from each category for a total of six different food items to taste. The food items were labeled as: locally sourced tomato sauce, not locally sourced tomato sauce, organic granola, conventional granola, and low-fat and regular cottage cheese. Both samples of the tomato sauce were actually identical and locally sourced; both samples of granola were identical and organic, and both samples of the cottage cheese were identical and low-fat. The only difference within each food category was the food label displayed. The university’s Institutional Review Board approved this study.

Participants: Study participants consisted of a convenience sample of 110 male and female college-aged students ranging from ages 18-23 of various race and ethnic backgrounds. All study participants agreed to sample foods from one to three food categories. Not all subjects were able (due to food allergies or intolerances) or willing to try foods from all three categories, and consequently sample size varied across the three
food categories. 97 subjects tasted the tomato sauce, 99 subjects tasted the granola and 69 subjects tried the cottage cheese. There was no specified “stopping rule” as the sample size was intended to include all students who agreed to participate during the predetermined two hour block of time over three days. 65 subjects (20 females and 45 males) provided complete data and tasted foods in all three food categories. Students were blinded as to the purpose of the study.

Procedure: Students were invited to taste the two samples in each food category. Trained interviewers administered one of two versions of a survey (which included the exact verbal prompts used) counterbalanced for order of questions, asking students for taste preference and which food option they were more likely to try (See Appendix). Version One required students (n=55) to choose which food option (in each food category) they would be most likely to try based on the label before tasting. Version Two required students (n=55) to taste each food within a food category before asking which they would be more likely to try. Thus, in Version One, participants indicated which option in the pair they would be more likely to try, then they tasted both options, and then rated which one they preferred the taste of. In Version Two, participants tasted both options, and then rated which one they preferred the taste of, and finally indicated which option in the pair they would be more likely to try. These two versions of the survey were used in order to assess any influence of the ordering of questions. Answers were recorded on a five-point Likert scale ranging from 1–5, 1 being “locally-sourced”, “organic”, and “low-fat” and 5 representing the opposing labels. All participants tasted and rated the tomato sauce, granola, and cottage cheese in that order.
Data Analysis: One-sample t-tests for each food category evaluated whether the mean rating on each Likert scale question differed from the midpoint of “no preference”. An ANOVA was performed to analyze differences in ratings across rating question, food category, participant gender, and survey version. The first two variables were repeated measures and the second two variables were between subjects. SPSS-Version 22 was used for all data analysis and alpha was set at .05.

Results

One sample t-tests showed a labeling effect for tomato sauce and granola but not for cottage cheese (Table 1). Participants were more willing to try and preferred the taste of the tomato sauce labeled as locally sourced compared to the alternative not locally sourced tomato sauce as evidenced by mean ratings that were significantly below the “no preference” midpoint of the rating scale. The organic label on the granola produced similar results with the organic label having a positive effect on willingness to try and preferred taste. Study subjects indicated they were more willing to try and preferred the taste of the granola labeled organic over granola labeled conventional. The cottage cheese low-fat label did not have a significant effect upon subjects’ willingness to try or the preferred taste relative to the regular label.

The ANOVA examined whether the size of the labeling effect differed over food category, rating type, participant sex, or survey counterbalance version. There were no main effects for the between subject factors of survey version and sex, nor did these factors interact with other factors in the model. A main effect of food category, $F(2,60)=9.91$, partial $\eta^2=0.26$ $p<.001$, indicates that the labeling effect was stronger for tomato sauce and granola than for cottage cheese. A main effect of judgment type,
$F(1,60)=4.93$, partial $\eta^2=0.08$, $p=.03$, indicates that the labeling effect was stronger for the “likely to try” rating than for the “prefer taste” rating. That is, when evaluating the taste of the two identical samples of tomato sauce or granola that were labeled differently, subjects were influenced by the label, but not as much as when they were rating their propensity to try the product – a judgment that is presumably based more directly on the label and not on the taste experience. Note that the effect of judgment type did not interact with survey version, $F(1,61)=1.13$, $\eta^2=0.02$, $p=0.29$, although in Version One participants rated willingness to try before tasting the product while in Version Two participants made this rating after tasting the product. Even though there was no interaction, it was only in Version One that the labeling effect was stronger for the “likely to try” ratings than for the “prefer taste” ratings (mean$_\text{prefer}$ 2.57, mean$_\text{try}$ = 2.19, $F(1,32)=6.05$, $\eta^2=.16$, $p=.020$). There is some indication that once participants tasted the food, this effect gets weaker. Specifically in Version Two where subjects had already tasted products before they gave their “likely to try” ratings, the two rating were statistically equivalent (mean$_\text{prefer}$ = 2.49, mean$_\text{try}$ = 2.22, $F(1,32)=.62$, $\eta^2=.02$, $p=.44$).

**Discussion**

Previous studies have demonstrated the influence of food labels on perceptions and taste evaluations of foods. The current study, however, specifically examined taste and willingness to try food items in food categories that are typically healthy, using labels that specifically target consumer perceptions of healthy food. Our findings demonstrate that participants are influenced by local and organic food labels when rating the taste profile and willingness to try a food item. Despite the fact both food samples of tomato sauce and granola were identical, study participants favored the sample labeled local or
organic over the sample labeled not locally sourced or conventional. That preference was
maintained even after participants tasted the two identical (but differently labeled) food
samples.

In most cases, food labels reflect the actual contents of the food product. Thus,
foods labeled organic generally are, while those not labeled organic usually are not, for
example. The current study and several previous studies (Irmak et al., 2011; Wansink et
al., 2007) isolated the effect of labels from that of the actual food contents by using
different labels for an identical food product. The effect of labels on food choice and
food perception in this paradigm indicates that consumers are influenced by the label
above and beyond the actual contents of the food product. Such an effect in indicative of
top-down processing, where expectations influence perceptions.

A study by Lee, Frederick, and Ariely (2006) compares the effect of top-down
labeling effects with bottom-up taste experience effects. College students were asked to
rate two different beers, one regular brand and one “special brew” that had a few drops of
balsamic vinegar added. The control group was blinded to the added ingredient in the
specialty beer and two disclosure groups were made aware of the addition of balsamic
vinegar in the special brew. The difference between the two disclosure groups was that
one group received the knowledge about the balsamic vinegar addition prior to tasting the
two beers and the other disclosure group received the information about the balsamic
vinegar addition after tasting the beers. The “blinded” group had the highest percentage
preference for the special brew followed by the disclosure group who received the
balsamic vinegar addition knowledge after tasting the beer. The disclosure group who
received the balsamic vinegar knowledge prior to tasting the beer had the lowest
percentage preference for the special brew, suggesting prior knowledge can change the gustatory experience via top-down processing. Importantly, this study indicates that taste experience trumps the labeling effect, in that the vinegar label was not as influential after the beer had been tasted as it was before the beer was tasted.

