Research Report

Examining Consumer Responses to Calorie Information on Restaurant Menus in a Discrete Choice Experiment

Roland Sturm, Haijing Crystal Huang, Flavia Tsang, Liisa Hiatt, Rosanna Smart, Cameron Wright, Helen Wu

RAND
CORPORATION

For more information on this publication, visit www.rand.org/t/RR1957

Library of Congress Cataloging-in-Publication Data is available for this publication.

ISBN: 978-0-8330-9838-2

Published by the RAND Corporation, Santa Monica, Calif.

Preface

The Office of the Assistant Secretary for Planning and Evaluation (ASPE) in the U.S. Department of Health and Human Services undertook this research to evaluate how providing calorie information on restaurant menus affects consumer choice. The 2014 U.S. Food and Drug Administration (FDA) final rule titled "Food Labeling: Nutrition Labeling of Standard Menu Items in Restaurants and Similar Retail Food Establishments" requires restaurants and similar retail food establishments that are part of a chain with 20 or more locations doing business under the same name and offering for sale substantially the same menu items to provide calorie and other nutrition information for menu items. This rule applies to standard menu items, including food on display and self-service food, and creates a nationwide, uniform requirement for displaying calorie information.

This is the final report on two tasks set out by ASPE in the contract: (1) developing and fielding the consumer-choice experiment and analyzing the resulting data to evaluate the potential effect of providing calorie information according to FDA menu labeling rules on consumer choice (addressed in Chapters One through Five); and (2) evaluation of menu changes over time (addressed in Chapter Six).

This work was sponsored by the Assistant Secretary for Planning and Evaluation under contract HHSP23320095649WC and task order HHSP23337037T, for which Amber Jessup serves as the contracting officer's representative. The research was conducted in RAND Health, a division of the RAND Corporation. A profile of RAND Health, abstracts of its publications, and ordering information can be found at www.rand.org/health.

Contents

Figures

Tables

Summary

The 2014 U.S. Food and Drug Administration (FDA) final rule titled “Food Labeling: Nutrition Labeling of Standard Menu Items in Restaurants and Similar Retail Food Establishments” requires information on the calorie content of food items to be clearly displayed on menus (FDA, 2014). The FDA menu-labeling rule applies to restaurants and similar retail food establishments that are part of a chain with 20 or more locations doing business under the same name and offering for sale substantially the same menu items. Under this rule, restaurants must provide calorie and other nutrition information for standard menu items, including food on display and self-service food.

The new federal standard creates a uniform requirement for calorie information nationwide. This will reduce situations where establishments have to meet many different menu-labeling requirements because of varying state and local regulations. The FDA rule may also cover some establishments that may not have been covered under some state laws.

Numerous studies (and several systematic reviews) have previously tried to assess the effects of local labeling rules, but the results have been mixed and sometimes contradictory (VanEpps et al., 2016; Sarink et al., 2016; Long et al., 2015; Sinclair, Cooper, and Mansfield, 2014; Swartz, Braxton, and Viera, 2011). There are plausible reasons for these different findings, including study design elements like sample size and varying types of labels (e.g., calories alone versus contextual), the restaurant setting in which the study took place, and types of customers. Most prior studies approached the provision of calorie information on menus only from the perspective of reducing energy intake, but such labeling can serve other purposes, like improving customer decisionmaking by providing relevant information for customers to use to meet their needs or objectives. For instance, some customers may prefer items with fewer calories, whereas others may prefer items with more calories. Some previous studies also created confusion between substantively significant and statistically significant effects. Some studies with insufficient sample sizes for precise estimates have interpreted treatment parameters with large standard errors as evidence that providing calorie information on menus “does not work,” because the results are statistically insignificant even if the estimated effect sizes are substantively large enough to reverse the obesity epidemic (Sinclair, Cooper, and Mansfield, 2014).

In light of this previous research and the 2014 FDA final rule, our study looked at how the provision of calorie information on restaurant menus affects consumers. To gain insight on the consumer perspective, we designed an online experiment in which participants chose items from the menus of nine different restaurant settings, ranging from fast-food outlets to movie theaters. The calorie labels on those menus followed the requirements described in the FDA rule, and the survey also collected data on sociodemographic characteristics, attitudes toward food, and use of nutrition and calorie labels.

In a separate analysis, we studied time trends in restaurant offerings. We would have liked to link these changes with local menu labeling regulations, but data on chain restaurant menu offerings over time in relation to such regulations were not available. Therefore, this part of the study was limited to identifying changes in menus from 2010 to 2015 for national chains.

Objective 1: Consumer Choice Experiment

The online consumer choice experiment sought to estimate consumer responses to labels that satisfy the FDA labeling rule for calorie information by testing whether consumers order fewer calories if they see a menu that provides calorie information and whether their choices can be associated with individual characteristics, including sociodemographics. The results should also provide insight to help researchers and policymakers better understand the heterogeneity observed across prior studies and perhaps better target or design future educational or informational interventions on consumer food choices in restaurants. This section of the study investigates the following topics:

1. **Overall effect of providing calorie information.** Is there an overall effect of calorie labeling on the menu items people choose? Is "average treatment effect" a meaningful concept in this type of study?
2. **Effect of labeling on calorie choice by restaurant type.** Does the effect of providing calorie information differ across restaurant settings? Are study participants more or less responsive to labeling when selecting foods in standard restaurant settings versus food establishments that serve snacks or desserts (such as ice cream parlors or movie theaters)?
3. **Variation in consumer responses.** Do responses to labels vary across study participants? Do study participants who would typically order large meals, in terms of calorie content, change their orders when presented with calorie information? Or are the effects of calorie-labeled menus concentrated among study participants who would typically order smaller or lower calorie meals (perhaps because they are already trying to reduce calorie intake)?
4. **Characteristics predicting response to calorie information.** Can subgroups of individuals who are more or less likely to react to labeling be identified based on their observable characteristics?

The online experiment was fielded in 2016 among 2,200 participants through RAND's American Life Panel (RAND American Life Panel, undated). We created nine fictitious menus for different restaurants that would be subject to the FDA rule (six menus for standard meal settings: Asian, Burger, Mexican, Pizza Restaurant, Pizza Stand, and Salad Bar; and three menus for nonstandard meal settings: Ice Cream Parlor, Movie Theater, and Coffee Shop). The menus were designed to replicate the experience of seeing a large menu board when walking into a restaurant. Each respondent saw all nine menus, but the experiment randomized: (1) the order of menus; (2) whether a particular menu had calorie labels; and (3) prices (only for some menus). For these menus, we used one of two types of label treatment: The "regular" treatment satisfied the minimal size/visibility requirements for providing calorie information and the "bold" treatment met the requirements but made calorie labels stand out a bit more. The contextual information was identical in both cases. Respondents were asked to indicate what they would order if they visited the restaurant, and they were allowed to opt out of choosing items from a menu. We also asked the participants follow-up questions regarding satisfaction with the choice made, rating of the restaurant, and how often they would visit similar restaurants.

Results

Overall effect of providing calorie information. Our analysis of participants and their choices suggests that, among participants who selected at least one item, displaying calories on menus reduced the energy amount ordered by 30 kilocalories (kcal)[1] (95 percent confidence interval [CI]: 20–40), corresponding to a decrease of 7 percent across all settings. Results were adjusted for clustering (multiple observations by the same individuals). We found no substantial or statistically significant difference between regular and bold calorie information (although the mean decrease in food calories ordered was slightly more for bold labels); therefore, we analyzed them together as a single labeling intervention. Providing calorie information did not affect participants' satisfaction with choices they made or their ratings of restaurants.

Effect of labeling on calorie choice by restaurant type. Providing calorie information typically had a statistically significant effect, with a meaningful magnitude of effect size, in standard meal–type restaurant settings (Asian, Burger, Mexican, Pizza Restaurant, Pizza Stand, and Salad Bar). In contrast, there was no effect of labeling menus with calorie information on the number of calories participants chose in the three nonstandard meal–type establishments (Ice Cream Parlor, Movie Theater, or Coffee Shop). This general effect of calorie-labeled menus was observed both through direct experimental comparison (labeled versus unlabeled group) and through other specifications, such as regression models with different forms, although different specifications could change significance for some of the regular restaurants.

Controlling for demographic characteristics and attitudes, Table S.1 shows the average label effects by restaurant type.

[1] The scientific unit of measure for energy in food is the kcal, which is the same as one food calorie (C), but in everyday parlance most people say "calorie." This includes FDA descriptions of how to use the nutrition facts labels (see FDA, 2017). We follow that convention throughout this report.

Table S.1. Average Label Effects on Calories of Chosen Item, by Restaurant Type

Restaurant	Mean Change	Standard Error	Statistical Significance
Asian	−57	12	***
Burgers	−27	13	**
Mexican	−34	16	**
Pizza restaurant	−14	16	*
Pizza stand	−60	16	***
Salad bar	−25	6	***
Coffee shop	−14	9	*
Ice cream parlor	0	8	*
Movie theater	−38	26	*
Pooled	−30	5	***

NOTE: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$ (not significant).

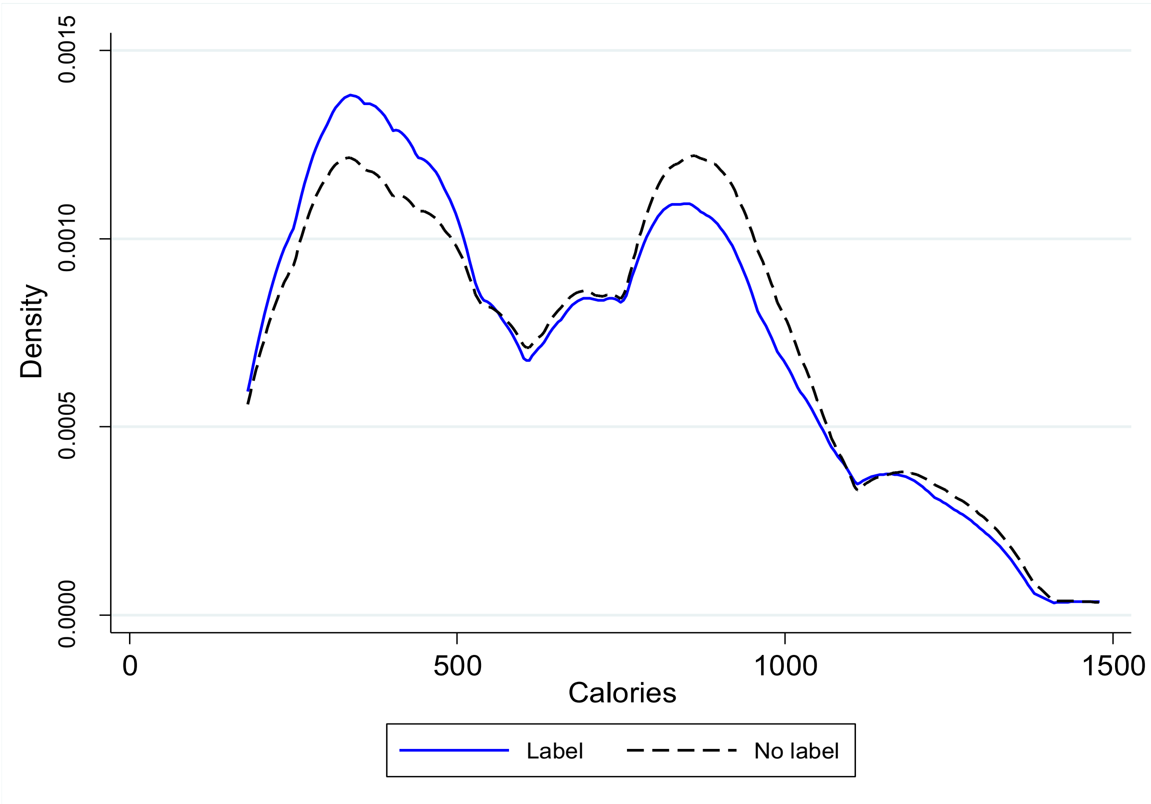
A likely reason for the variation in mean change in food calories ordered is that customers react differently across settings, although another factor that may contribute to the variation is differences in customer bases across settings (i.e., population subgroups are differently represented among the customers of a type of restaurant). As the customer base of a particular restaurant type diverges from the general population, label effects may change, and so there may be two pathways for variation: the setting pathway (the type of restaurant changes the response to calorie information among its customers) and the customer base pathway (different types of people are customers in different types of restaurants).

Note that the question of whether or how differences in the customer base across restaurants could lead to differing labeling effects is entirely different from the question of whether seeing a label changes the probability of any food selection. In this experiment, the answer to the latter is no: Calorie labels do not affect participants' decisions of whether to make a selection in a particular type of restaurant.

Variation in consumer responses. The concept of an "average treatment effect" does not imply that the effect of calorie information is uniform across the sample. Underlying an average effect may be substantial variation in how study participants respond to calorie information provided on menus. When we consider the distribution of food choices, rather than an average, heterogeneity is clearly visible. Graphing the results shows that, instead of simply shifting the distribution in a parallel fashion (which would happen if the average treatment effect was applied uniformly), the shape of the distribution changes and there are new or more-pronounced modes for some lower-calorie items. For example, the shape of the distribution for the Burger menu in Figure S.1 below illustrates such a change (see the main body of this report for graphs for all menus). Participants shown menus with calorie-labeled items (blue line) and those shown menus without labeling (black dashed line) were similarly likely to pick the highest-calorie items. However, participants shown the calorie information were less likely to choose items in the 800–

1,000 kcal range and more likely to choose items in the 400–500 kcal range than those who were not shown that information.

Figure S.1. Distribution of Calories Ordered for the Burger Menu



Although it is quite possible that providing menus labeled with calorie information increases the amount of calories ordered among some people (e.g., some people may prefer bigger portions or calorie-dense items with more value for the dollar), we generally do not see any increased probability for high-calorie choices (i.e., in Figure S.1 the blue line remains below the dashed line in the higher calorie range).

Characteristics predicting response to calorie information. The variation in response to calorie labels reflects, in part, individual preferences, which could be correlated with observable characteristics such as gender, race/ethnicity, and education. In this study, we saw a very strong direct association of sociodemographic characteristics with calories ordered. Male participants ordered items with more calories than female participants; African-American and Hispanic participants ordered more than white participants or participants of other racial groups; participants with fewer years of education ordered more than those with more years of education; and participants with higher body mass index (BMI) ordered more than those with lower BMI. (All of those associations are significant at $p < 0.01$.)

However, there was no interaction effect of seeing calorie-labeled menus with observable characteristics, including gender, age, education, income, race/ethnicity, or BMI, on calories chosen. In other words, we found no evidence that the effect of providing calorie information varies by sociodemographic characteristics across all menus. This lack of interaction between calorie-labeled menus and observable characteristics suggests that sociodemographic differences in those who selected items on the menus are not causing different average labeling effects across settings. A caveat is that the statistical power to do reliable subgroup analyses by menu is limited. We can only conclude that there are no large interaction effects.

As with sociodemographic characteristics, participants' attitudes about food and their use of either nutrition or calorie labeling are predictive of total calories ordered. Participants who prefer healthier foods, users of nutrition labels in supermarkets, and users of calorie labels in restaurants all ordered smaller meals. In addition, those participants responded more robustly to calorie information than others, by about 20 to 40 kcal.

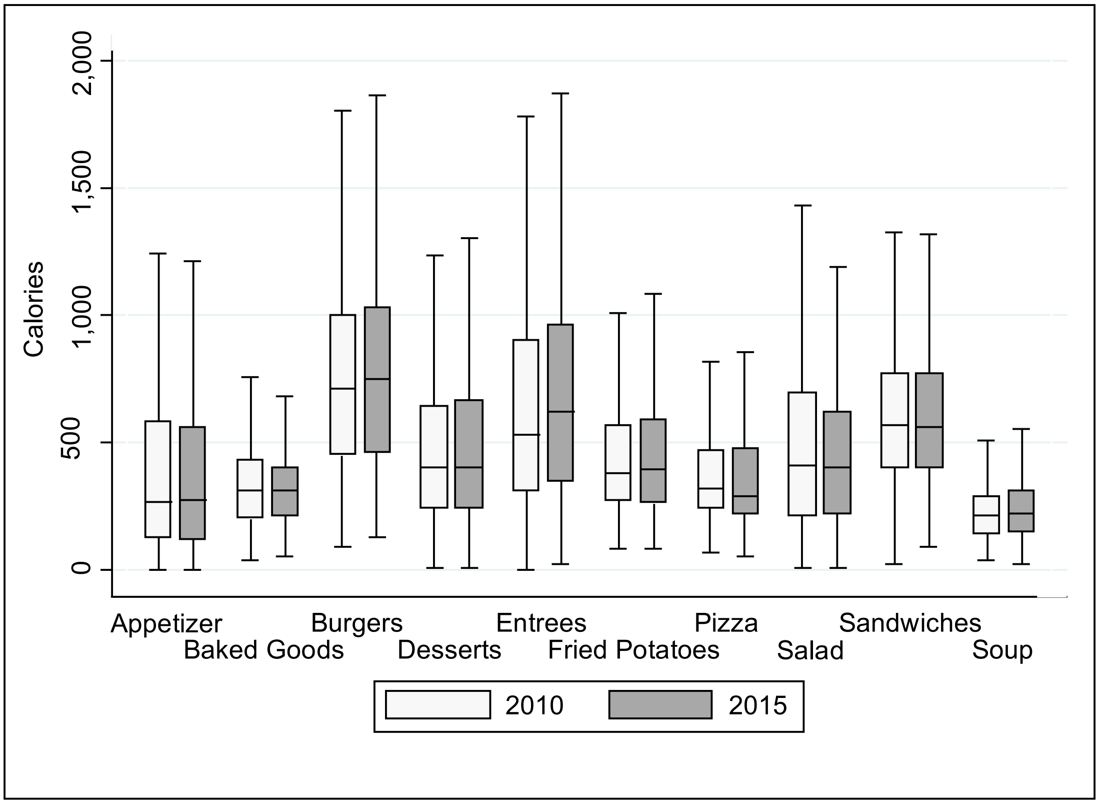
Objective 2: Evaluation of Menu Changes over Time

The second objective of this study was to evaluate restaurant menu changes over time and by type of restaurant. Previous studies have suggested that large chain restaurants reduced the number of calories in newly introduced menu items between 2012 and 2014 (Bleich, Wolfson, and Jarlenski, 2015, 2016). We analyzed data collected by MenuStat supplemented with 2010 data collected by RAND (Wu and Sturm, 2013). With menu-item information from 164 restaurants, we examined how menus of major chain restaurants have changed from 2010 to 2015.

Results

We found no statistically significant evidence of a change in calories per menu item between 2010 and 2015. Figure S.2 shows that, across ten categories of food items, the calorie amounts per item category were not substantially different in 2015 than they were in 2010.

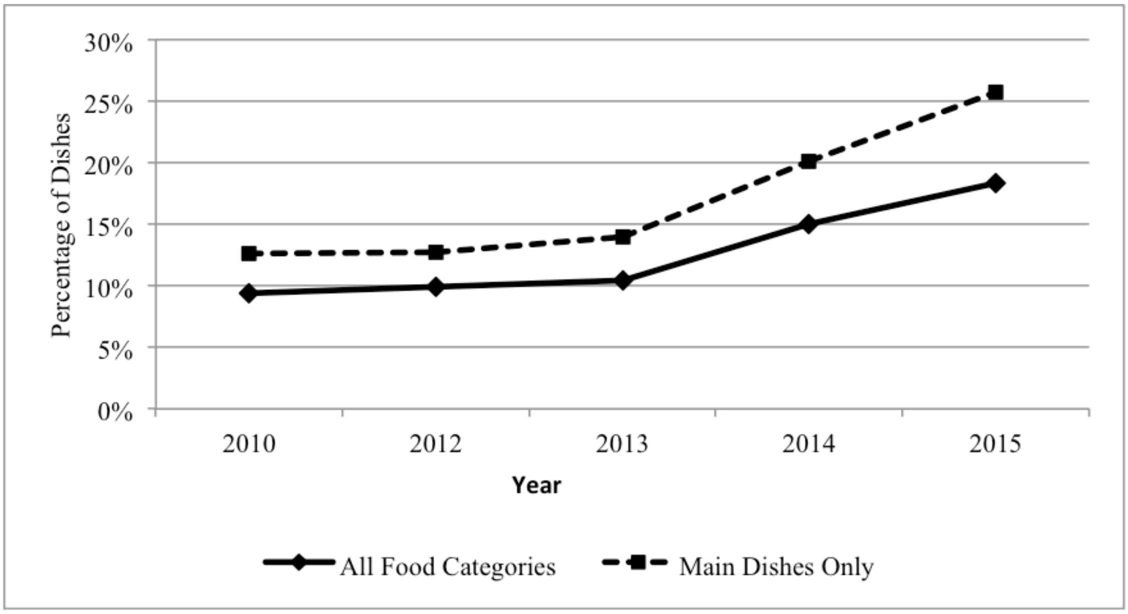
Figure S.2. Calories by Food Category, All Items à la Carte



NOTE: Includes only restaurants present in both the 2010 and 2015 data. Box and whisker plot shows interquartile range in boxes and upper/lower adjacent values in lines (Tukey, 1977).

We did find an important trend, however: Restaurants increasingly offer customizable items (in which the customer chooses a protein and one or two sides and/or condiments) (Figure S.3). This customization may present difficulties for analyzing caloric content of menu items. For this study, we determined that customizable items should not be analyzed à la carte because they are always presented to the customer as a combination.

Figure S.3. Percentage of Total Dishes That Are Customizable, All Restaurants



Average calories among customizable dishes offered in both 2010 and 2015 may have increased by 6 to 7 percent, but defining what constitutes a typical dish becomes difficult because so many variations are possible.

The presentation and usability of nutrition information also becomes more complex with customizable items. Labeling calorie content by menu item components makes information less user friendly, but if only calorie ranges were provided it could obscure the total calories of a given dish choice. Future consumer education efforts may need to focus on raising awareness of this customization trend to improve customers' understanding of how to use calorie information displays across restaurants. This trend toward customization also presents challenges for the design of tools developed to improve consumer food decisionmaking, such as MenuStat.

Acknowledgments

This project was made possible by funding from the Office of the Assistant Secretary for Planning and Evaluation (ASPE) and much input from our contracting officer's representative, Amber Jessup, as well as comments from Chung-Tung Jordan Lin at the U.S. Food and Drug Administration, Daniel Lawver at ASPE, and Daniel Wilmoth at the Small Business Administration. We thank them for their helpful insight.

In addition, we would like to thank our former RAND colleagues Salar Jahedi for comments on the initial design, Ujwal Kharel for the initial implementation of our protocol in the RAND American Life Panel software, and Alerk Amin for the final software changes. We thank Pardee RAND Graduate School students who pilot tested the survey and helped prepare it for fielding, including Gursel Rafiq Aliyev, Aziza Arifkhanova, Gulrez Shah Azhar, Emilio Rigel Chavez-Herrerias, Amanda F. Edelman, Carlos Ignacio Gutierrez, Melody Harvey, Kathleen Loa, and Nelly Josefina Mejia Gonzalez.

Finally, we would also like to thank our RAND colleague Andrea Richardson and Christina Roberto at the University of Pennsylvania for their careful technical reviews of this document. We also thank RAND communications analyst Monique Martineau for her many contributions to improve the readability and flow of this report.

Abbreviations

ASPE	Office of the Assistant Secretary for Planning and Evaluation
BMI	body mass index
C	Food Calorie
FDA	U.S. Food and Drug Administration
HHS	U.S. Department of Health and Human Services
kcal	kilocalorie
OLS	ordinary least squares

Chapter One. Introduction

The 2014 U.S. Food and Drug Administration (FDA) final rule titled “Food Labeling: Nutrition Labeling of Standard Menu Items in Restaurants and Similar Retail Food Establishments” requires restaurants and similar retail food establishments that are part of a chain with 20 or more locations doing business under the same name and offering for sale substantially the same menu items to provide calorie and other nutrition information for standard menu items, including food on display and self-service food (FDA, 2014). Menus and menu boards are required to display calorie information, and the regulations specify that the calorie count cannot be in smaller type than the name or price of the menu item (whichever is smaller). For salad bars and buffets, the calorie information must be displayed on signs near the foods so the consumer can see the information while selecting food items. To help put the calorie information in the context of their total daily diet, the rule also requires the following statement to be included on menus and menu boards: “2,000 calories a day is used for general nutrition advice, but calorie needs vary.” Written nutrition information for standard menu items must also be made available upon request, and establishments must post a statement to this effect on menus and menu boards.

These new federal standards create a uniform requirement for providing calorie information on menus nationwide, which reduces situations where establishments have to meet many different requirements because of varying state and local rules. The 2014 FDA rule may cover some establishments not previously covered by local or state regulations, such as entertainment venues, grocery, and convenience stores that meet the basic requirements (e.g., chain with 20 or more locations doing business under the same name and offering for sale substantially the same menu items) and offer for sale restaurant-type food.

Providing calorie information on menus could allow consumers to better assess the nutritional value of restaurant foods and thereby improve their decisionmaking. Even trained dietitians seem unable to reliably assess the nutrient content of common restaurant meals. One study showed that, while dietitians could accurately assess the calorie and fat content of a glass of milk, they underestimated calories of restaurant meals shown to them (Backstrand et al., 1997). Likewise, health professionals are no better at predicting the calorie content of common restaurant meals than the general public (Perkins, 2012).

Numerous studies (and several systematic reviews) have tried to assess the effects of local menu labeling rules, but the results of the reviews have been mixed and sometimes contradictory (VanEpps et al., 2016; Sarink et al., 2016; Long et al., 2015; Sinclair, Cooper, and Mansfield, 2014; Swartz, Braxton, and Viera, 2011). There are plausible reasons for this heterogeneity, such as differences in label styles and information provided, differences in the types of restaurants in the study, and variance in groups of participants. There is no reason to assume that response to labels would be uniform even among participants who use calorie information. Some consumers will prefer fewer calories, and others will prefer more calories. Both types of customers may use labeling to meet their needs, even if responses are in opposite directions. Most prior studies approach menu labeling from the sole perspective of limiting calories.

Across the literature, there has been confusion between substantively important and statistically significant effects. Studies with small sample sizes may have imprecise estimates and therefore have statistically insignificant results, or (due to chance) statistically significant estimates that are likely to be exaggerations of true effect sizes. Sinclair, Cooper, and Mansfield (2014) reported that labeling menus with calories alone was associated with a decrease of 31 kilocalories (kcal) selected and that such labeling "did not have the intended effect of decreasing calories selected" because the observed decrease was not statistically significant.[1] Our results show a very similar overall effect of providing calorie-labeled menus, which in our data corresponds to a 7-percent decrease in calories selected (30 kcal in multivariate regression as in Table 4.7, 38 kcal in the unadjusted comparison as in Table 4.1). However, we do not view this as a small effect; this is substantively a large change. Reducing the amount of food people eat away from home—which accounts for one-third of the energy intake among Americans—by 7 percent would result in weight loss (unless that calorie reduction was compensated for by increasing intake elsewhere) (U.S. Department of Agriculture, 2016). At an average daily intake of 2,000 kcal, one-third of which is from food away from home, a reduction of 7 percent of calories from food away from home would be about 42 kcal less energy eaten per day. That is about six times the size of the estimated daily energy gap underlying the obesity epidemic (Hall et al., 2011).

As with calculations of "average" intake or energy gap, an average treatment effect is an incomplete assessment of treatment effects for studies of dietary intake. The average obscures differences by restaurant type and across individuals, an observation that is highlighted in this report. The most recent systematic review of field studies did not estimate an average treatment effect, but concluded that "the evidence regarding menu labeling is mixed, showing that labels may reduce the energy content of food purchased in some contexts, but have little effect in other contexts" (VanEpps et al., 2016). The consumer choice experiment in our study provides data on which type of context influences the effect of calorie-labeled menus.

The second part of our study looks at restaurants' responses to the evolving marketplace. The large majority of research to date on menu labeling efforts has focused on consumer responses, but the restaurant industry response is also important to consider. Restaurants constantly have to adapt to changing consumer demand, and have done so in the past. Clear information on caloric content may further increase demand for lower-calorie meals and may spur restaurants to position themselves as offering "healthy" alternatives. New branding strategies could include

---

[1] The scientific unit of measure for energy in food is the kcal, which is the same as one food calorie (C), but in everyday parlance most people say "calorie." This includes FDA descriptions of how to use the nutrition facts labels (see FDA, 2017). We follow that convention throughout this report.

reducing serving sizes, changes in menu offerings, reformulation of existing items, or revamping menus entirely.

The definition of what constitutes a meal may be changing as well; restaurant offerings have become more diverse and customized to individual consumer requests. In 2014, restaurant revenue grew 1.3 percent overall, but revenues for fast-casual restaurants grew much faster, particularly in the "build-your-own" segment that emphasizes individual customization, which was up 22 percent (Newman, 2015).

Study Objectives

The first objective of the study presented here was to create an online consumer choice experiment in which consumers were randomly exposed to nine restaurant menus that displayed different types of calorie and price information, to survey how such information would affect the food the consumer would order. The menu information labels followed the requirements on font size, visibility, and contextual information according to the 2014 FDA final rule (FDA, 2014). This survey was also designed to provide more information on the diversity of consumer responses across restaurant settings by sociodemographic characteristics, attitudes about food, and use of information. The results in this report focus on randomized outcomes, but the data collected are rich and may inform other analyses. The raw data will be made available to interested researchers through the RAND American Life Panel (ALP) website after September 2017 (see ALP, undated).

A secondary objective of the study was to analyze how restaurant menus have changed over time. We documented an increasing trend toward menu-item customization (e.g., a national Mexican fast-casual chain's build-your-own burrito option) that could complicate customers' interpretation of calorie information.

Objective 1: Consumer Choice Experiment

Our online survey aimed to estimate how study participants respond to calorie information on menus. The results may provide a better understanding of the response heterogeneity across prior studies, and insights that can improve the targeting or design of educational and informational interventions. The study investigates the following questions:

1. Is there an overall effect of labeling restaurant menus with calorie information? Is an average treatment effect a meaningful concept in this type of study?
2. Does the effect of providing calorie information differ across restaurant settings? Are study participants more or less responsive to labeling when selecting among snack or dessert calories (e.g., ice cream, popcorn at the movies) rather than a meal in a restaurant?
3. Do responses to labels vary across study participants? Do study participants ordering higher-calorie meals change what they would have ordered after seeing a menu labeled with calorie information? Or are the effects of calorie-labeled menus concentrated among

study participants ordering lower-calorie meals (maybe because these are individuals already trying to reduce calorie intake)?

4. Can subgroups of participants who are more or less likely to react to calorie information be identified based on observable characteristics?

Objective 2: Evaluation of Menu Changes over Time

To evaluate changes over time in restaurant menus under the second study objective, we analyzed data collected by MenuStat, supplemented with 2010 data collected by RAND (Wu and Sturm, 2013). We document how menus of major chain restaurants have changed from 2010 to 2015. The analysis includes menu-item information from 164 restaurants available from 2010 to 2015 in the MenuStat database.

Chapter Two. Design and Fielding of the Consumer Choice Experiment

We created an online experiment with random assignment to estimate consumer responses to labels that would meet the FDA rule requirements for menu labeling at restaurants. This chapter describes the research approach, the design of menus, field procedures and data report, and procedures for data cleaning.