The current study parallels the Lee et al. (2006) study somewhat in that the two counterbalance versions of the questionnaire varied whether participants tasted the food before or after rating their willingness to try. Although we did not find a significant interaction between survey version and rating type, the labeling effect was stronger with willingness to try ratings than the preference ratings, especially with Version One (where participants tasted the food only after indicating their willingness to try), in line with Lee et al.’s results. We did not have a condition like Lee et al.’s where subjects tasted the item and then saw the label. We may have obtained a smaller effect or even no label effect if we had included a condition (as Lee et al. did) where subjects first tasted the items and then saw the labels before determining preference and taste. We did not include such a condition out of realism concerns—food labels are almost always accessible to consumers prior to tasting and evaluating the product. We arranged for consumers to see the label prior to taking a mouthful of the food, allowing the label to be most impactful upon perception of the food item.

The current results indicate that consumers base their evaluation of the taste of a food at least in part on the label and the expectations it engenders, rather than solely on the sensory perceptions from ingesting the food. This finding is in line with previous research (Irmak et al., 2011; Lee et al., 2006; Wansink et al., 2007). However, the current study goes beyond previous research by examining the effects of specific food
labels that are currently in high use for health and environmental reasons. Although foods touted as being organic have not been found to be nutritionally superior over foods conventionally grown, participants in the current study preferred the taste of the granola labeled as organic. The “locally sourced” label on a food provided sufficient evidence to study participants that they concluded that the product tastes better, and is preferable, over a product labeled not locally sourced.

Wansink and Chandon (2006) found that labeling a food low-fat had a significant effect, unlike this study where an effect was not seen with a low-fat label. In the Wansink and Chandon (2006) study, participants ate significantly more M&Ms and granola when the items were labeled low-fat, than when they were not labeled low-fat. There are a few explanations as to why the same outcome with the low-fat label was not seen with the cottage cheese in this study. The Wansink and Chandon study utilized a between subject design with a foods considered indulgent (M&Ms and granola) and this study employed a within subject design with an item considered healthy (cottage cheese). Therefore, Wansink and Chandon’s participants did not make a direct comparison between items, and the presence of a low-fat label on a highly palatable snack food may have provided a moral license to eat more of an indulgent item, i.e., guiltless gluttony. An additional difference between the two studies was the dependent measure used for the two studies. Wansink and Chandon measured the effect a low-fat label had upon amount of consumption while this study looked at the effect a low-fat label had upon ratings of taste and preference. Amount consumed is not always a reflection of taste but can be affected by various external cues such as container size, as evidenced in a study where
participants ate more of an unpalatable item (stale popcorn) from a large container than from a small container (Wansink & Kim, 2005).

The results of the current study suggest the low-fat label alone may not provide the same type of indication of the qualities of the food that was seen with the local and organic labels. Cottage cheese preference ratings suggest a low-fat label may even impose a negative connotation and be a deterrent from enjoying the taste of an item. This is presumably because a low-fat label connotes both healthiness and low palatability. In contrast, organic and local labels presumably connote both health and taste benefits. It is possible that the fixed order of the foods being tasted (tomato sauce followed by granola and last cottage cheese) may have contributed to smaller effect of the cottage cheese label. Counterbalancing the order of foods to be tasted may have yielded different results if the cottage cheese samples were tasted first or second for some participants.

The results of this study have implications for policies aimed at enticing consumers to try more low-fat dairy products and fresh fruits and vegetables. The 2010 Dietary Guidelines for Americans promote increased fruit, vegetables and low-fat dairy (USDA & DHHS, 2010). Dairy, fruits and vegetables from local food systems should always be labeled as “local.” Dining establishments who purchase and serve products sourced locally should use the “local” label to entice customers to try the item and to increase the perceived taste profile. The same rationale should be used for all organic food items where increased consumption is desirable. Certain labels such as local and organic can serve both functions: increase sales of products and encourage consumers to eat healthy foods. Notably, although there is more evidence supporting the nutritional benefits of low-fat foods than of organic or local foods, use of the low-fat label is not
likely to be as successful in enticing consumers to choose food products or to increase their enjoyment.

Labeling unhealthy food as organic (e.g., organic toaster pastries or sugary breakfast cereals with no artificial dyes), even when that label is accurate, however, may have negative implications for health. The organic label may increase the appeal of the food and even its perceived taste, leading to over-consumption of indulgent foods. In addition, the low-fat label should be used cautiously as the taste profile may be negatively impacted if a menu item is labeled as low-fat. Although some consumers specifically seek out low-fat food and would benefit from use of that label, other consumers would gain health benefits and an improved culinary experience if food were prepared using low-fat ingredients but not labeled as such. Reliance on labels may encourage consumers to pay more for and eat more food products that are not nutritionally superior or turn away from a tasty, nutritious item because it carries a low-fat label.

The current results reinforce the fact that consumers do taste with their eyes. These findings can be harnessed to encourage consumers to select more healthy foods, specifically fresh produce. This outcome could be a win-win situation for consumer health and marketer profitability. The labeling insights of this study have implications for policy makers and food marketers in determining food product packaging.
Table 1. Mean Ratings and Single Sample t-Tests Comparing to Scale Midpoint

<table>
<thead>
<tr>
<th>Rating Question</th>
<th>N</th>
<th>Mean Rating</th>
<th>95% CI</th>
<th>t test</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato Sauce More Likely to Try</td>
<td>97</td>
<td>1.81</td>
<td>[1.58, 2.05]</td>
<td>-10.009</td>
<td>.000</td>
</tr>
<tr>
<td>Tomato Sauce Prefer</td>
<td>97</td>
<td>2.14</td>
<td>[1.87, 2.42]</td>
<td>-6.088</td>
<td>.000</td>
</tr>
<tr>
<td>Granola More Likely to Try</td>
<td>99</td>
<td>1.95</td>
<td>[1.67, 2.23]</td>
<td>-7.453</td>
<td>.000</td>
</tr>
<tr>
<td>Granola Prefer</td>
<td>99</td>
<td>2.08</td>
<td>[1.81, 2.35]</td>
<td>-6.799</td>
<td>.000</td>
</tr>
<tr>
<td>Cottage Cheese More Likely to Try</td>
<td>69</td>
<td>2.78</td>
<td>[2.36, 3.21]</td>
<td>-1.023</td>
<td>.310</td>
</tr>
<tr>
<td>Cottage Cheese Prefer</td>
<td>69</td>
<td>3.35</td>
<td>[2.96, 3.73]</td>
<td>1.798</td>
<td>.077</td>
</tr>
</tbody>
</table>
Appendix: The two versions of the Surveys used to assess student willingness to try and taste preferences. Surveys differed in only of ordering of questions.