Each online interview consisted of two parts. In the first part, survey respondents were shown nine different menus, each representing a different type of food outlet. Participants were asked to review each of the menus and indicate what they would order (if anything) from that type of restaurant, and then were asked to answer a few follow-up questions about their rating of the value and healthiness of the menu, satisfaction with their choice, and how often they typically choose to eat at that type of restaurant. In the second part, after working through all nine menus and questions, participants were also asked to answer questions on attitudes toward health, nutrition, calorie labeling, and factors they consider important when making food selections (e.g., taste, healthiness, value).

Respondents (RAND American Life Panel)

The online experiment was conducted using the ALP. The ALP consists of a panel of about 6,000 U.S. respondents ages 18 and older who regularly take surveys over the Internet. Since January 2006, the ALP has fielded over 400 surveys on topics including financial decisionmaking, well-being, health decisionmaking, Social Security knowledge and expectations, and more. The ALP has an advantage over most other Internet panels in that the panel can be based on a probability sample of the United States. As with all surveys based on random samples, the composition of the unweighted sample differs from the population composition, and weights are available to make the sample as representative of the population of interest as possible. The benchmark distributions against which the ALP is weighted are derived from the Current Population Survey (see ALP, undated). A typical interview takes no more than 30 minutes, and respondents are paid an incentive to participate ($20 per 30 minutes of interview time); we designed our study to take no more than 30 minutes.

The Office of Management and Budget approved this study as an experiment, but not as a nationally representative study. All main results, therefore, refer to study participants only. Some additional weighted results are provided in the appendix for the purpose of a sensitivity analysis.

Menu Design

We created nine different menus to test variations in labeling menus with calorie information across settings. The menus represent different types of fast-food or fast-casual restaurant outlets, and a few nonmeal-based outlets serving snacks or treats (Table 2.1) (full menus are shown in the appendix). A key design goal was for participants to see menus that resemble, as realistically as possible, those encountered at actual food outlets while maintaining simplicity in the design. To create the menus, we collected photos and samples of real-life menus in each setting, and downloaded nutrition information from restaurant websites. Figure 2.1 shows, as an example, the Asian fast-casual menu.

Table 2.1. Nine Types of Food Outlets

Name Used in Study	Type of Food	Style
Asian	Chinese Asian	Fast-casual
Burgers	Burgers	Fast-food
Mexican	Mexican	Casual, sit down
Pizza restaurant	Pizza with “organic,” “locally sourced” ingredients	Fast-casual
Pizza stand	Pizza, ordered by the slice	Fast-food
Salad bar	Prepared salads (not a buffet)	Fast-casual
Coffee shop	Coffee	Café
Ice cream parlor	Ice cream	Ice cream parlor
Movie theater	Popcorn/candy	Movie theater counter

For each setting, the style of the menu, content, prices, and calories reflected those seen in an actual setting of that type. Item names were adjusted to avoid listing anything that sounded specific to an existing brand. All menus were listed as new restaurants. Unlike repeat customers of existing chains, survey participants needed to familiarize themselves with the full menu. Thus, calorie information may be more salient in this experiment than if it were added to a familiar menu.

With the exception of the Burgers, Movie Theater, and Coffee Shop menus, we did not include drink options. We developed additional menus for other settings, for example different full-service sit-down restaurants. A limitation is that we could not include them all due to survey length. We did not want to field menus on only a subsample because of the loss of statistical power.

Figure 2.1. Asian Fast-Casual Menu, with Labeling

For each menu presented, respondents would see a screen with the title of the type of restaurant corresponding to the menu, and a short prompt. For example, for the Burgers restaurant, the prompt read "Imagine you're at a fast-food restaurant for lunch. It's a new fast-food restaurant chain, similar to McDonald's, Burger King, and Wendy's. What would you order from the following menu?" Survey respondents would then click the radio button next to the food item name or picture to indicate their selection. At the bottom of each menu, we included a "none of the above" option so that respondents who would not choose something from that menu were able to opt out of being a customer. Respondents were able to go back to any point in the survey to revise their response.

A conscious design element was varying the choice set and corresponding caloric content within the same "taste" category. For example, within the category of beef burgers in the Burgers menu, we offered burgers in three portion sizes: a quarter-pound, a half-pound, and three-quarters of a pound. This gave respondents the option to choose a smaller portion while holding "taste" constant; that is, someone with a strong taste preference for beef could choose a lower-calorie beef item instead of a higher-calorie one without having to switch to a different type of food. Likewise, when possible, we varied main menu features by offering different sizes of items, such as with the Ice Cream Parlor and Coffee Shop menus. These design elements allowed us to hold taste preference as a constant to the extent possible, to better identify the effect of labeling.

Asian—Fast-Casual

Fast-casual restaurants typically do not offer full table service, but try to position themselves as offering higher quality food with fewer frozen or processed ingredients and as more "upscale" than traditional fast-food restaurants (Specter, 2015; Newman, 2015). Our Asian restaurant menu was meant to represent a fast-casual establishment, and its items were based on a selection of offerings in an Asian restaurant chain. Fast-casual places typically have set meals that include an entrée and one or more sides. We followed this format and offered an entrée plus a side. Survey respondents were asked to create a "bowl" by choosing one entrée and one side among eight entrée options (three beef, four chicken, and one shrimp) and five sides (three rice, one noodle, and one vegetable). As is customary for these types of restaurants, we set a fixed price for the bowl. Participants did not necessarily have to select both an entrée and a side; they were able to select one without the other and calories were adjusted accordingly.

Burgers—Fast-Food

Our fast-food menu resembled those seen in major fast-food burger chains across the United States, where key features of the menu include a selection of burgers, the option to create a "combo," and a smaller number of salad options. We included three beef burger sandwich options and three chicken sandwich options of varying calories, as well as two salad options at half- or full-size portions. We also allowed all six sandwich options to be selected either as a sandwich only or as part of a combo. A section of the menu showed a photo of the combo with the text: "Make it a combo! Small combo comes with small fries and a drink of your choice." The calorie labels on combo items showed an upper and lower bound that spanned 150 calories, which is equivalent to the calories in a 12-oz soft drink. If the respondent selected the combo option on the menu, a follow-up question would pop up: "For your combo, would you order a regular or diet soft drink?" Those who selected a diet soft drink were assigned the lower bound for calories, and those who selected a regular soft drink were assigned the upper bound for calories.

Mexican—Fast-Casual or Casual

"Casual" dining restaurants often offer full table service and serve food at mid-range prices that are slightly higher than the prices at fast-casual restaurants. Our Mexican menu could be used in either type of service, but we imagined it as a casual dining outlet. Items on the menu were based on items offered at two casual Mexican dining outlets in the United States. Calories for items with customizable ingredients are sometimes presented in a range, which may overlap with other options. We simplified our menu to have three types of clearly defined foods: burritos, taco salads, and tacos, with 17 items in total. Each type had a chicken, pork, steak, or vegetarian option and included a short description of items included, e.g., “Crispy tacos with meat, avocado, salsa, sour cream, and romaine lettuce.” For burritos and tacos, we allowed one customization: respondents were able to choose to “make it a bowl (no tortilla)” which is 300 calories less than having a tortilla. To preserve realism, this menu allowed respondents to select multiple options; i.e., respondents could choose a burrito or salad with additional tacos.

Pizza Restaurant and Pizza Stand

The Pizza Stand menu represented offerings at mainstream U.S. pizza chains, whereas the Pizza Restaurant menu resembled that found in a chain featuring locally sourced, organic ingredients. Each menu contained ten types of pizza, designed to be identical in terms of pizza type and calories but different in terms of how they were presented across the menus. For example, a “regular cheese” pizza in the Pizza Stand corresponded to the “three-cheese bonanza” in the Pizza Restaurant, though they had the same calories. Similarly, the “Hawaiian” pizza at the Pizza Stand was equivalent to “Maui Zaui” at the Pizza Restaurant. For the Pizza Restaurant, each item had a description next to it, e.g., “Parmesan, cheddar, ricotta, and feta cheese, with chopped fresh oregano and thyme over our traditional tomato sauce.” Although pizza outlets often sell the entire pizza pies, in our survey, the pizza was sold only by the slice. Hence, in both of our pizza menus we allowed respondents to select the number of slices they wanted for each type of pizza in order to facilitate calculating individual calorie consumption. Both menus had a fixed price per slice mentioned at the top of the menu. For the Pizza Stand, it was $2 per slice; for the Pizza Restaurant it was $5 per slice.

Salad Bar

The Salad Bar menu represented a “healthy” fast-casual dining atmosphere. This menu contained 12 items in total under three categories: salad, panini (i.e., grilled) sandwich, and non-grilled sandwich. Each item had a description next to it, e.g., “Fresh Cobb salad—avocado, egg, crispy bacon, cherry tomatoes, blue cheese crumbles, with honey mustard dressing.” We named it Salad Bar to indicate a brand name, but people did not assemble their own salads as in a buffet. Instead, only standard menu items were offered.

Coffee Shop

The Coffee Shop menu was designed to resemble coffee chains. Respondents were prompted to choose items within three categories of drinks: espresso-based drinks (cappuccinos, lattes, and espresso shots), coffees (regular brew, café au lait, and café mocha), or alternatives (hot chocolate, chai latte, and brewed tea). Each item could either be regular (16 oz) or large size (20 oz).

A design feature unique to the coffee shop menu allowed participants to choose the type of milk they would have with their coffee. This was done to preserve realism and to account for differential caloric intake based on the type of milk chosen. For 14 items that typically come with milk (lattes, cappuccinos, etc.), respondents were asked a follow-up question on what type of milk respondents would have with their drink: "You ordered [a large latte]. What type of milk do you want with this drink?" The default choice presented in the labeled menu is for 2-percent milk, but respondents were also allowed to choose skim, whole, or soy milk. For those in the groups viewing calorie-labeled menus, the calorie difference from the default 2-percent milk was shown next to their choice.

Ice Cream Parlor

This menu was designed to resemble typical ice cream chains. We simplified the menu to include nine possible selections in three ice cream "styles": waffle cone, bowl, and low fat (from highest calorie to lowest calorie). We included three size options within each style to allow further calorie variation: single, double, or triple scoop. Once respondents selected a style, they were asked to select the number of scoops and choose from different flavors. For simplicity, we did not present flavor-specific calorie information; offering a selection of flavors was included for realism.

Movie Theater

We included a Movie Theater menu to represent food establishments in entertainment venues, which would also be required by the new FDA rule to label menus with calorie information if the establishment is part of a movie-theater chain. Our menu offered 14 total items in three categories of foods typically found in movie theaters: popcorn, drinks, and candy. Within the popcorn and drinks categories we offered three size and calorie variations (small, regular, and large), and within candy choices we offered two size variations (regular and large). For popcorn, respondents could also choose between two flavors: plain (lower in calories) or buttered (higher in calories). For drinks, respondents could choose between regular or diet soda. For this menu, we allowed multiple selections, meaning a respondent could choose one large popcorn and one large drink, or one item from each category.

Randomization

Three layers of randomization were incorporated into the experiment. We first randomized the sequence of menus seen for each individual. Thus, the order in which the nine menus could appear was chosen at random, and this randomization eliminates any confounding of labeling or menu effects with the sequence. The order of presentation was not a factor of substantive interest per se and we do not analyze it any further; it was only added to avoid any potential contamination of menu effects from any menu being placed in a fixed position in the experiment (especially being first or last).

Second, for each instance a respondent was shown a menu, we randomized whether calorie labels were included (so each respondent was likely to see some labeled and some unlabeled menus). Participants who viewed calorie-labeled menus were in the "treatment" arm of the experiment. Calorie labeling on all menus complied with FDA requirements at the time of the experiment, which stipulated that labels must be in the same color, or a similar color and contrast, as that used for the name of the associated menu item. The rule also required a contextual statement about recommended daily caloric intake, which was included at the bottom of menus that listed calorie information. In addition to these "regular" calorie labels, on four menus we also used a "bold" calorie label, which met the requirements of the new regulation, but used a typeface that is more pronounced than that of the regular label group (e.g., through the use of a heavier font and/or colors that stand out from the background). While many restaurants will use minimal requirements in the regular label setting, some are likely to feature calories more prominently. The menus that included the bold calorie treatment were: Asian Fast-Casual, Salad Bar, Pizza Stand, and Pizza Restaurant. Because all participants see the same menus, some displaying calorie information and some not, this study might exaggerate the effect of labeling menus with calorie information if the presence of calorie labeling on some menus was to become more salient after viewing a menu without labels.

The final randomization addition to the experiment introduced price variation to four menus (Burgers, Ice Cream Parlor, Movie Theater, and Mexican). This price manipulation breaks the fixed relationship between prices and calories, in which larger portions are always more expensive than smaller portions of the same food. The price differential therefore influences choices as well. Some people switch from a larger to a smaller portion size when given calorie information and when there is a large price differential. The same people might not switch to a smaller portion size with a smaller price differential. Manipulating the prices could therefore outline the relative importance of price versus information. We randomized each menu/participant combination to see one of three prices: the default price; a health subsidy where lower-calorie choices are approximately 20 percent cheaper; or a calorie surcharge, or tax, where high-calorie choices are approximately 20 percent more expensive. The price variation randomization was shown both to participants who saw labels and to the control group. For the Mexican and Burgers settings, *low-calorie items* were determined to be all items equal to or less than 500 calories and *high-calorie items* were determined to be all items equal to or higher than 900 calories. For the Ice Cream Parlor and Movie Theater settings, low-calorie items were those sized small and high-calorie items were those sized large. Table A.1 in the appendix shows the calories and prices per item for the Burgers menu. As it turns out, price responsiveness was so small and imprecisely measured that we do not report separate results on prices.

An alternative method to break the fixed relationship between higher prices and higher calories is to have identical prices for all items (or alternatively, there is no price effect when switching to higher or lower calories). We used that approach in three menus (Asian, Pizza Stand, and Pizza Restaurant). This allowed a clean identification of the labeling effects for these menus without confounding it with price effects. In those settings, a fixed price also seems realistic.

Table 2.2 summarizes the presentations for each menu, as well as the means and ranges for calories and prices.

Table 2.2. Randomization and Average Calories and Prices of Items, Per Menu

	Treatments			Calories			Prices (Default Setting)		
	Regular Label	Bold Label	Price Variation	Mean	Minimum	Maximum	Mean	Minimum	Maximum
Asian	X	X		324	70	690	7.59	7.59	7.59
Burgers	X		X	707	180	1,480	4.62	2.49	6.69
Mexican	X		X	698	240	1,025	5.36	2.49	6.09
Pizza restaurant	X	X		303	210	430	5.00	5.00	5.00
Pizza stand	X	X		303	210	430	2.50	2.50	2.50
Salad bar	X	X		519	355	820	8.08	7.95	8.45
Coffee shop	X			193	0.00	500	2.94	1.75	4.75
Ice cream parlor	X		X	422	100	850	3.66	2.79	4.59
Movie theater	X		X	416	0.00	1,100	4.71	3.75	5.75

Postsurvey Questions

After the main experiment, a final section collected additional data on the following items:

- behavioral characteristics: use of nutrition information in supermarkets and use of calorie information in restaurants
- attitudes: feelings regarding a number of food choice characteristics, e.g., price, healthfulness, taste, and novelty
- knowledge or understanding of calories: respondents' estimate of the amount of calories in one 12-oz can of Coca-Cola
- physical characteristics: height, weight, and self-perception of weight
- current level of hunger at the time they completed the survey.

Analysis of the answers to these questions is discussed in the next chapter.

Data Collection

A pilot version of the survey was cognitively pretested on ten volunteers. The full survey was pretested in June 2016. The pretest was fielded on 113 individuals: 104 completed the survey and nine ended the survey early. We tested randomization and data output and found no problems.