Version One
Age:   Dining Hall: Br N LDC Bu
Year:  1  2  3  4  5+    Sex:  M  F
1a. “Do you have any food allergies or dietary restrictions?”
   Yes   No
1b. “If yes, please specify”:___________________________________________
2a. “Regarding the tomato sauce, which option will you be more likely to try?”
   1  2  3  4  5
Locally Sourced   Maybe Local   No preference   Maybe Not Local   Not Local
“Okay, try locally sourced.”
“Now, try the other option.”
2b. “Which one did you prefer the taste of?”
   1  2  3  4  5
Locally Sourced   Maybe Local   No preference   Maybe Not Local   Not Local
3a. “Regarding the granola, which option will you be more likely to try?”
   1  2  3  4  5
Organic   Maybe Organic   No preference   Maybe Conventional   Conventional
“Okay, try organic.”
“Now, try the other option.”
3b. “Which one did you prefer the taste of?”
   1  2  3  4  5
Organic   Maybe Organic   No preference   Maybe Conventional   Conventional
4a. “Regarding the cottage cheese, which option will you be more likely to try?”
   1  2  3  4  5
Low-fat   Maybe Low-fat   No preference   Maybe Regular   Regular
“Okay, try low-fat.”
“Now, try the other option.”
4b. “Which one did you prefer the taste of?”
   1  2  3  4  5
Low-fat   Maybe Low-fat   No preference   Maybe Regular   Regular
Version Two
Age: Dining Hall: Br N LDC Bu
Year: 1 2 3 4 5+ Sex: M F

1a. “Do you have any food allergies or dietary restrictions?”
   Yes  No

1b. “If yes, please specify”:___________________________________________

   “Okay, try not locally sourced.”
   “Now, try the other option.”

2a. “Which one did you prefer the taste of?”

   1  2  3  4  5
   Locally Sourced  Maybe Local  No preference  Maybe Not Local  Not Local

2b. “Regarding the tomato sauce, which option will you be more likely to try?”

   1  2  3  4  5
   Locally Sourced  Maybe Local  No preference  Maybe Not Local  Not Local

   “Okay, try conventional.”
   “Now, try the other option.”

3a. “Which one did you prefer the taste of?”

   1  2  3  4  5
   Organic  Maybe Organic  No preference  Maybe Conventional  Conventional

3b. “Regarding the granola, which option will you be more likely to try?”

   1  2  3  4  5
   Organic  Maybe Organic  No preference  Maybe Conventional  Conventional

   “Okay, try regular.”
   “Now, try the other option.”

4a. “Which one did you prefer the taste of?”

   1  2  3  4  5
   Low-fat  Maybe Low-fat  No preference  Maybe Regular  Regular

4b. “Regarding the cottage cheese, which option will you be more likely to try?”

   1  2  3  4  5
   Low-fat  Maybe Low-fat  No preference  Maybe Regular  Regular
CHAPTER FOUR
AMERICA RUNS ON NUDGES

Research Letter

The average weight gain, per year, for an adult in the US is between one and two pounds (Hutfless et al., 2013). Can a nudge towards healthier food options be the key to controlling weight? Subtle prompts, such as pictures of vegetables on cafeteria lunch trays, increased the percentage of children selecting green beans (Reicks, Redden, Mann, Mykerezi, & Vickers, 2012). In a hospital cafeteria, nudging customers towards healthy items using a color-coded labeling system increased purchase of healthy beverages by 16.5% and decreased purchase of unhealthy beverages by 9.6% (Thorndike, Sonnenberg, Riis, Barraclough, & Levy, 2012). Verbal prompts have been effective in reducing portion size of starchy side dishes (Schwartz, Riis, Elbel, & Ariely, 2012). Specifically, when asked if they would like to downsize to a smaller portion of a side dish, up to 33% of the customers at a fast food Chinese restaurant accepted the offer, regardless of monetary reward or calorie labels. The purpose of the current study was to test whether a simple prompt would nudge customers towards a healthier coffee order at a national franchise.

Dunkin’ Donuts has 94% brand awareness and sells 30 cups of coffee every second. (Dunkin’ Donuts, 2015). Consequently, any behavioral nudge that is effective at altering the behavior of Dunkin’ Donuts customers could have enormous national impact on weight control.
Methods

We tracked number of regular latte and Latte Lite orders during weekdays at a university campus center Dunkin’ Donuts franchise across three phases: a 5-day baseline (no prompt), a 10-day experimental (prompt), and a 20-day follow-up (no prompt) phase. During the experimental phase, all customers who ordered a latte were prompted by trained cashiers with the phrase, “Would you like to make that a Lite?” A Latte Lite© is a reduced-calorie beverage made with skim milk, while a regular latte is made with whole milk. Since cashiers were not blind to the hypothesis, mystery shoppers ordered lattes from the franchise throughout the study period to ensure the research protocol was followed. Product mix (sales mix) cash register reports for each day of the study were used to extract frequencies of regular and Lite latte orders for each study period, and chi square analyses were performed.

Results

During the 5-day baseline phase, 18.9% of all lattes ordered were Lites, while during the 10-day experimental phase 51.5% of all latte orders were Lite, \(\chi^2(1,N=1391)=118.56, p<.001\). During the 20-day follow-up period, 50.5% of latte orders were Lite. There was no significant difference between the experimental phase and the follow-up phase \(\chi^2=(1,N=2772)=0.268, p = .60\) suggesting a strong carry-over of the prompt for four weeks beyond the experimental prompt phase (Table 1).

Comment

Although it is not unexpected that an overt, verbal prompt to switch from a regular latte to a Latte Lite would have a significant effect on ordering practices, it is surprising how large and enduring the effect is. A medium regular latte (16 oz.) contains
170 Calories and 9 grams of fat while the same size Latte Lite contains 110 Calories and zero grams of fat (Dunkin’ Donuts, 2015). If a customer who visits Dunkin’ Donuts for a latte every weekday switched from ordering a Latte Lite 18.9% of the time to 51.5% of the time, mirroring our study results, this 60 Calorie savings over time (5 days per week for 48 weeks) would equate to a 4,550 Calorie savings per year, causing one not to gain 1.3 pounds per year (3500 Calories = one pound)—that is, to avoid the average weight gain of the US population of 1-2 pounds per year. Thus, this simple, no-cost prompt could singularly undo the national average weight gain of adults, making it more effective than expensive nutrition education interventions which require extensive training.
**Table 1.** Total customer orders for regular lattes and Latte Lites© during baseline, experimental and follow-up phases.

<table>
<thead>
<tr>
<th>Study Phase</th>
<th>Latte Orders*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regular</td>
</tr>
<tr>
<td>Baseline (5 days)</td>
<td>304 (81.1%)</td>
</tr>
<tr>
<td>Experimental (10 days)</td>
<td>493 (48.5%)</td>
</tr>
<tr>
<td>Follow-Up (20 days)</td>
<td>870 (49.5%)</td>
</tr>
</tbody>
</table>

*Regular latte orders refer to orders made with whole milk. Lite latte orders refer to orders made with skim milk. The data source did not indicate which orders had added sugar, sugar free sweeteners or sugar-sweetened or sugar free flavored syrups.
CHAPTER FIVE