Fielding for the final survey started on August 15, 2016. As this corresponded with the peak period of summer vacation, we expected low participation and a survey duration of three weeks to meet our target number of respondents (2,000). However, we exceeded the target within one week and closed the survey early, on August 21, 2016. There were a total of 2,231 at least partial responses; 79 of those were incomplete surveys. Of those 2,231 interviews, eight individuals did not see any, nor respond to any, of the menus and one had no treatment assignment recorded. We have dropped those nine from any analysis. An additional two did not have weights and missed other background variables, so we dropped them from our analytic files as well. The raw data file includes all data collected in the survey, but dropping those 11 individuals results in a total sample of 2,220 (see Table 2.3).

Table 2.3. Sample Survey Disposition

Response Overview	Number of Responses
Available sample at time of selection	3,847
Completed the survey	2,152
Started interview, but did not complete survey	79
Total number of at least partial interviews	2,231
Minus individuals not providing any answers, missing assignment, or background variables	11
Full sample used for analysis	2,220

Quality Check: Is the Experiment Balanced?

In randomized experiments, a direct comparison between treatment (e.g., participants who viewed calorie-labeled menus) and control groups is a statistically valid analysis because random assignment ensures that treatment and control groups are statistically equivalent on observable and unobservable characteristics. But random assignment does not guarantee that group characteristics are always perfectly balanced (i.e., mean differences between treatment and control groups along observable characteristics may not be statistically different than zero) even if there is no systematic bias.

To check for balance in the random assignments, we compared the means of treatment (seeing a price variation or menu labeled with calorie information) and control groups (seeing regular prices and no calorie information on menus) along socioeconomic and demographic characteristics and an indicator for whether the participant is of normal weight (if their body mass index [BMI] is less than 25), and reported the *p*-value from a chi-square test. We additionally checked for balance on the postsurvey attitude questions we collected, which included hunger and factors that influence food decisionmaking (large portion, good value, low in calories, low in price, etc.). Because these additional variables are likely correlated with calories chosen, this additional check is useful for informing us of imbalanced variables, if any, so we may control for them in later regressions. In total, that gives 26 variables checked for balancing. Given our experimental design, there were a total of 13 randomizations: nine for menu labeling variations (labeling with bold and regular design styles) and four for prices. Note that for some menus, we compared between two groups (regular/no label) and for others we compared between three groups (regular/bold/no label, or normal price/health subsidy/calorie tax).

As a parsimonious way of displaying results from balancing tables, we show graphs of ranked *p*-values associated with the mean tests in each menu for the nine calorie labeling–treatment menus (Figure 2.2) and four price treatment menus (Figure 2.3). The horizontal red lines represent *p*-value 0.05. We have 26 variables per menu, multiplied by 13 tables, so there should be a few significant differences (one in 20 tests) due to chance.

The figures show that the experiment/control groups are balanced. Few menus have differences between control and treatment in more than one variable below or at *p*-value 0.05. The exception to this is the calorie label randomization for the Ice Cream Parlor menu, where there were eight variables that differ by calorie label assignment with statistical significance below *p*-value 0.05. Inspecting the balancing table further, most of these variables were the food attitude variables: good value, low price, low calories, healthy, control weight, and taste good. For this menu, including attitude variables in later regressions may control for the lack of balance.

Figure 2.2. Ranking of *P*-Values from Mean Comparisons, Calorie Label Menus

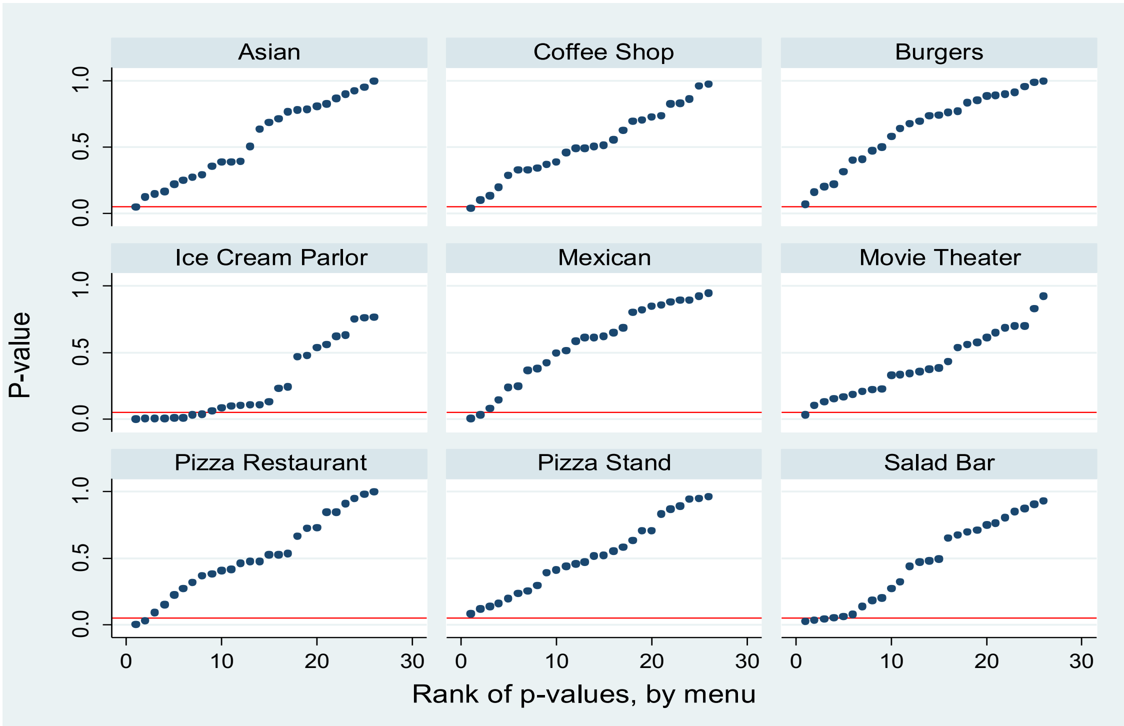
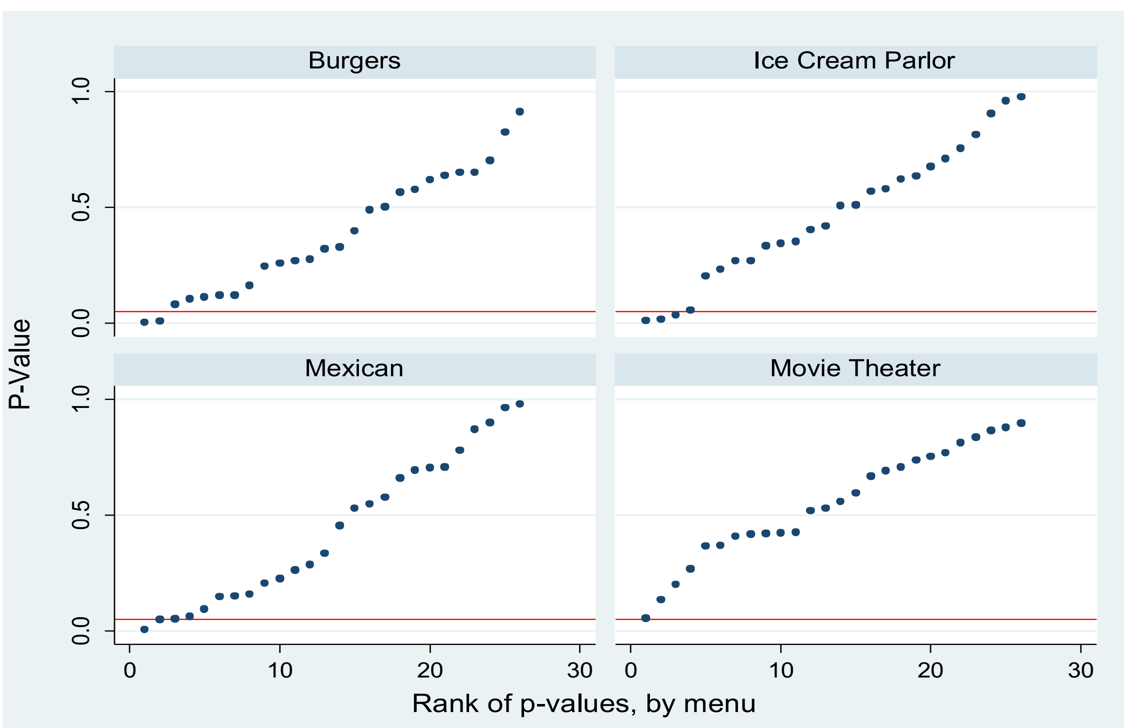


Figure 2.3. Ranking of *P*-Values from Mean Comparisons, Price Treatment Menus



As described above, the order of menus seen was randomized for every participant. Table 2.4 shows sample sizes for each menu, by the order in which they were seen. Note that while 2,200 people responded to the survey, each person would have been assigned to all nine different menus: the total menu by individual sample is 19,800. The sample distribution shows that there is no clustering of participants who saw a certain menu at a later or earlier stage in the survey. A chi-square test of proportions shows that there are statistically significant differences in these proportions across all 81 (9x9) menus by order instances (p-value = 0.022). However, each menu-by-order is within the mid-200s range, suggesting that the randomization was implemented correctly and any statistically significant differences are due to random deviations rather than systematic error.

Table 2.4. Sample Sizes of Menus, by Order They Were Seen

Order	Asian	Burgers	Mexican	Pizza Restaurant	Pizza Stand	Salad Bar	Coffee Shop	Ice Cream Parlor	Movie Theater	Total
1	251	278	263	242	276	236	235	235	204	2,220
2	252	231	269	257	218	269	246	244	234	2,220
3	242	245	213	238	249	255	262	237	279	2,220
4	241	228	248	278	243	256	223	241	262	2,220
5	247	241	263	261	250	234	248	238	238	2,220
6	242	246	223	267	246	236	270	218	272	2,220
7	246	255	262	211	235	249	244	288	230	2,220
8	268	245	243	231	237	238	263	259	236	2,220
9	231	251	236	235	266	247	229	260	265	2,220
Total	2,220	2,220	2,220	2,220	2,220	2,220	2,220	2,220	2,220	19,800

NOTE: Chi-square test of proportions yields a chi-square state of 88.7 and p-value of 0.022.

Chapter Three. Descriptive Statistics for Consumer Choice Experiment

This chapter provides the descriptive statistics for the online consumer choice experiment, including demographic characteristics of respondents, attitude and knowledge, and response patterns.

Participant Characteristics

Forty-six percent of the sample was male, the average age was 56 years, and respondents had 15 years of education on average, with 96 percent completing high school and 84 percent completing some college. A majority of the sample was white (72 percent), 9 percent were African-American, and the remaining respondents were Asian or Pacific Islander or Other. Fourteen percent had Hispanic ethnicity. Fifty-five percent of the sample was currently employed (Table 3.1). Sociodemographic characteristics are available on all respondents, but there were nonresponses to some survey questions (some skipped questions, and 79 respondents did not get to the last screen of the survey).

Table 3.1. Sociodemographic Characteristics of Respondents

Variable	Mean	Standard Deviation	Minimum	Maximum
Non-Hispanic African-American	0.09		0.0	1
Non-Hispanic White	0.72		0.0	1
Asian or Pacific Islander	0.03		0.0	1
Other	0.02		0.0	1
Hispanic	0.14		0.0	1
Income (in thousands of dollars)	71.03	57.63	2.5	250
Male	0.46		0.0	1
Age	56.13	14.38	20.0	93
Years of education	15.00	2.17	6.0	18
Finished high school	0.96		0.0	1
Some college	0.84		0.0	1
College degree	0.48		0.0	1
Employed	0.55		0.0	1
Number of other people in household	0.89	1.37	0.0	10

NOTE: All variables have 2,220 observations, except for income, which had 2,213. Seven people did not report income. Income was constructed as a continuous variable using midpoints from 17 categories (e.g., if category is $25,000–$30,000, 27 is used).

Use of Nutrition and Calorie Labels

The survey asked respondents to answer the following questions:

- When you shop at a supermarket, do you look at nutritional information when choosing between similar foods?
- When calorie information is available in the restaurant, how often do you use this information to decide what to order?

The response categories (and corresponding code value in the analysis file) were: (1) never, (2) sometimes, (3) about half the time, (4) most of the time, and (5) always.[3]

A summary of responses to the two questions is shown in Table 3.2. The percentage of participants using calorie labels at restaurants "always" or "most of the time" is less than for those using nutrition labels in supermarkets, but the variables are nevertheless strongly correlated (we used a Pearson correlation coefficient of 0.6).

Table 3.2. Responses to the Use of Nutrition/Calorie Labels Questions

	Percentage of Responses					
Survey Question	**Always**	**Most of the Time**	**About Half of the Time**	**Sometimes**	**Never**	**Number of Responses**
When you shop at a supermarket, do you look at nutritional information when choosing between similar foods?	18.8	28.5	13.5	28.2	11.1	2,171
When calorie information is available in the restaurant, how often do you use this information to decide what to order?	8.8	19.6	16.8	29.9	24.9	2,171

Attitudes About Food

The survey included a set of attitude questions that ask, "How important are the following characteristics for the selection you made on the previous pages?" Nine items are shown to the respondents: large portion, good value for money, low price, vegetarian, is low in calories, keeps me healthy, helps me control my weight, needs to taste good, and is something new. The respondents were asked to rate these items on a five-point scale: (1) not at all important, (2) not very important, (3) somewhat important, (4) important, and (5) very important. The summary statistics for this set of questions are shown in Table 3.3.

[3] When using the raw data, note that those responses are coded in reverse (always is 1, never is 5). The question about the use of the restaurant labels conditions the response on the availability of calorie information, i.e., "when calorie information is available."

The most–highly rated item was “needs to taste good,” with almost 95 percent of the respondents rating it as “very important” or “important.” This “ceiling” effect makes the taste variable one that is not useful for explaining the variation in calories chosen. It is the most important criterion, but because that value is universally shared, it does not provide information on differences in choices. The second most–highly rated characteristic was “good value for money,” with 75.6 percent of respondents rating it as “very important” or “important.” This tells us that price consciousness is important overall, but unlike “needs to taste good,” this variable was not consistently rated across the sample and therefore can explain variation in choices. Three items concerning healthfulness, “is low in calories,” “keeps me healthy,” and “helps me control my weight,” have the most-common responses around the middle of the response scale.

There were characteristics that were not highly valued overall: 69.1 percent of respondents rated “vegetarian” as “not very important” or “not at all important.” Novelty also was not highly valued by the majority: 51.2 percent of respondents rated it as “not very important” or “not at all important.”

Table 3.3. Responses to the Attitude Questions

	Percentage of Responses					
Characteristic Assessed	**Very Important**	**Important**	**Somewhat Important**	**Not Very Important**	**Not at All Important**	**Number of Responses[a]**
Large portion	7.8	15.9	31.1	31.8	13.4	2,167
Good value for money	38.2	37.4	19.3	3.8	1.3	2,170
Low price	24.9	28.7	32.2	11.9	2.3	2,167
Vegetarian	7.6	7.5	15.8	26.6	42.5	2,166
Is low in calories	11.6	18.9	38.7	19.3	11.5	2,168
Keeps me healthy	22.8	29.2	33.5	9.6	5.0	2,167
Helps me control my weight	19.2	23.8	34.3	14.3	8.4	2,168
Needs to taste good	68.9	25.5	3.5	1.0	1.2	2,169
Is something new	7.2	11.6	30.0	31.8	19.4	2,165

[a] The size of the full survey sample is 2,220. The number of responses tends to be slightly smaller than the size of the full sample because some respondents skip some of the questions.

Knowledge of Calories

To gauge respondents’ knowledge of calorie amounts in common food items, the survey asked for an estimate of the number of calories in a can of Coca-Cola (shown in Figure 3.1).

Figure 3.1. "What Is Your Estimate of How Many Calories Are in a Standard-Sized Can of Coca-Cola (12oz, or 355 mL)?"