DRINKING WITH YOUR HEART ON YOUR STRAW

Abstract

Sugar sweetened beverage (SSB) consumption has been linked to death and disease worldwide and cited as a major contributor to the obesity epidemic in the US. The objective of this paper was to utilize the mechanisms of Behavioral Economics to examine which type of nudge would be most effective to entice customers to choose water instead of SSB with their meal. Three types of nudge interventions, with washout periods between, were used throughout the seven-week study. Posters displaying nutrition (self-interest), charity (pro-social) or a combination of both nudges were displayed in an Italian-style fast-food franchise. We used multi-level logistic regression to compare the proportions of customers who chose water as a beverage across the three experimental conditions and controlled for fixed effects of day of week, cashier, and food order. We also assessed if frequency of visits to the dining establishment over the study period moderated the effect of experimental condition on beverage choice. Multiple data points from the same customer were treated as repeated measures. There were 6730 meals purchased by 2393 unique customers. The nutrition and combination poster increased choice of water relative to the washout periods, but the charity poster did not. The same results were found when controlling for fixed effects. Frequent diners were less influenced by the nutrition poster than less frequent diners but dining frequency did not moderate the effect of the charity and nutrition combination poster. A nudge can be utilized in a foodservice operation to decrease SSB and increase water intake.
Sugar-sweetened beverages (SSBs) are consumed worldwide and often purported to be a major contributor to the global obesity epidemic (Basu, McKee, Galea, & Stuckler, 2013). A recent study named SSBs as a “single modifiable component of the diet” that can have a “preventable influence” on global prevalence of morbidity and mortality among adults (Singh, Micha, Khatibzadeh, Lim, Ezzati, & Mozaffarian, 2015). Data collected from 611,971 individuals in 51 countries by the 2010 Global Burden of Diseases Nutrition and Chronic Diseases Expert Group revealed the BMI-mediated effects of SSB consumption on diabetes, cardio-vascular disease (CVD) and cancer mortalities and morbidities. 184,000 deaths/year were attributed to SSB consumption, with the majority of deaths (73%) attributed to diabetes. (Singh et al., 2015). Global morbidity in 2010 due to SSB intake totaled 8,526,456 (0.7% of all reported cases of morbidity) with the majority of morbidity (49.5%) due to CVD.

A study by Stookey, Constant, Gardner and Popkin (2007) found that decreasing consumption of SSBs and replacing them with water can lower total energy intake (especially among overweight dieters) without further compensation of calories by increasing intake of other foods. Several ad campaigns have targeted SSB as the culprit for weight gain; however, nutrition education on the consequences of unhealthy eating has not proven effective in reducing consumption of unhealthy items (Coburn, 2007).

Environmental factors can influence and compel a person to behave in a specific manner. A “nudge” is a social psychological and behavioral economic technique that makes use of choice architecture to encourage people to act in a certain way without removing freedom of choice (Marteau, Ogilvie, Roland, Suhrcke, & Kelly, 2011). Nudges can be used to alter the defaults that define a serving of food or beverage, change
the layout of a food establishment to cue purchase of one food item over another, or make a healthy dietary option more salient. Nudges are traditionally low cost, can be used across a variety of environments, and do not require legislation. A recent study by Dragos Petrescu reported on at the 2015 European Congress on Obesity suggested that a nudging intervention would be perceived more favorably than traditional interventions to decrease consumption of unhealthy beverages and increase healthy beverage consumption in an effort to decrease obesity (Nainggolan, 2015). Researchers compared five interventions that can be used to decrease consumption of SSB. Study participants (n=2,175) in the United States and the United Kingdom were polled on their acceptance towards nudge interventions (limiting portion size, changing container shape and changing shelf location) and two traditional interventions (taxation and nutrition education). Nutrition education had the greatest acceptance (86% in the United Kingdom and 90% in the United States); however, the majority of study participants (up to 70% depending on the exact nudge) accepted the three nudge interventions. Taxation of SSB was accepted by only 40% of the study participants.

The current study examined the effect of two types of nudges (pro-social and self-interest) and a combination of both nudges on college students’ choice of water over a SSB. The pro-social nudge used in this study tested whether college students in a university dining cash operation would opt for fountain water as a beverage with a prix fixe meal (meal combo), instead of a SSB, if the food cost savings would be donated to charity. College students are exceedingly willing to make charitable donations, which benefit their community (Flandez, 2010). Charitable donations, such as a meal “sign away”, are routinely implemented in university dining halls. The self-interest nudge
reminded students of the calorie and sugar savings in choosing water instead of a SSB. Both nudges promote choosing a healthy beverage, while still allowing freedom of beverage choice.

Nudges are an accepted intervention to decrease SSBs over traditionally suggested taxation (Nainggolan, 2015); they use an alternative approach to decreasing SSB intake over previous failed attempts of education alone (Coburn, 2007), and the pro-social aspect of the nudge is a novel approach that has not been tested in previous research.

A study by Schwartz, Riis, Elbel, and Ariely (2012) tested whether a nudge (prompt) to encourage self-regulation could be an effective means of changing customer behavior. In this study customers at a Chinese fast food restaurant were asked if they wanted to downsize portions of carbohydrate-heavy side dishes, which accompanied the main entrée, addressing the research question “Can a nudge be used to activate self-control?” in a real life setting. Subjects included university staff, students and visitors. The researchers assessed whether downsizing one meal component would lead to compensatory indulgence in other meal components and whether downsizing appeals only to customers who would have discarded unwanted food. Register receipts for orders were used to assess the dependent variable of purchase of half orders of starchy side dishes to the main meal. During the baseline phases, less than 1% of customers spontaneously opted for a half portion of side dishes. During the “nudge phase”, 33% of customers choose a half portion. Offering a minimal discount ($0.25) for agreeing to a half portion did not increase this percentage. In a follow-up study investigating the effect of calorie labeling, including calorie labels on the menu board had a perverse effect on
ordering, and actually diminished the effect of the nudge. This finding is consistent with
the work done by Bollinger, Leslie, and Sorensen (2010) who also found no effect of
calorie postings in chain restaurants. In the Schwartz et al. (2012) study, before calorie
labels were available, 21% of customers opted for a half portion of a side dish when
“nudged” to do so, but only 14% of customers downsized their order after introducing the
calorie labels. Downsizing did not change the amount of leftover food on the tray, nor did
customers compensate for calories declined by downsizing by ordering more calories in
their main entrée. Calorie savings during purchasing was transferred to calorie savings
during consumption and averaged 200 kcal per meal. If an average customer saved 200
calories two times per week, the individual would avoid a weight gain of approximately
six pounds a year.

The results of the Schwartz study shows that people can be nudged towards self-
control, independent of financial gain or posted calorie savings, two self-interest motives.
The Schwartz study, however, did not assess the motive behind the decision to downsize.
The results of the Schwartz study show customers can be nudged towards self-regulation.
However, the motive as to why a customer would choose to self-regulate was not studied.
Did the customer choose half a portion of side dish for nutritional reasons to save
calories? Was the decision based more in environmental concerns for not wanting to
waste food? Or was the decision to self-regulate based solely on the fact that a cashier
suggested they do so with a verbal prompt asking if they would like to downsize their
order and the customer felt embarrassed if he or she did not comply? Without knowing
the motive behind why a customer would downsize, we could be missing out on a larger
effect size that could be obtained by honing in on the motive that formulates an individuals' decision to self-regulate.

The current study extends the work of Schwartz et al. (2012) by directly contrasting two potential motives that consumers may have for responding to a prompt to select a healthy option in a restaurant setting. The current study also improves on the Schwartz et al. study by tracking repeat transactions by the same consumer during the study period. Programming cash registers to capture sales of various items has been used in previous studies (e.g., Thorndike, Sonnenberg, Riis, Barraclough, & Levy, 2012). However, the current study was unique because of the opportunity to obtain individual-level data and to identify repeat customers in a field study data set of real food purchases.

Methods

Pilot Study

To test the feasibility of conducting research within the Rutgers University (RU) Dining setting, we conducted a pilot study in Spring 2014, recording data on students who were using their meal plan to purchase a meal combo. A meal combo consisted of a main entrée, side dish (i.e., fries) and fountain beverage and would “cost” the student one of their meal plan swipes. For the pilot study, we implemented two message interventions that tapped a pro-social charitable motive versus a self-interest nutrition motive. There were three phases (baseline, nutrition motive, and charity and nutrition motive) and each phase lasted one week. In the baseline phase, we recorded the number of customers who ordered water of their own accord before any intervention was introduced. The nutrition phase included posters at point of service highlighting the nutritional benefits of choosing water over a SSB, and the charity phase added a pro-social motive (in addition to the
nutrition motive) to choose water as a beverage as the food cost savings of having fountain water over a SSB would be donated to charity. The food cost savings of a student choosing water over a SSB is approximately $0.25. A total of 9,311 meal combos were purchased over the 3 weeks of the study. In each of the three phases of the study, when a student used their meal plan to purchase a “meal combo” which consisted of a center of plate item such as a hamburger, fries, and a beverage, cashiers would record whether the student chose water by hitting a special button labeled water. Water cups were marked accordingly for easy recognition by the cashiers. The number of diners selecting fountain water increased from 3.57% of all meals during baseline to 6.64% during the nutrition phase to 14.84% during the charity and nutrition phase, \( \chi^2 = 275.2680, p < .001 \) (Table 1). Thus, the charity and nutrition combination appeal was more effective than the nutrition appeal, suggesting that individuals are more willing to forgo SSBs to help others than to help themselves.

The pilot study had limitations, thus the results should be viewed with caution. Recognizing these limitations, modifications to the original study design were made. The pilot study did not track repeat customers, so we were not able to perform proper repeated-measures statistical analyses. The current study utilized the new computerized cash register system (Sequoia) that is now in use. It provides individual customer cash register receipts that list foods and beverages purchased for each transaction. Customers were tracked in the cash register system with a unique ID.

Another limitation of the pilot study was that the message posters for the charity intervention emphasized both charity and nutrition rationales for selecting water. Thus, it may be that the charity intervention worked best simply because it combined two
different messages. In the current study, we addressed this limitation by separating the charity and nutrition messages on different posters. A final limitation of the pilot study was that, due to the limited time frame available for conducting the study, the three phases were staged consecutively, with no washout period intervening. Consequently, some of the success of the charity phase might reflect a carryover effect of the nutrition message. Study 1 included washout periods between each experimental phase.

**Study 1**

The study was run in an Italian style university-run dining operation, which accepts a meal swipe for a specified amount of food and beverage (i.e., meal combo). Meal combo choices include a beverage with two slices of pizza, slice of pizza and side salad, slice of pizza and five wings, pasta with meatballs, 10 wings, or a whole pizza for two meal swipes. There are a variety of fountain beverage options, including water, offered every day. The study was conducted over a seven-week period of time in the middle of the semester, so as to observe a snapshot of typical student eating behaviors, which is not heavily influenced by early semester or late semester stressors such as acclimating to a new environment or final exams. The study data were collected Monday through Friday between the hours of 10:30 am to 2:30 pm to ensure accuracy of sale transactions being inputted into the cash register computer system as this was when the regularly scheduled, full time, trained employees worked. There were three one-week intervention periods, with one-week wash out periods between the three interventions. During the first week, we tracked baseline data on customers who spontaneously ordered water as a beverage with a meal combo. During Intervention period 1, posters identifying only the charity motive for choosing water as a beverage were displayed at two points in
the service areas (where the line forms to order food and at the register where order is taken) within the dining establishment. The posters indicated that if the customer chooses fountain water, the savings in food cost would be donated to a specific charity (Rutgers Against Hunger). Promotional materials for the charity were on display (See Appendix for all posters). During Intervention period 2, posters identifying only the nutrition motive for choosing water were displayed at point of service areas in the dining establishment. These posters detailed the calorie savings from choosing water instead of a SSB. During Intervention period 3, posters combining the charity and nutrition motives were displayed in these areas. One-week washout periods with no message intervention were included in between each intervention period and also following the final intervention period. During the baseline period, all three intervention periods, and intervening washout periods, data were tracked on customers who used a meal swipe for a combo meal and ordered water as a beverage using cash register records and tracked using a unique ID. Repeat customers were identified, enabling repeated-measures analysis of the data. Cashiers in the dining establishment were trained on how to code the water as beverage into the cash register system prior to the start of the study and “mystery shoppers” made purchases in the dining environment throughout the seven-week study period to confirm the accuracy of the cashiers’ input of data into the cash register.

We hypothesized that the charity-only poster would be more effective than the nutrition-only poster in incentivizing customers to choose water as a beverage with their meal combo because a pro-social motive could be more engaging than a self-interest motive as it not only provides a healthy result, one feels good while doing so. We further hypothesized that the nutrition and charity poster would have the same effect as the
charity only poster, indicating that it is only the charity motive, not the nutrition motive that encourages healthy beverage choices.

We used multi-level logistic regression to compare the proportions of customers who chose water as a beverage across the three experimental conditions. The dichotomous dependent variable was selecting the targeted beverage option (fountain water). The independent variable included the study phase (charity, nutrition, or charity + nutrition, which were compared to the pooled washout as the reference level). We controlled for day of the week, cashier, and menu order and treated multiple data points from the same customer as repeated measures. With 2,393 unique individuals, we have the power to detect an odds ratios as small as 1.18 with $\alpha=.05$ and $\beta=.80$ (Gpower 3.1).

**Pretest to evaluate effectiveness of posters**

Prior to conducting the main study, we pre-tested the messaging posters that were to be displayed at point of service in the dining establishment used for the study. Three distinct posters to promote specific dietary choices were developed (See Appendix). Each poster focused on choosing water for either a charity motive, nutrition motive or a combined nutrition and charity motive. Using an online Psychology Department subject pool, 207 subjects evaluated the different posters by responding to Likert-type scale questions asking how likely the subject would be to follow the dietary choice indicated on the poster and how likely they think other customers would be to follow the choice indicated on the poster.

We examined whether participants judged a higher likelihood to choose water for self and others for the charity and charity + nutrition posters than for the nutrition poster. Analyses included multivariate, repeated measures ANOVA. The independent repeated-
measures variables were poster version (three levels) and actor (self vs. other) and the dependent variable were ratings of likelihood to choose water for self and others. We anticipated a main effect of poster version.