The correct number is 140 calories for a can of Coca-Cola. We chose this particular soft drink as a commonly recognizable drink. Of course, other soft drinks may have slightly different values; Vanilla or Cherry Coca-Cola and Pepsi are slightly higher at 150 kcal; Dr. Pepper is 160 kcal and Mountain Dew is 170 kcal. As such, some responses may anchor to these values depending on how familiar the respondent is with a particular soft drink. In later analysis we analyze responses by allowing ranges within the true number. In the survey there were no cues or categories given; respondents had to enter a number, and there was no option for "do not know" (although it is possible to skip screens or to break off the survey early, resulting in no responses). Requiring a numeric response provided data for separating individuals who have some, if not exact, understanding of calorie amounts from those who have no or very little understanding.

Overall, the mean estimate by all respondents was 286.3 kcal and the median estimate was 230 kcal (Table 3.4). As shown, the variation in the responses was high, with a standard deviation of 248.3 kcal.

We created an indicator variable for "good knowledge" if the number provided fell within a narrow range around the true answer. We defined this as between 120 and 170 kcal, which is a buffer of plus or minus 20 kcal around the 140 (Coca-Cola) to 150 (Pepsi) kcal range, essentially indicating an informed response. We found that 3.9 percent of the respondents gave the correct value for Coca-Cola, 9.1 percent for Pepsi, and 8.8 percent gave a response in the good knowledge interval (Table 3.5).

We also calculated the number of individuals who gave a "reasonable" number but did not know the exact value. We used the interval 90 kcal (for the smallest bottle size of Coca-Cola) to 300 kcal (for a 24-ounce bottle of Pepsi). Of all the respondents, 46.9 percent fell into this category (Table 3.5).

Table 3.4. Respondents' Estimates of the Number of Calories in One 12-Ounce Can of Coca-Cola

Survey Question	Responses (N)	Mean	Median	Standard Deviation	Minimum	Maximum
How many calories are in one 12-oz can of Coca-Cola?	2,159	286.3	230.0	248.3	0.0	5,000.0

Table 3.5. Grouping Responses on Calorie Knowledge

Description	Respondents' Guesses for the Number of Calories in a 12-oz Can of Coca-Cola	Frequency	Percentage	Cumulative Percentage
Good knowledge	140	87	3.9	3.9
	150	203	9.1	13.1
	120 to 170	196	8.8	21.9
Reasonable knowledge	90 to 300	1,040	46.9	68.7
Little or no knowledge	Less than 90 or greater than 300	633	28.5	97.3
	No response	61	2.8	100.0
Total		2,220		

Height, Weight, and Self-Perceived Overweight

Self-reported respondent height and weight were used to calculate respondents' BMI, which is defined as the weight in kilograms divided by the square of the height in meters (World Health Organization, 2006). We excluded extreme values: height under 4 feet, height over 8 feet, and weight over 400 pounds, which set eight observations to a missing BMI (Table 3.6). We looked at each of those responses individually and they appear to be mistakes in reporting. There is virtually no change in means or standard deviations with or without these exclusions.

Table 3.6. Respondents' Self-Reported Physical Characteristics, With and Without Extreme Values

	Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Before dropping extreme values	Height (in)	2,152	67.1	4.3	36.0	105.0
	Weight (lb)	2,148	183.6	46.7	94.0	475.0
	BMI	2,146	28.6	6.7	11.2	74.9
After dropping extreme values	Height (in)	2,148	67.1	4.1	52.0	83.0
	Weight (lb)	2,145	183.2	45.6	94.0	400.0
	BMI	2,138	28.5	6.4	16.1	58.5

A separate question asked, "Do you consider yourself to be [underweight/about the right weight/overweight]. As shown, for most of the respondents, their perception about their own weight was in agreement with their BMI classification. Only in the overweight category is there about an even split between "overweight" and "about the right weight." Table 3.7 shows the comparison of BMI classification with the respondents' own perceptions.

Table 3.7. Adult Underweight, Overweight, and Obesity Status, BMI Classification Versus Self-Perception

	Respondents' Own Perception							
BMI Classification	Underweight (n, percentage)		About the Right Weight (n, percentage)		Overweight (n, percentage)		Row Total (n, percentage)	
Underweight (<18.5)	18	27	10	1	2	0	30	1
Normal (18.5 to 24.99)	40	60	569	57	41	4	650	30
Overweight (25 to 29.99)	4	6	384	38	361	34	749	35
Obese Class I (30 to 34.99)	2	3	33	3	366	34	401	19
Obese Class II (35 to 39.99)	0	0	8	1	175	16	183	9
Obese Class III (40+)	3	4	1	0	121	11	125	6
Row sum	67	100	1,005	100	1,066	100		
Total							2,138	

NOTE: Sample refers to the full sample of people who responded to the question "Do you consider yourself to be underweight, about the right weight, or overweight?"

Current Level of Hunger

It is very likely that a person's current level of hunger affects food choices. We reasoned that asking how hungry participants were when making a choice could provide a covariate that reduces the unexplained variance. The question was, "How hungry are you at the moment?" and the response scale ranged from 1 (not hungry at all) to 10 (extremely hungry). Table 3.8 gives the response frequencies.

Table 3.8. How Hungry Are You at the Moment?

Rating Scale	Number of Respondents	Percentage	Cumulative Percentage
1	152	7.00	7.00
2	255	11.75	18.75
3	358	16.49	35.24
4	310	14.28	49.52
5	344	15.85	65.36
6	263	12.11	77.48
7	233	10.73	88.21
8	174	8.01	96.22
9	43	1.98	98.20
10	39	1.80	100.00
Total	2,171	100.00	

NOTE: The rating scale ranged from 1 (“not hungry at all”) to 10 (“extremely hungry”).

Food Selection and Response Patterns

Table 3.9 shows the mean calories chosen by menu and the number of respondents selecting at least one item on the menu. Respondents could also indicate that they would not order anything from this restaurant. Some restaurant settings are more popular than others in terms of the number of respondents making a choice. In our experiment, individuals were least likely to order anything from the Movie Theater and the Coffee Shop menus. The highest average calories ordered were from the Movie Theater and the Mexican restaurant menus. There were a few very enthusiastic customers, ordering dozens of slices of pizza. Rather than set differing cut-offs in each menu, for consistency across menus we remove outliers by setting any orders over 2,500 calories to “missing.” This affected 82 out of 19,659 responses (0.4%): 36 in the Pizza Stand menu, 30 in the Pizza Restaurant menu, and 18 in the Mexican restaurant. The following tables reflect the sample after dropping these outliers.

Table 3.9. Mean Calories Selected, by Menu

Menu	kcal	Number of Respondents	Standard Error	Minimum	Maximum
Asian	559	2,034	5.72	70	1,220
Burgers	643	1,924	7.08	180	1,480
Mexican	941	1,808	8.38	240	2,430
Pizza restaurant	514	1,728	7.54	160	2,490
Pizza stand	583	1,939	7.94	160	2,480
Salad bar	568	1,914	3.20	355	820
Coffee shop	156	1,497	4.67	5	530
Ice cream parlor	344	1,953	3.95	100	850
Movie theater	978	1,322	13.97	275	2,200

NOTE: Only responses with food choices are shown. Selections over 2,500 kcal have been excluded.

The Pizza Restaurant and Pizza Stand essentially offer the same menu, although they were presented differently. The main substantive difference is price, resulting in 211 fewer customers in the Pizza Restaurant. The average number of slices ordered was slightly smaller in the Pizza Restaurant (1.8 in the Pizza Restaurant and 1.9 in the Pizza Stand).

The mean values of calories selected in this experiment are lower than those from restaurant studies. There are several possible reasons for that: First, people only chose items for themselves in this experiment (no sharing or orders for multiple people); second, most menus excluded drinks (a decision made for feasibility given time constraints); and finally, only the Pizza and Mexican menus allowed for ordering multiple items. For comparison, Dumanovsky et al. (2011) and Elbel et al. (2009) report means of 800 kcal in fast-food restaurants. Using data from a large coffee chain, Bollinger, Leslie, and Sorensen (2011) report average drink calories per transaction of 143 kcal, slightly below the average in our experiment. We have no comparable data for real transactions in the Ice Cream Parlor or Movie Theater restaurants.

Table 3.10 shows the average cost of selections made by customers.

Table 3.10. Price of Food Ordered

Menu	Cost (dollars)	Number of Respondents	Standard Error	Minimum	Maximum
Asian	8.00	2,034	0.00	7.59	7.59
Burgers	4.48	1,924	0.03	1.99	8.03
Mexican	7.35	1,808	0.07	2.49	21.03
Pizza restaurant	9.12	1,728	0.12	5.00	45.00
Pizza stand	3.85	1,939	0.05	2.00	16.00
Salad bar	7.94	1,914	0.01	7.59	8.45
Coffee shop	2.62	1,497	0.02	1.75	4.75
Ice cream parlor	2.94	1,953	0.02	1.79	5.59
Movie theater	10.04	1,322	0.10	2.75	18.25

NOTE: Only responses with food choices are shown. Selections over 2,500 kcal have been excluded.

Movie Theater customers had the highest average bill (and also the highest average calories ordered), but it had the fewest customers.

It is important to emphasize that not all respondents become "customers." The survey design allowed a respondent to either indicate that they would not buy anything from that restaurant ("no selection") or skip over a setting entirely without providing a response ("skip"). Table 3.11 breaks down the number of nonresponses by "no selection" and "skip" options. The number of skips remains fairly constant across menus, and represents a small portion of the respondent pool, ranging from 33 to 39. Many skips derive from incomplete interviews (the participant never reached the final screen). Out of 2,220 total final respondents, ten skipped all menus, 69 skipped some menus, and 2,141 answered all of the items. The number of no selections varies by menu, with the highest number for Movie Theater (860) and Coffee Shop (685). The Pizza Restaurant menu had twice the number of no selections as the Pizza Stand, despite having essentially the same menu items, suggesting that the price variation affected respondents' decisions on that menu.

Table 3.11. Number of "No Selection" and "Skip" Options Per Menu

Menu	No Selection	Skip
Asian	149	37
Burgers	257	39
Mexican	363	33
Pizza restaurant	426	36
Pizza stand	210	35
Salad bar	273	33
Coffee shop	685	38
Ice cream parlor	233	34
Movie theater	860	38

NOTE: We coded calories ordered as 0 for the no selection group and as missing for the skip group.

Menu Ratings and Satisfaction with Choice

After respondents made their selection, we asked three questions about their satisfaction with their choice and their rating of the menu:

- On a scale of 1 (least satisfied) to 5 (most satisfied), how satisfied are you with your choice?
- On a scale of 1 (poorest value) to 5 (greatest value), how do you rate the value of the available choices?
- On a scale of 1 (least healthy) to 5 (most healthy), how do you rate the healthfulness of the menu?

"I don't know" was also provided as an option, on the far right of the scale. Note that both participants who made a selection and those who opted out of a choice were asked these questions.

Table 3.12 shows the percentage of respondents who were not satisfied with their choice, considered the choices of poor value, and considered the menu unhealthy. We did this for both customers and the full sample.

In general, most people indicated being satisfied with their choice, and only 1.7 to 5.4 percent of respondents were not satisfied across menus and sample. The full sample, which includes respondents who explicitly did not order any food, generally rated menu choices as having poorer value or being less healthy than customers who did order food.

A minority of respondents found the menus had "poor value," with a range of proportions across menus. The Asian menu had the lowest assessment of poor value (6 to 7 percent of the sample) and the Movie Theater had the highest assessment of poor value (38 to 43 percent of the sample). Burgers, Ice Cream Parlor, Movie Theater, and Pizza Stand were rated the least healthy, whereas Asian, Mexican, and Salad Bar received much higher ratings of healthiness. A majority of both customers and the full sample rated the Movie Theater menu as unhealthy: 67.7 percent and 67.8 percent, respectively. Despite offering essentially the same items as the Pizza Stand, only 23.6 percent of the full sample considered the Pizza Restaurant menu unhealthy compared with 38.2 percent for the Pizza Stand, likely due to the framing of the Pizza Restaurant menu as "organic" and "locally sourced." Across all menus, a higher proportion of those in the full sample (including the no selection group) found items offered to be of poor value and unhealthy compared with the customer sample.

Table 3.12. Percentage of Respondents Dissatisfied, Rating Choices as Having Poor Value, and Rating Menu as Unhealthy

	Unsatisfied		Poor Value		Unhealthy Menu	
Menu	**Customers**	**Full Sample**	**Customers**	**Full Sample**	**Customers**	**Full Sample**
Asian	2.7	3.3	6.0	6.9	17.0	17.6
Burgers	2.7	3.4	8.4	11.2	45.3	47.4
Mexican	2.5	4.3	7.2	10.6	19.3	22.1
Pizza restaurant	2.5	4.4	13.2	17.9	21.8	23.6
Pizza stand	1.7	2.9	5.8	8.3	36.6	38.2
Salad bar	2.9	4.3	8.1	10.9	9.1	10.3
Coffee shop	2.1	3.8	12.6	17.1	23.9	25.4
Ice cream parlor	2.7	3.3	8.2	9.9	43.8	44.3
Movie theater	5.4	5.9	38.0	42.8	67.7	67.8

Chapter Four. Effect of Labeling Menus with Calorie Information

This chapter shows the main results of the online experiment across all menus and by individual menus. We discuss two different definitions of average labeling effects (among customers and among the full sample).

The primary analysis method is a direct comparison of groups by treatment assignment (menus with calorie information versus menus without calorie information) and estimates the average treatment effect among participants in the experiment. In addition, we use regression models, ordinary least squares (OLS) for continuous outcomes (such as calories chosen), and logistic regression for discrete outcomes (selection of any food). Regression models can provide better statistical precision than direct experimental comparisons by reducing the variance, but mainly are considered here as a sensitivity analysis. In analyses that pool across menus, standard errors are corrected for multiple responses by the same individual (clustering).

Labeling Effects Among Customers and Among the Full Sample

Table 4.1 pools all menus to calculate an overall average labeling effect on calories chosen. We present two comparisons: The first column calculates the effect for customers only, defined as individuals who made a (nonzero) selection on that menu. The second column calculates the effect among our full sample, including individuals who explicitly made no selection. Depending on the menu, this could be selecting “none of the above” or, in the Asian Fast-Casual menu, selecting both “would not order an entrée” and “would not order a side,” for which we have assigned 0 calories.

Customers who saw labeled menus selected items with 38 fewer calories (95 percent; CI: 26–49; p-value < 0.001). Among all survey respondents (the full sample), those who saw labeled menus selected items with 24 fewer calories (95 percent; CI: 12–35; p-value < 0.001).

Table 4.1. Average Calories Chosen, Pooled Across Menus (Calorie Information Label Versus No Label)

	Customers Only	Full Sample
No calorie information	604	493
Number of respondents	6,778	8,303
Standard error (mean)	5	5
Calorie information	566	469
Number of respondents	9,341	11,272
Standard error (mean)	4	4
Difference in calories ordered (no label−label)	38	24
p-value of difference	< 0.001	< 0.001
Upper confidence interval	26	12
Lower confidence interval	49	35

NOTE: Calorie means, standard errors, and confidence intervals are rounded to the nearest whole number.

The approach used for calculating average treatment effect in field studies that either collected receipts (e.g., Auchincloss et al., 2013; Krieger et al., 2013; Elbel, 2011) or used sales data (Bollinger et al., 2011) corresponds to that of the customer comparison. The full sample comparison, however, includes zero values for people who would not frequent this type of food outlet and who, in our experiment, indicated that they would not order anything. While the full sample approach is the correct one to use for calculating the average treatment effect for all participants, it may not be a relevant statistic: People who do not go to a restaurant will never see a menu (with or without a label) and will not buy any food. From this perspective, the comparison among customers may be more relevant than the comparison among the full sample.

But there is an additional consideration: If labeling menus with calorie information were to cause people to not order food, then analyzing choices only among customers (as with studies that collect receipts) would underestimate the effects of labeling. Therefore it is necessary to test whether labeling changes the probability of making a choice in this experiment.