Results

Pre-test. Seven participants with missing responses were removed from the dataset, leaving 200 in the analysis. Using a within subject design, the pretest poster survey revealed the highest ratings in the Charity and Nutrition Poster conditions (Table 2). Ratings were higher for self than other in all poster conditions meaning the posters elicited a higher likelihood rating on one’s own choice to choose water than on what the subject felt others would do after seeing the poster. There was a significant effect of poster and actor but not for the interaction between poster and actor (Table 3). The results of the pretest poster survey confirmed our hypothesis that poster version would have an effect of a subject’s rating for likely to choose water as a beverage with the charity and nutrition poster providing the highest ratings for the dependent variable of likelihood to choose water.

Main study. Figure 1 shows the percentage water choice during each week of the study period. Over the seven-week field study, there were 6,730 combo meals purchased by 2,393 unique customers. Multi-level modeling examined beverage choice (water vs. other) by customer for the three poster versions (charity, nutrition, charity and nutrition) each compared to the reference level of pooled washout periods. As shown in Table 4, the experimental phases of nutrition poster and nutrition and charity combination poster each had a significant effect upon the dependent variable (beverage choice) relative to the washout reference level, but the experimental phase with the charity poster did not. We
repeated the multi-level model controlling for fixed effects of day of week (reference level = Friday), cashier (reference level = the primary full-time cashier) and food ordered (reference level = two slices of pizza, the most common order). The results for this version of the model were consistent with previous results. The nutrition and nutrition and charity combination poster each had an effect on beverage choice but the charity poster did not have an effect relative to the washout periods.

An examination of the control variables revealed that beverage choice differed across day of the week ($\chi^2=10.29, p=.04$). Water was chosen more on Mondays than Fridays, $\beta=0.118$, $p=.001$. There was a significant effect of cashier, with some cashiers ringing up fewer water purchases than the main employee (who served as the reference level) ($\chi^2=83.74, p<.001$). There was a significant effect of food order on water choice ($\chi^2=41.05, p<.001$). Among customers who ordered 2 slices of pizza (the reference level and most common order), 14% selected water; however, water was less likely to be ordered with wings or a whole pizza. Few customers ordered the whole pizza meal combo during the study period (2% of total combos) but those who did rarely selected water as a beverage choice (2% of beverage selections among whole pizza orders, $\beta=-.078$, $p<.001$). Customers who chose wings for the meal combo (10% of all orders) are also not the type of customer who order water (water selected for 10% of these orders, $\beta=-.014$, $p=.006$).

Next we examined whether frequency of visits to the dining establishment over the seven weeks of the study moderated the effect of experimental condition on beverage choice. The multi-level model included the three poster conditions compared to the pooled washout periods as a reference level, each customer’s frequency of patronizing
the dining establishment over the study period (centered, range 1 – 32 times), and the interaction between frequency of visits and each of the three poster conditions. The Nutrition poster continued to have a significant effect upon beverage choice; however, the effect was moderated by frequency of visits. Specifically, for customers who patronized the establishment more frequently, the Nutrition poster was less effective at encouraging water as a beverage choice. The effect of the combination poster was not degraded by the frequency of visits (Table 5).

**Discussion**

The results of our main study are opposite of our predictions from the results of the pilot study and the pretest ratings of the posters. The charity poster was not more effective than the nutrition poster in enticing customers to choose water rather than a SSB with a meal combo. The nutrition and charity combination poster was effective in encouraging water as a beverage choice, but not better than the nutrition poster alone. In contrast, in the pilot study the charity and nutrition combination poster was more effective than the nutrition poster, and in the pre-test ratings, the combination poster was also rated to be the most effective, with the nutrition poster rated as the least effective. Recognizing the weak design of the pilot study, the main study results are used for the basis of our conclusions.

It is interesting that the poster pre-test participants thought the nutrition poster would be the least influential when it turned out to be the most influential when actual behavior was assessed in the main study. This provides evidence that hypothetical scenario studies are not a substitute for real life field studies.
The results from our “frequent diner” analysis indicate frequent diners were less influenced by the nutrition poster than were their less frequent diner counterparts, whereas this moderating relationship was not observed for the charity and nutrition combination poster. If the same customers are frequenting an eating establishment every day, the addition of a pro-social motive to encourage water as a beverage may be more effective than a self-interest motive alone. Thus, the charity-plus-nutrition poster could be the most effective for particular subsets of consumers. The university setting used for this study is extremely large with approximately 17,000 students having meal plans that could be used for purchasing the meal combos described in this study. Students have a large variety of dining venues to patronize, and students need not patronize the same venue every day. The results of the frequent diner analysis suggest that a self-interest (nutrition) and pro-social (charity) type combination intervention would be most effective in a middle school or work place cafeteria which has a larger percentage of daily frequent diners who eat in the same cafeteria daily. For less frequent customers, a nutrition appeal is likely to be at least as effective as a combination appeal.

SSBs are energy dense but not nutrient dense and thus constitute a source of excess calories. They have been implicated as a major cause of global obesity (Basu et al., 2013). Researchers are calling for “Global prevention plans” as SSBs are a single moderator in the diet which could be addressed to prevent morbidity and mortality worldwide (Singh et al., 2015). Utilizing a low cost nudge, as studied in this paper, can be an effective intervention to influence adults on an international level. On a more local level, harnessing a nudge to change dietary behaviors could be utilized in a foodservice operation which has a large number of the same daily customers as a way to decrease
SSBs and increase water intake. From a health and nutrition perspective, such manipulations could be used to decrease daily calorie intake and reverse the obesity epidemic. From a foodservice business perspective, a nudge could decrease food costs, as customers would be satisfied with a menu item (fountain water) that is less expensive than a SSB.
**Table 1.** Results from charity pilot study

<table>
<thead>
<tr>
<th>Condition</th>
<th>N</th>
<th>Frequency of water choice</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>3168</td>
<td>113</td>
<td>3.57%</td>
</tr>
<tr>
<td>Nutrition</td>
<td>3146</td>
<td>209</td>
<td>6.64%</td>
</tr>
<tr>
<td>Charity and Nutrition</td>
<td>2997</td>
<td>445</td>
<td>14.84%</td>
</tr>
</tbody>
</table>
Table 2. Mean Ratings (SD) of Likelihood to Order Water as a Beverage in the Pretest (1= Unlikely, 5 Very likely), N=200

<table>
<thead>
<tr>
<th>Poster Condition</th>
<th>Self</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charity Poster</td>
<td>4.04</td>
<td>3.22</td>
</tr>
<tr>
<td></td>
<td>(1.18)</td>
<td>(1.06)</td>
</tr>
<tr>
<td>Nutrition Poster</td>
<td>3.90</td>
<td>2.98</td>
</tr>
<tr>
<td></td>
<td>(1.33)</td>
<td>(1.16)</td>
</tr>
<tr>
<td>Charity and Nutrition</td>
<td>4.18</td>
<td>3.37</td>
</tr>
<tr>
<td></td>
<td>(1.04)</td>
<td>(1.06)</td>
</tr>
</tbody>
</table>
Table 3. ANOVA Results from Poster Pre-Test

<table>
<thead>
<tr>
<th>Effect</th>
<th>df</th>
<th>F</th>
<th>Partial η²</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poster</td>
<td>2,398</td>
<td>13.15</td>
<td>.03</td>
<td>.000</td>
</tr>
<tr>
<td>Actor</td>
<td>1,199</td>
<td>132.87</td>
<td>.40</td>
<td>.000</td>
</tr>
<tr>
<td>Poster x Actor</td>
<td>2,398</td>
<td>1.15</td>
<td>.006</td>
<td>.32</td>
</tr>
</tbody>
</table>
Table 4. Percent of water as beverage choice for each condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>% Water Choice</th>
<th>Model Without Control Variables</th>
<th>Model With Control Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>β</td>
<td>95% CI</td>
</tr>
<tr>
<td>Pooled Washout</td>
<td>13.2%</td>
<td>ref</td>
<td></td>
</tr>
<tr>
<td>Charity</td>
<td>13.1%</td>
<td>-0.001</td>
<td>-0.028, .026</td>
</tr>
<tr>
<td>Nutrition</td>
<td>19.2%</td>
<td>.051</td>
<td>.021, .081</td>
</tr>
<tr>
<td>Charity &amp; Nutrition</td>
<td>18.3%</td>
<td>.060</td>
<td>.023, .097</td>
</tr>
<tr>
<td>Control variables?</td>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Table 5.** Moderating effect of frequency of visits to the dining establishment

<table>
<thead>
<tr>
<th>Condition</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pooled Washout</td>
<td>ref</td>
<td></td>
</tr>
<tr>
<td>Charity</td>
<td>-.001</td>
<td>-.028, .026</td>
</tr>
<tr>
<td>Nutrition</td>
<td>.063</td>
<td>.026, .100</td>
</tr>
<tr>
<td>Charity &amp; Nutrition</td>
<td>.050</td>
<td>.020, .079</td>
</tr>
<tr>
<td>Frequency of Visits</td>
<td>-.001</td>
<td>-.004, .002</td>
</tr>
<tr>
<td>Frequency x Charity</td>
<td>-.001</td>
<td>-.005, .002</td>
</tr>
<tr>
<td>Frequency x Nutrition</td>
<td>-.005</td>
<td>-.010, .000</td>
</tr>
<tr>
<td>Frequency x Charity &amp; Nutrition</td>
<td>.004</td>
<td>-.001, .010</td>
</tr>
</tbody>
</table>
Figure 1. Percentage choice of water as a beverage during each week of the study period. Error bars show 95% CIs.
Appendix: Three poster versions displayed in Italian Franchise Dining Establishment

Nutrition Poster

Downsize Your Meal to Save Calories!

Choosing water over a fountain drink or soda greatly lowers your calorie and sugar consumption.

24 ounces of Water
0 calories
0 grams of sugar

24 ounces of Soda
310 calories
82.8 grams of sugar

*Substitute fountain drink or soda with fountain water. Standard meal charges apply*

Charity Poster

Help feed someone at Elijah’s Promise by simply getting Water!

= ½ a Meal Donation

-Yes, it’s that easy! If you make the healthy switch to fountain water instead of soda, food cost savings will provide ½ a free meal at the Elijah’s Promise soup kitchen!

Charity and Nutrition Poster

Help feed someone at Elijah’s Promise by simply getting Water!

= ½ a Meal Donation

-Yes, it’s that easy! If you make the healthy switch to fountain water instead of soda, food cost savings will automatically be donated to Elijah’s Promise*

*Standard Meal Charges Apply*
CHAPTER 6

GENERAL DISCUSSION

Concepts from Behavioral Economics have been used effectively to change consumer actions, and the four studies in this dissertation provide further evidence to support the use of nudges as a low cost measure to entice behavior change while still allowing freedom of choice. The results of these studies also add to the body of literature by shedding light on which types of nudges are most effective at channeling behavior change in dietary choices. In the first study, *Put the Healthy Item First*, we found a very subtle nudge on a health salient menu (re-ordering ingredients on a menu to list healthy items first and placing a star next to healthy ingredients) had a small but potentially significant impact on ingredient choice. The results of this study showed that, relative to the standard menu, the health salient menu was calorie and fat neutral in terms of choice of ingredients but decreased choice of foods high in sodium and fat, which over time could be impactful against chronic diseases. The *Tasting with Your Eyes* study demonstrated that people often use a “top down” in addition to just a “bottom up” approach when evaluating the taste profile and judging their preferences for certain food items. A single modification in the way a food was labeled impacted perceived taste and preference of an item, independent of the actual contents of the food item. These results add to the body of evidence that people determine what to eat based on many factors beyond the actual content of the food, and these factors can potentially be harnessed in a positive way to increase consumption of healthy items such as fruits, vegetables, and low-fat dairy. *American Runs on Nudges* used an overt nudge to encourage customers to choose a lower fat, lower calorie beverage. The verbal prompt nudge produced significant
results found not only during the study period but also throughout a four-week follow-up period. Dunkin’ Donuts sells 30 cups of coffee every second, or 2.5 million cups of coffee per day. With this magnitude in sales, any change in ordering practices would equate to a substantial change in national dietary practices. From a simple cue from the staff of Dunkin’ Donuts asking if the customer wanted to make their latte order a Lite, we saw an increase of Latte Lite orders from 18.9% of sales during baseline to 51.5% of sales during the intervention and follow up period. Each switch equated to a 60 Calorie savings, which, for a frequent Dunkin’ Donuts Latte drinking customer, could translate into avoiding the 1-2 pound per year average weight gain most Americans face. The study *Drinking with your Heart on Your Straw* found that a self-interest nudge (nutrition rewards) was more effective than a pro-social nudge (charity rewards) in enticing people to choose water instead of a SSB with their prix fixe meal. This result was opposite of what was hypothesized. We had predicted that the charity poster would be most effective at nudging individuals towards a healthy beverage choice, based on a scenario study. We found that people act differently in real life settings than they purport to in a hypothetical scenario situation.

**Strengths of Current Research**

The current studies have a number of methodological strengths that should be carried forward into future work. Three of the studies were field studies in which data were received from customers who did not know they were being watched, and thus behaved in a usual fashion, uninfluenced by demand effects. It is well recognized, and supported by the results of the *Drinking with your Heart on Your Straw* study which had results which were in contradictory to the results from the pretest scenario study, that
individuals do not always act in real life in accord with their judgments in hypothetical scenarios. Consequently, field studies should be the “gold standard” for behaviorally-based research. Another significant strength to the type of field studies reported here was that we still were able to have experimental manipulations within the field setting. The excellent relationship between the researcher and dining franchise was key to having this opportunity. Profits are the bottom line for foodservice operations and if a trust between the researcher and dining operation is not pre-established, a foodservice operation may not agree to cooperate for fear of loss of profits with certain experimental manipulations. The experimental manipulations used in all four studies presented would not have been able to be carried out without a strong and trusting relationship between the researcher and dining franchise. The ability to track individual sales to identify repeat customers was a notable strength of the Drinking with your Heart on Your Straw study. Utilizing a computer system that allowed this type of data collection allowed the use of appropriate repeated measures ANOVA and multi-level models. Using pooled sales records as a data collection tool (as was necessary in the Put the Healthy Item First and American Runs on Nudges studies) runs the risk of few individuals with many purchases driving the data and does not allow for appropriate clustering of the error terms. Future studies would benefit from a methodology to obtain individual level data.