We estimated a logit model for the probability of selecting a food. In this model, the outcome is an indicator of calories greater than 0, the explanatory variable is an indicator of any label, and menu dummies are included to account for the variation of menu types. We saw no evidence that labels affect the probability of making a choice: The odds ratio for any label was 0.96 (95-percent CI: 0.88–1.05), and the p-value for testing that the odds ratio differs from 1 was $p = 0.42$.

Next we examined whether the type of food outlet influences choices and whether the effect of labels differs by menu. Table 4.2 breaks down the label–no label comparison among customers by menu.

Across all menus, participants who viewed calorie-labeled menus chose fewer calories on average than those in the control group, though the magnitude and significance of the difference vary across restaurant settings. Customers of the Pizza Stand and Asian Fast-Casual settings had the largest reduction in calories (62 kcal), followed by Burgers, Mexican, and Salad Bar settings (25–31 kcal). The Pizza Restaurant change is small and statistically insignificant even at $p < 0.1$.

None of the changes in calorie selections among the nonmeal settings (Ice Cream Parlor, Movie Theater, Coffee Shop) was significant, and the Ice Cream Parlor and Coffee Shop changes were small in magnitude. The mean estimate in the Movie Theater menu was larger and not negligible substantively, but the variation in choices was so large that this effect does not become statistically significant. There are no studies of labeling in real ice cream parlor or movie theater settings, but there is one study on a coffee chain (Bollinger, Leslie, and Sorensen, 2011) that found no significant change in calories from drinks, only from foods.

Table 4.2. Average Calories Chosen, by Menu—Any Versus No Calorie Information Label (Customers)

	Asian	Burgers	Mexican	Pizza Restaurant	Pizza Stand	Salad Bar	Coffee Shop	Ice Cream Parlor	Movie Theater
No calorie information	601	657	956	524	624	585	163	346	996
Number of respondents	660	930	919	616	640	656	733	982	642
Standard error (mean)	10	10	11	12	15	6	7	6	20
Calorie information	539	631	925	507	562	559	150	342	960
Number of respondents	1,374	994	889	1,112	1,299	1,258	764	971	680
Standard error (mean)	7	10	12	10	9	4	6	6	20
Difference in calories ordered (no label−label)	62	26	31	17	62	25	13	4	36
P-value of difference	0.000	0.065	0.062	0.279	0.000	0.000	0.175	0.580	0.194
Upper CI	86	54	64	48	94	39	31	20	91
Lower CI	39	−2	−2	−14	28	12	−6	−11	−18

Table 4.3 shows the same for the full sample (which includes individuals stating they would not order anything). The average calories are smaller because it is now a weighted average including many zeros, the variances increase, and estimates become less precise. There are no large substantive changes; the largest calorie reductions still came from customers of the Asian and Pizza Stand settings (still significant at $p < 0.01$), and none of the label effects in the nonmeal settings was significant.

Table 4.3. Average Calories Chosen, by Menu—Any Label Versus No Label (Full Sample)

	Asian	Burgers	Mexican	Pizza Restaurant	Pizza Stand	Salad Bar	Coffee Shop	Ice Cream Parlor	Movie Theater
No calorie information	552	585	796	431	567	516	111	309	602
Number of respondents	719	1,045	1,104	749	704	744	1,075	1,100	1,063
Standard error (mean)	11	11	14	13	15	9	5	6	19
Calorie information	506	552	771	402	505	488	104	306	583
Number of respondents	1,464	1,136	1,067	1,405	1,445	1,443	1,107	1,086	1,119
Standard error (mean)	7	11	15	9	9	6	5	6	19
Difference in calories ordered (no label−label)	46	33	25	30	62	28	7	3	18
P-value of difference	0.0004	0.0329	0.2169	0.0586	0.0003	0.0070	0.2994	0.6831	0.4902
Upper CI	72	63	66	60	95	48	21	20	70
Lower CI	21	3	−15	−1	28	8	−7	−13	−34

NOTE: Calorie means, standard errors, and CIs are rounded to the nearest whole number.

Nevertheless, to make sure that we were not overlooking an important contextual effect, we repeated the test for selection by menu (logit model). Table 4.4 shows odds ratios indicating that respondents who saw labeled menus were less (odds ratio < 1) or more likely (odds ratio > 1) to make a selection. Estimates are close to one and none is significantly different from one. Four-point estimates are larger than one; five are smaller than one. Among the two furthest away from one, the odds ratio is less than one for the Asian menu and greater than one for the Pizza Restaurant menu, so we observed no pattern that relates calorie information to choice probabilities. Seeing no evidence that labeling affects the probability of making any choice in this experiment, we therefore focused on findings among respondents who made a selection (i.e., those in the customer group).

Table 4.4. Odds Ratios of No Selection, by Menu

	Asian	Burgers	Mexican	Pizza Restaurant	Pizza Stand	Salad Bar	Coffee Shop	Ice Cream Parlor	Movie Theater
Calorie information	0.733* (0.128)	1.155 (0.154)	0.995 (0.114)	1.220* (0.142)	1.124 (0.177)	1.096 (0.151)	0.962 (0.089)	0.986 (0.137)	0.984 (0.086)
Number of respondents	2,183	2,181	2,171	2,154	2,149	2,187	2,182	2,186	2,182

NOTE: Standard errors in parentheses. * $p < 0.1$.

Regular and Bold Labels

In four settings (Asian, Pizza Restaurant, Pizza Stand, and Salad Bar), two different label designs were tested: regular and bold. The regular design satisfies the FDA requirements; the bold label design uses increased font size and contrast to make the calorie information stand out more. In these four settings, the probability of assignment was 1/3 no label, 1/3 bold, and 1/3 regular label.

Overall, there was no statistically significant difference in calories chosen between bold and regular labels (Table 4.5). When stratifying by menu, there was a larger (but not statistically significant) difference in the Asian restaurant labels, where customers exposed to more-prominent labeling chose 24 fewer calories than in the regular label group (p-value = 0.07). But this result needs to be viewed in the context of all four restaurant settings. For the Pizza Restaurant, there was a similarly sized increase associated with the bold label (21), while the means were almost identical for regular versus bold labels in the remaining two settings. Together, these results indicate that the difference between these two types of labels had no effect on the calorie content of chosen menu items.

Table 4.5. Bold Versus Regular Calorie Labels

	Asian	Pizza Restaurant	Pizza Stand	Salad Bar
No calorie information	601	524	624	585
Number of respondents	660	616	640	656
Standard error (mean)	10	12	15	6
Regular calorie label	551	497	561	560
Number of respondents	695	555	658	661
Standard error (mean)	10	13	13	5
Bold calorie label	526	517	564	558
Number of respondents	679	557	641	597
Standard error (mean)	10	14	13	6
Control	601	524	624	585
P-value of difference (bold versus regular)	0.07	0.29	0.88	0.83

NOTE: Calorie means, standard errors, and CIs are rounded to the nearest whole number.

Framing Effects for Similar Menu Choices

The Pizza Restaurant and Pizza Stand menus offered the same ten types of pizza with identical calories, but the food options were framed or presented differently. The Pizza Restaurant's menu was presented as being healthier; its name was "Whole Earth" and its description of offerings included "fresh, organic, locally sourced ingredients." Conversely, the

Pizza Stand was intended to look more like a typical pizza-by-the-slice stand. Indeed, fewer people rated the Pizza Restaurant menu as offering unhealthy food compared with the Pizza Stand menu (see Table 3.12 in Chapter Three). Table 3.12 also shows that the Pizza Restaurant was rated as having “poor value” by twice the percentage of people in comparison with the Pizza Stand value rating (an absolute increase of 10 percentage points). Prices were different as well, which may have contributed to fewer customers for the Pizza Restaurant (see Table 3.10 in Chapter Three).

We have two conflicting hypotheses for why responses to labeling in terms of calorie choice could differ across these two pizza settings. The first hypothesis is that the “Whole Earth” wording used for the Pizza Restaurant increases the salience of “health” as a decisionmaking criterion relative to the cheaper Pizza Stand setting, encouraging respondents to select more-healthful and lower-calorie options. Conversely, this framing could create a “health halo” effect where customers ignore the calorie information altogether, assuming everything is healthy and lower in calories.

Empirically, the response to any calorie labeling of menus in the Pizza Stand is consistently large and statistically significant; the response to such labeling in the Pizza Restaurant (expensive, healthy, organic) is much smaller and never statistically significant. This holds whether we use just the comparison of label versus no label; a regression model that adds sociodemographic characteristics and health attitudes to improve precision of estimates; and if the comparison is for customers versus the full sample. Table 4.6 (excerpted from Table 4.2) shows the typical difference. While the results are suggestive of a difference in labeling effect between the two styles of Pizza Restaurant, we cannot conclude that this is so, because the confidence intervals of the label effect overlap with those of the Pizza Stand.

Table 4.6. Framing Effects for Pizza Restaurant and Pizza Stand Menus, Average Calories Chosen

	Pizza Restaurant	Pizza Stand
No calorie information	524	624
Any label	507	562
Difference (calories−any label)	17	62
Upper CI	48	94
Lower CI	−14	28

NOTE: Mean calories are rounded to whole values.

Regression Models to Improve Statistical Power

While a direct comparison of treatment and control mean values is a valid analysis in experiments, regression models can improve the precision of estimates by reducing the unexplained variance in the model. In addition, a regression model serves as a sensitivity analysis because the estimates should not change substantially in magnitude compared with the previous tables. If the randomization succeeded in balancing individual characteristics across treatment and control groups (as we have shown in the previous section to be generally the case), then point estimates should not change substantively when more controls are added.

The socioeconomic and demographic variables we include as controls are race, income (continuous), gender, age, years of education, employment status, and number of people living in the household. Three additional health variables included are BMI (calculated from reported weight and height), hunger at the time of taking the survey (rated on a scale of one to ten with one meaning stuffed and ten meaning starving), and a binary "any health-conscious" variable equal to one if respondents rated any of the following three food characteristics—"keeps me healthy," "helps me control my weight," "is low in calories"—as "very important" to them. We use the binary variable for health-consciousness rather than the continuous factor in Table 4.7 because it makes the coefficient easier to interpret. BMI is a continuous variable and we drop outliers.

Table 4.7 provides the full regression analysis. The estimated effects of labeling are virtually identical to the direct (customer) comparison discussed above, as Table 4.8 shows.

Table 4.7. Estimated Effects of Providing Calorie Information on Calories Chosen, Controlling for Sociodemographic and Health Covariates

Variables	Asian	Burgers	Mexican	Pizza Restaurant	Pizza Stand	Salad Bar	Coffee Shop	Ice Cream Parlor	Movie Theater	Pooled
Calorie information label	−56.534***	−26.567**	−34.072**	−13.833	−60.173***	−25.331***	−13.557	0.078	−38.017	−30.412***
	(11.786)	(13.085)	(16.281)	(15.585)	(16.063)	(6.435)	(9.113)	(7.717)	(25.870)	(4.771)
African-American	−10.200	8.868	118.485***	18.802	41.397	16.419	47.472***	9.654	92.053**	36.768***
	(19.962)	(23.196)	(29.733)	(28.143)	(27.697)	(11.208)	(17.191)	(13.711)	(42.380)	(11.949)
Hispanic	10.009	−0.179	35.640	9.689	38.031	−17.605*	35.119**	−13.384	39.783	14.317
	(17.308)	(20.846)	(25.774)	(23.990)	(23.875)	(9.876)	(13.991)	(12.185)	(39.015)	(10.687)
White (reference category)										
Income	−0.069	−0.201	−0.343**	−0.087	−0.599***	−0.133**	−0.214**	0.059	−1.101***	−0.271***
	(0.111)	(0.132)	(0.162)	(0.147)	(0.152)	(0.062)	(0.090)	(0.077)	(0.266)	(0.060)
Male	54.194***	127.950***	133.136***	79.487***	156.672***	52.426***	−44.942***	42.107***	137.333***	82.686***
	(11.344)	(13.421)	(16.820)	(15.396)	(15.573)	(6.287)	(9.411)	(7.950)	(26.820)	(6.326)
Age	−2.747***	−5.386***	−0.848	−0.963	−2.208***	0.506*	−1.071***	−1.174***	−4.706***	−1.994***
	(0.492)	(0.582)	(0.722)	(0.658)	(0.669)	(0.272)	(0.403)	(0.340)	(1.143)	(0.278)
Years of education	−3.853	−7.335**	−16.122***	−14.326***	−18.385***	−8.516***	−4.019*	−2.744	−40.360***	−11.812***
	(2.894)	(3.435)	(4.310)	(3.968)	(3.987)	(1.598)	(2.410)	(2.023)	(6.866)	(1.690)
Employed	−14.814	−9.037	−33.400*	−9.782	−19.433	−4.157	−1.193	−0.962	−0.348	−12.194*
	(12.948)	(15.305)	(19.143)	(17.469)	(17.760)	(7.154)	(10.535)	(9.012)	(30.245)	(7.306)
Number of people in household	−2.046	−5.218	18.050***	−3.701	9.078	2.185	6.896*	0.885	54.172***	8.468***
	(4.640)	(5.485)	(6.891)	(6.471)	(6.386)	(2.639)	(3.821)	(3.221)	(10.076)	(2.556)
BMI	2.632***	5.040***	1.571	4.366***	4.262***	1.333***	1.395*	2.421***	3.286	2.854***
	(0.885)	(1.045)	(1.317)	(1.211)	(1.198)	(0.494)	(0.721)	(0.614)	(2.012)	(0.499)
Hunger	4.715*	11.827***	15.421***	13.997***	12.674***	1.019	3.909*	7.821***	13.813**	9.388***
	(2.514)	(2.995)	(3.771)	(3.435)	(3.476)	(1.421)	(2.086)	(1.755)	(5.905)	(1.472)
Any health-conscious	−114.602***	−148.869***	−34.492**	−33.852**	−72.787***	−57.928***	−27.669***	−70.589***	−100.010***	−74.705***
	(11.655)	(13.991)	(17.325)	(15.922)	(16.194)	(6.481)	(9.735)	(8.273)	(27.887)	(6.665)
Number of responses	1,980	1,878	1,765	1,691	1,893	1,870	1,468	1,904	1,298	15,747
R-squared	0.100	0.179	0.089	0.052	0.127	0.121	0.085	0.083	0.173	0.828

NOTE: Standard errors in parentheses. Pooled regression includes menu fixed effects and clustered standard errors.
*** p < 0.01; ** p < 0.05; * p < 0.1.

Table 4.8. Label Effects on Calories Chosen from Unadjusted Mean Comparison Versus Regression Model

Model	Asian	Burgers	Mexican	Pizza Restaurant	Pizza Stand	Salad Bar	Coffee Shop	Ice Cream Parlor	Movie Theater
Mean comparison, from Table 4.2	62	26	31	17	62	25	13	4	36
Regression from Table 4.7	57	27	34	14	60	25	14	0	38

Respondent Characteristics Associated with Calorie Choices Among Customers

A number of socioeconomic, demographic, and health variables are significantly associated with calorie choices. The regression model only considers the direct effect on calories ordered, not any interaction of sociodemographic variables with seeing calorie labels or not. (We consider consumer heterogeneity in response to labeling in the next chapter.)

Men ordered 42 to 137 more calories than women across all menus, with the exception of the Coffee Shop menu, from which men ordered fewer calories than women (p-value < 0.01 for all male-female comparisons).

Older customers generally ordered fewer calories, as did more highly educated customers. Education had a particularly large effect on calories ordered in the Movie Theater and from the Pizza Stand menu. There was no consistent difference in how people of different races or ethnicities ordered food across the nine menus, although African-Americans ordered significantly more calories in three settings (Mexican, Coffee Shop, and Movie Theater).

Higher BMI was associated with higher-calorie choices in most settings. People who reported being hungrier while filling out the survey ordered more calories (as hunger was rated on a ten-point scale, the difference in calories ordered between those who were extremely hungry and not hungry was 150 kcal for the Mexican menu and 130 kcal for the Pizza Stand menu).

Lastly, for the health-consciousness variable, those who considered it very important that food "keeps me healthy," "helps me control my weight," or "is low in calories" selected significantly fewer calories in any setting, with the largest effect in the Burgers restaurant (−149 calories).

Satisfaction with Menu Selection and Restaurant Rating

An argument sometimes made against labeling menus with calorie information is that showing calorie information may reduce people's satisfaction from eating out, because knowing the calories would either compel them to switch away from their preferred choice or reduce their enjoyment from the meal. Could either switching to an otherwise less-desired option or knowing information reduce satisfaction? Our survey elicited responses on satisfaction with each food choice participants made, including those who made no selection (i.e., from the full sample). After making a selection from each menu, respondents were asked, "On a scale of 1 (least satisfied) to 5 (most satisfied), how satisfied are you with your choice?"

We estimated an ordered logit (allowing for clustered responses by respondents). Labeling overall had no effect on satisfaction with choices (Table 4.9). Individual menus, however, did. People were particularly satisfied with their choices for the Ice Cream Parlor, Coffee Shop, and Pizza Stand (the Salad Bar is the reference category). Customers indicated that they were not very satisfied with their selection in the Movie Theater or the Burgers restaurant, relative to the

Salad Bar menu. Note that the satisfaction with choices increased in the full study population; in fact, it even reverses for Movie Theater.

Table 4.9. Effect of Labeling on Satisfaction with Choice

Variables	Customers	Full Sample
Any label	1.027	1.054
	(0.040)	(0.037)
Menu fixed effects		
Asian	1.257***	1.260***
	(0.089)	(0.084)
Burgers	0.896	0.986
	(0.064)	(0.066)
Mexican	1.063	1.058
	(0.078)	(0.071)
Pizza restaurant	1.068	1.128*
	(0.079)	(0.076)
Pizza stand	1.301***	1.307***
	(0.094)	(0.088)
Coffee shop	1.970***	2.046***
	(0.159)	(0.145)
Ice cream parlor	1.689***	1.685***
	(0.124)	(0.116)
Movie theater	0.857*	1.323***
	(0.070)	(0.091)
Salad bar	(reference category)	
Observations	15,929	18,863
Number of respondents	2,188	2,197

NOTE: Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Tables 4.10 and 4.11 show results from ordered logit regressions for ratings of the value of restaurant meals and perceived healthfulness, respectively. There is no observed effect of labeling affecting ratings on either value or perceived healthfulness. For individual menus, compared with the Salad Bar menu, the Asian restaurant and Pizza Stand are considered of good value, the Pizza Restaurant is considered of poor value, and the Movie Theater is considered of very poor value.

Table 4.10. Effect of Labeling on Value of Menu

Variables	Customers	Full Sample
Any label	1.039	1.015
	(0.035)	(0.031)
Menu fixed effects		
Asian	1.559***	1.624***
	(0.097)	(0.096)
Burgers	1.147**	1.110*
	(0.073)	(0.065)
Mexican	1.233***	1.163**
	(0.079)	(0.069)
Pizza restaurant	0.705***	0.659***
	(0.046)	(0.039)
Pizza stand	1.953***	1.836***
	(0.125)	(0.110)
Coffee shop	1.003	0.897*
	(0.069)	(0.055)
Ice cream parlor	1.023	1.090
	(0.064)	(0.064)
Movie theater	0.152***	0.166***
	(0.011)	(0.010)
Salad bar	(reference category)	
Observations	15,817	18,509
Number of groups	2,186	2,194

NOTE: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Value of choices in the menus is rated on a scale of 1 (poorest value) to 5 (greatest value).

For the healthfulness of menus, odds ratios are all smaller than one because respondents considered the Salad Bar menu as the healthiest relative to the other menus used in this experiment. The Movie Theater menu was rated by far the least healthy, followed by Ice Cream Parlor and Burgers. In the disaggregated analysis for each menu, we also did not find that labeling affected satisfaction.

Taken together, we conclude that there is no evidence that providing people with calorie-labeled menus has any effect on consumer satisfaction, perception of restaurant value, or perception of menu healthfulness.

Table 4.11. Effect of Labeling on Perceived Healthfulness

Variables	Customers	Full Sample
Any label	1.027	1.037
	(0.034)	(0.031)
Menu fixed effects		
Asian	0.497***	0.533***
	(0.031)	(0.031)
Burgers	0.118***	0.127***
	(0.008)	(0.008)
Mexican	0.369***	0.365***
	(0.024)	(0.021)
Pizza restaurant	0.338***	0.344***
	(0.022)	(0.020)
Pizza stand	0.141***	0.157***
	(0.009)	(0.009)
Coffee shop	0.317***	0.332***
	(0.022)	(0.020)
Ice cream parlor	0.101***	0.122***
	(0.007)	(0.007)
Movie theater	0.023***	0.029***
	(0.002)	(0.002)
Salad bar	(reference category)	
Observations	15,805	18,607
Number of groups	2,187	2,196

NOTE: Standard errors in parentheses. *** p <0.01, ** p < 0.05, * p < 0.1. Healthfulness of choices in menu is rated on a scale of 1 (least healthy) to 5 (most healthy).

Effect of Price Variations on Calories Chosen

A second randomization used in this study, uncorrelated with labeling, was price variation in four menus (Burgers, Ice Cream Parlor, Movie Theater, and Mexican). The intention was to break an otherwise fixed relationship between calories and prices. We created three sets of variables for prices, which could be described as "regular," "calorie tax," and "small-portion subsidy." The "calorie tax" in the Burgers and Mexican menus increased prices by 20 percent on items that were 900 kcal or higher. The small-portion subsidy variable decreased prices by 20 percent for items that were 500 kcal or lower. For the Movie Theater and Ice Cream Parlor menus, the calorie tax variable added $1 to large items and the small-portion subsidy variable subtracted $1 for small items. Table 4.12 shows results from regressions of calories chosen in the four menus on indicators for the price treatment seen, where the coefficients presented are relative to the base category of regular prices. For three out of four menus, calories chosen increased in both the small-portion subsidy and calorie tax variables, relative to regular prices. For the Mexican setting, calories chosen decreased relative to regular prices. However, none of these coefficients are statistically significant at conventional levels (i.e., $p < 0.05$).

Table 4.12. Effect of Price Treatment on Calories Chosen

Variables	Burgers	Ice Cream Parlor	Movie Theater	Mexican
Price—health subsidy	3.105	8.009	10.582	−11.669
	(17.319)	(9.621)	(34.273)	(20.645)
Price—calorie tax	13.199	6.656	8.570	−15.362
	(17.546)	(9.721)	(34.033)	(20.423)
Observations	1,924	1,953	1,322	1,808

NOTE: Numbers are average change in calories relative to regular prices. Standard errors are in parentheses.

Chapter Five. Heterogeneity in Responses

People respond to calorie-labeled menus in different ways, and an estimated average treatment effect is just that—an average. "Calorie-conscious" consumers who are aware of the calorie content of their diets may respond to labeling by reducing their (already small) portions. Conversely, "value-conscious" consumers, who care more about the amount of food purchased per dollar, may increase their portions. Due to the differences in people's responses, the average change could be close to zero. Even if no group increases calories ordered, there may be subgroups of customers who are more or less responsive to calorie information. As we discussed in the previous chapter, most empirical studies that examine the effect of calorie-labeled menus on food choices only estimate an average treatment effect.

In contrast, we begin this chapter by analyzing the distribution in calories chosen descriptively and by using quantile regression. We then revisit predictors of calories chosen, restaurant choice, and label use and test whether interactions with those predictors reflect differential labeling effects.

Distribution of Calorie Choice With and Without Calorie Labels

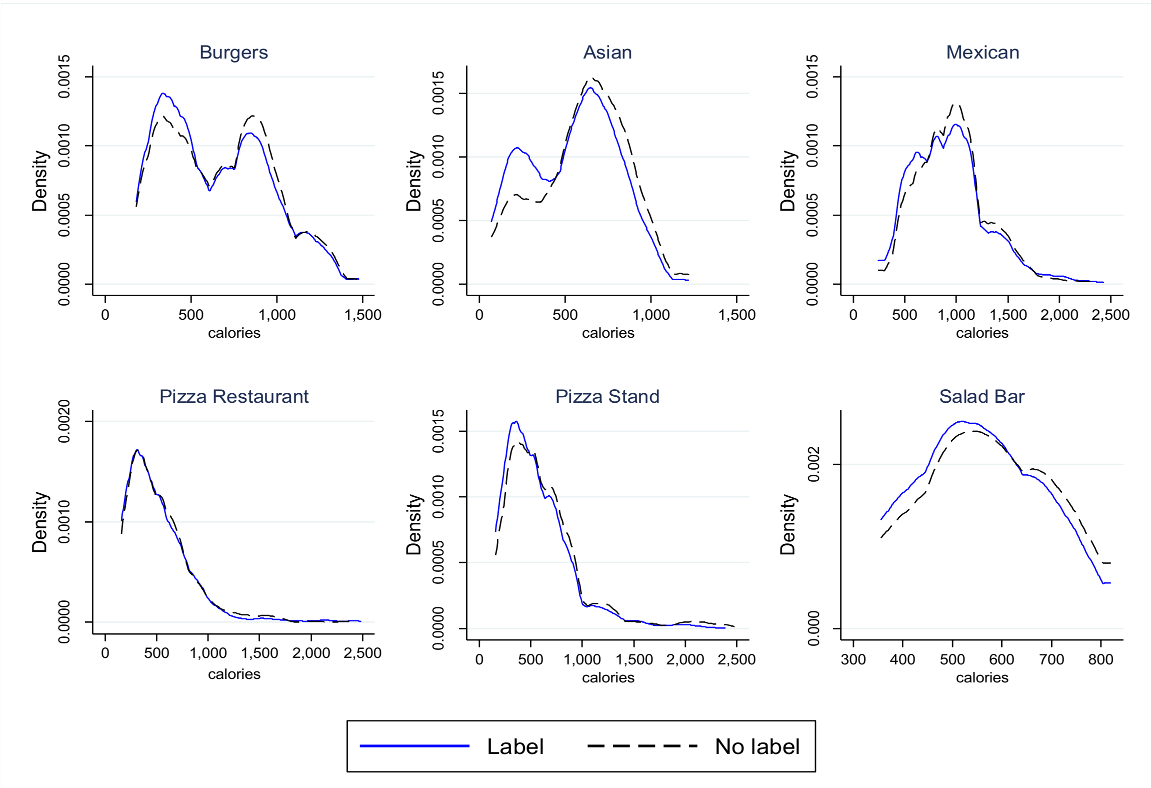
The (smoothed) distributions of calories ordered in restaurants are shown in Figure 5.1 for standard restaurant settings and Figure 5.2 (for the Movie Theater, Ice Cream Parlor, and Coffee Shop settings). If the average treatment effect were the representative response for all individuals, then distributions would shift left with the group of participants who saw menus with calorie labels compared with the no label control group. The dashed black line shows the density[4] of calorie choices without labeling and the blue line shows calorie choices with labeling. The top row of Figure 5.1 shows the distribution for the Burgers, Asian, and Mexican menus, and the shape of each distribution is different. The mode in the distribution without labeling becomes smaller, and instead there is a new peak at a lower value. There is little change at the top end of the distribution.

The second row plots the distribution for the Pizza Restaurant, Pizza Stand, and Salad Bar. At both the Pizza Restaurant and Pizza Stand, the most commonly ordered number of slices was two, so we see the distribution in the calorie peak corresponding to two slices, although the calories ordered vary more given the range of calories per slice. The average label effect was not statistically significant for the Pizza Restaurant, and we also see no change in the distribution. In contrast, for the Pizza Stand, the calorie distribution becomes more peaked (a higher mode). The

[4] For discrete distributions, the corresponding concept is *probability*. But when drawing distribution for a continuous range, the technical term is *density*. In the same way that probabilities add to one, the integral over the range adds to one.

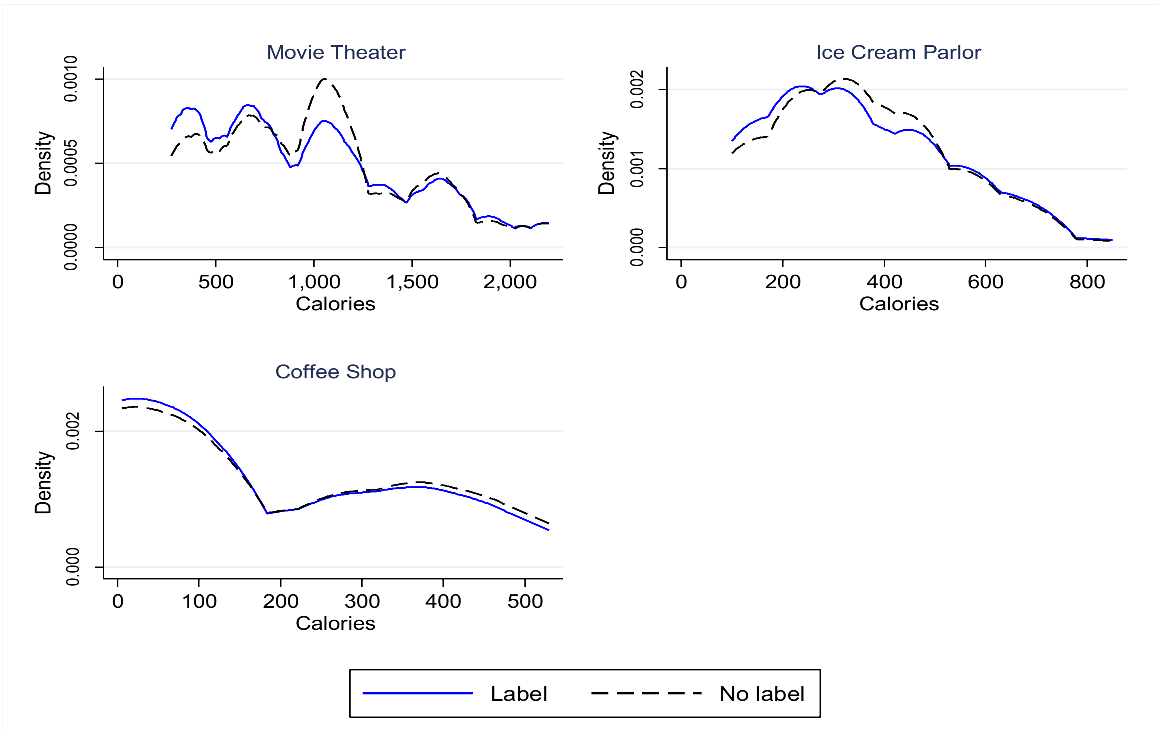
reason for this shift for the Pizza Stand is because an additional 4 percent of customers ordered only one or two slices (rather than three or more) when given calorie information. The distribution of the calories ordered in the Salad Bar looks as if it is shifted to the left throughout the full range.

Figure 5.1. Distribution of Calories by Menu Type, Meal-Type Restaurant Settings



There was no significant average label effect for the three nonstandard food outlets in Chapter Four. Graphing the full distribution qualifies this view slightly. In the Movie Theater menu, there was a noticeable drop in the middle of the distribution, resulting in a new mode on the lower-calorie side of the distribution. However, there was also a small increase among higher-calorie selections. The smoothing method is needed for menus with many possible calorie choices. It is less useful when there are just a few discrete possibilities, as with the Ice Cream Parlor menu. We want to be consistent for all menus; therefore, all graphs are smoothed in the same way. However, for the Ice Cream Parlor, showing the probability for the few discrete calorie possibilities would be clearer. For the Ice Cream Parlor menu, the mode both with and without calorie labeling in the raw data is actually at 350 kcal (which is not clear in the smoothed graph). The share of customers ordering less than 350 kcal increases from 37 percent to 43 percent with labels, but the share of customers ordering 450 kcal or more also increases from 31 percent to 33 percent, offsetting enough to make the average calorie change insignificant. The calorie distribution in the Coffee Shop menu was not affected by labels and the mean is largely driven by the modal response, with 50 percent of customers selecting only plain coffee.