**What Was Learned**

Nudges are effective to support dietary behavioral change; however, all types of nudges are not equally effective. The current research found that the more overt the nudge, the greater effect it had on behavior change. Put the Healthy Item First used a subtle nudge (ingredients reordered on menu and healthy items starred), which had a
small effect whereas America Runs on Nudges utilized an overt nudge (verbal prompt), which had a large and enduring effect on behavior change. The take–away message suggests to always use very explicit overt nudges, but not all eating establishments may allow this type of manipulation, especially if sales are negatively impacted. Consequently, in some settings a subtle nudge may be the only choice. In a foodservice establishment, a nudge must be either cost neutral or monetarily beneficial or the researcher will not have buy-in by the dining establishment. Encouraging fountain water as a beverage, as was done in the Drinking with Your Heart on Your Straw, would not be seen as favorable in a regular dining operation, which profits from sales of fountain beverages other than water. For this study, the encouragement of water instead of SSB was monetarily beneficial for the foodservice operation as the meal was prix fixed. Thus, when someone choose water with their meal combo, they still paid the same price (one meal subtracted from their meal plan), but there was a $0.25 saving for the foodservice operation by providing fountain water instead of a SSB. An experimental manipulation promoting water sales would only be cost neutral, and probably only be allowed by the foodservice operation, if solely bottled beverages were retailed and water was the same cost as other beverages. An example of this would be beverage purchases from a vending machine or from a concession food environment. The use of explicit, overt nudges is realistically limited within a dining franchise. Specifically, cashiers can likely only prompt costumers on one behavior. Consequently, it may be beneficial to combine subtle and obvious nudges. An example of this would be if Dunkin’ Donuts not only used a verbal prompt toward Latte Lites but also rearranged their menu boards to put the healthy menu options at the top of the menu.
**Interventions Working Opposite**

The purpose of the current studies in Behavioral Nutrition was to nudge people towards healthier dietary choices. Sometimes however, the opposite effects occur to counteract any positive dietary changes. For example, the manipulation in the *Put the Healthy Item First* study increased choice of turkey (healthier choice) on sandwiches but also increased the choice of mayonnaise (unhealthy choice) at the same time. The positive effect of the manipulation was counteracted by the negative effect of increased choice of mayonnaise as a spread on sandwiches. The concept of moral licensing may come into play (allowing oneself to indulge after complying with a healthy selection) or turkey just tastes better with mayonnaise than other healthier spreads.

A low-fat label is frequently used to entice individuals to eat a product for health reasons and a “good for you feel”. The *Tasting With Your Eyes* study, however, found that labeling a food, as low-fat was not effective at enticing people to want to try the item. If we wish individuals to partake in low-fat options, it may be best to offer a low-fat item but not label it as such.

In the *Drinking with Your Heart on Your Straw*, we hypothesized that the charity poster would be more effective than a nutrition poster in having customers choose water instead of a SSB because the charity motive allows consumers to feel good about themselves when selecting a healthy option. This prediction did not hold true, and the nutrition poster was effective in driving beverage choice but the charity poster was not effective. The bottom line is that we must test all interventions to be sure of their effects, and there are cases where consumers compensate for a nudge.
Policy Implications

Techniques derived from Behavioral Economics can be used as part of the Total Diet Approach supported by the Academy of Nutrition and Dietetics. All foods can be enjoyed but in moderation and small changes in dietary intake can, over time, lead to significant changes in weight and health status. This goal can be accomplished without legislation, without taking away freedom of choice, and without the consumer having to make a conscious effort toward healthy dietary choices. From a dining franchise perspective, a nudge can be effective at keeping customers just as satisfied with a less expensive menu item as with a more costly item. This low or no cost intervention could be a win-win situation for the consumer and food industry. The food and restaurant industry can harness the use of nudges to encourage healthy behavior but still make money.
APPENDIX

Interdisciplinary Research - Lessons Learned

The studies presented in this dissertation harnessed the power of Interdisciplinary Research to tackle the complex issue of nudging people towards the healthy option. The interdisciplinary approach combining theoretical work from nutrition and psychology was the ideal perspective to tackle this issue, as one discipline alone would not delve into all the associated factors involved in choosing nutritious foods. For these studies, Psychology and Nutrition are best suited to study questions related to behavioral nutrition. To illicit behavior change that would impact the nutrition profile of an individual, a multifaceted approach is warranted. Psychologists study the mechanism of how to change behavior but rarely are interested in the nutrition implications. Even changes that are both behaviorally feasible and nutritionally sound are not sufficient. The foodservice business end of the behavior change must also be considered, as a change in behavior that is nutritionally sound but not cost effective for the foodservice establishment would not be sustainable.

Interdisciplinary research can be effective in solving complex problems; however, it does have critics. Interdisciplinary research is challenging as researchers across disciplines think differently. Some argue that the interdisciplinary approach dilutes rigor relative to work done within the boundaries of any one discipline (Strober, 2011). Using an interdisciplinary model for research can also present problems when assigning credit in a team for tasks completed (Strober, 2011). This becomes problematic when faculty are reviewed for promotions and tenure.

Despite potential glitches with interdisciplinary research, the approach was effective in addressing the questions addressed in this dissertation. However, this model would only work well for a Rutgers dissertation for a student who was a "Rutgers insider". A
student would need to have fingertip knowledge of the institution, classes offered, graduate school requirements and appropriate faculty to have on the dissertation committee. A current staff person or someone who completed a Masters Degree at Rutgers could be a potential candidate for a future interdisciplinary research dissertation. Without “inside knowledge” a student may get lost trying to navigate their way at a very large research institution. A novice student pursuing a PhD at Rutgers would not be the ideal candidate for an interdisciplinary program. Another lesson learned would be to broaden the scope of the dissertation committee beyond two departments. It is proposed that there should not be more than one committee member from any one department or the procedure for completing the PhD becomes too department-specific and conflicts between departments may ensue. Since the current dissertation addressed consumer choice, it may have been prudent to have a faculty member from the Marketing Department and one fewer Nutritional Sciences faculty member on the dissertation committee. Having a broader band of departments represented would also introduce the option of additional classes or didactic information to be taken or covered that may not have been considered with the current committee.

Interdisciplinary research appears to be the wave of the future; however it is not an area of study known to most graduate students. It is hoped the successful outcome of this dissertation model will encourage others to pursue a PhD in this fashion.
References


Schwartz, J., Riis, J., Elbel, B., & Ariely, D. (2012). Inviting consumers to downsize fast-