Figure 5.2. Distribution of Calories, Nonmeal Food Outlets

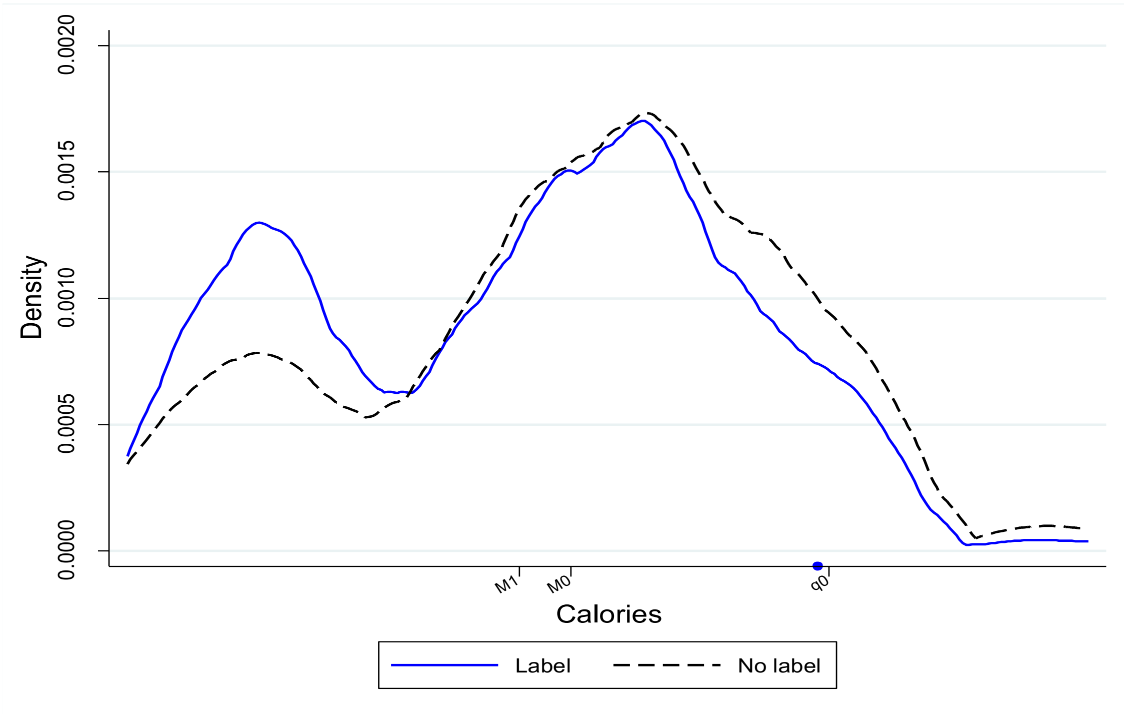


Quantile Regression

Quantile regression is a tool used to model the conditional distribution of calories chosen in each menu setting. It provides a more formal statistical test of whether the effect of labeling differs at various amounts of calories ordered, allowing us to answer the questions "Is the effect of calorie-labeled menus constant along the distribution of calories that participants chose?" "For high-calorie consumers, is the effect of labeling different than those found at the mean and median?" and "What about for low-calorie consumers?"

Quantile regression allows us to estimate differences at various points of the distribution between the groups with and without calorie information. Figure 5.3 shows the smoothed distributions for the Asian menu. The M0 and M1 points mark the means from the two distributions and the q0 and blue dot points mark the 90th percentile from the two distributions, where 1 refers to the labeling group and 0 refers to the control group (no calorie information). The average treatment effect is the difference between M1 and M0. On this graph, the horizontal distance between the blue dot (representing the 90th percentile for the label group) and q0 is smaller than the difference at the means—the quantile treatment effect at the 90th percentile is −10 calories compared with −62 calories at the means.

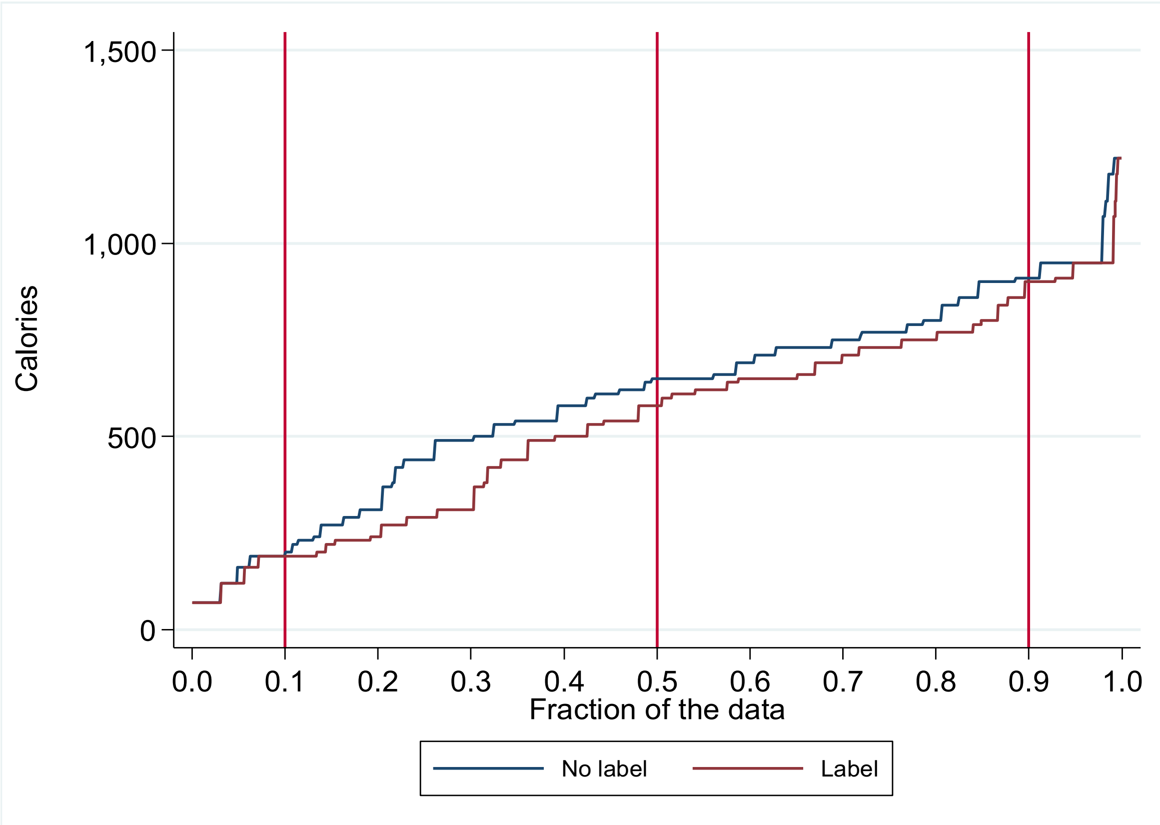
Figure 5.3. Asian Menu Distributions, Means and 90th Quantiles



NOTE: The blue dot marks the 90th percentile for the label group, and is used instead of text for clarity.

Another way of visualizing this is to plot the cumulative distribution function (CDF) by label and control, as shown for the Asian menu in Figure 5.4. For the label and control groups, the CDF shows the calories corresponding to the cumulative area under the distributions: The x-axis shows the quantiles, or fractions of the data, and the y-axis shows the calories corresponding to these quantiles. At the median (50th percentile, middle vertical red line), the difference between the label and control groups is 70 calories, while at the 90th percentile the difference is 10 calories, as previously found.

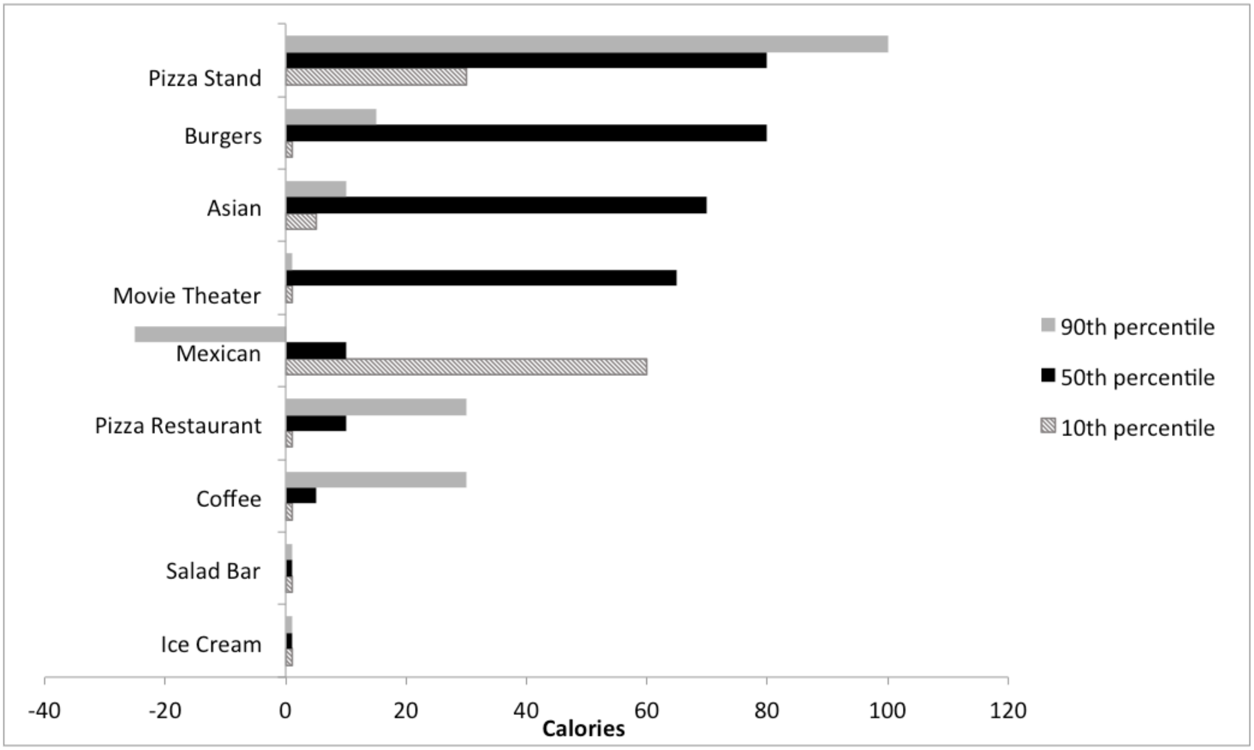
Figure 5.4. Asian Menu, Cumulative Distribution Function, by Labeling



We take the difference in calories chosen in all nine menus between the label and control groups for the 10th, 50th, and 90th percentiles and plot this difference in Figure 5.5. Note that some menus offer fewer choices than others, especially the Ice Cream Parlor (only nine discrete possibilities) and the Salad Bar (12 choices). These are more problematic for estimating differences at percentiles; because they are not continuous, the difference between labeling and control may be positive at one percentile point, but zero at a nearby percentile (since the lines overlap horizontally due to the discrete number of choices). Therefore, we find that the difference at the 10th, 50th, and 90th quantiles is zero for both the Ice Cream Parlor and Salad Bar.

For the remaining seven menus, which have a continuous calorie distribution, the 50th percentile has a larger treatment effect than the 10th percentile for six of the menus, and a larger effect than the 90th percentile for four of the menus. For Mexican, there is actually a reverse, in that those in the labeling group order more calories at the 90th percentile (which means that the difference of “no label” minus “label” is negative).

Figure 5.5. Quantile Differences, at the 10th, 50th, and 90th Percentiles: Changes in Calories Ordered



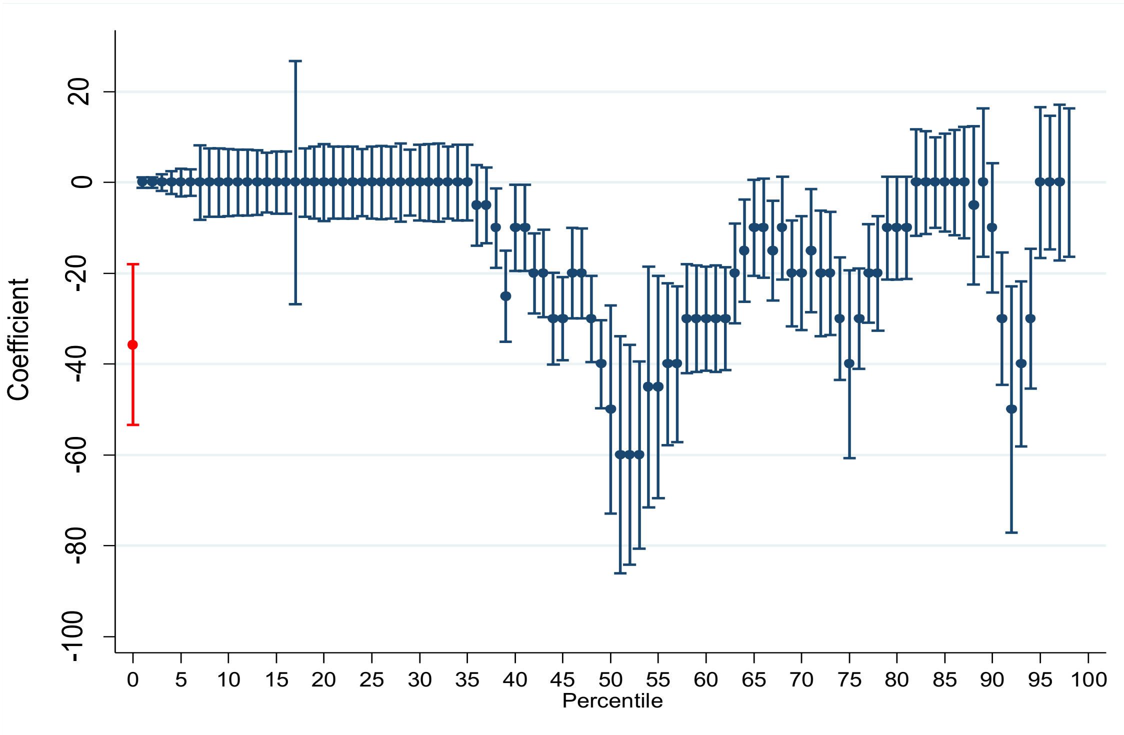
NOTE: Zero is displayed graphically as one for clarity, so that it is apparent on the graph.

We implement quantile analysis in a regression framework for a statistical test across all menus, except for the Ice Cream Parlor and the Salad Bar.

Figure 5.6 presents a visual summary of the pooled quantile regression results for those seven menus. For each percentile, we estimate the quantile treatment effects and show coefficients with 95-percent CIs, as well as the OLS coefficient estimates for the entire sample together (marked in red).

There is virtually no labeling effect at the lowest percentiles, from zero to 35, as none of the coefficients at these points are statistically different from zero. The largest decline in calories chosen occurs around the median; from the 45th to 55th percentiles, the calorie decline is between 40 and 60, with the largest labeling effect at the 50th to 53rd percentiles (−60). There are smaller-magnitude declines around the 75th and 90th percentiles that are about one-half to two-thirds the magnitude of the treatment effect around the median (−20 to −40, compared with −60).

Figure 5.6. OLS (Average) and Quantile Treatment Effects, Excluding the Ice Cream Parlor and Salad Bar



NOTE: OLS estimate is shown in red.

Who Are the Customers? Selection by Restaurant Type

In this study, the provision of calorie-labeled menus does not affect whether or not a respondent makes a food choice on tested menus (see Chapter Four), but different menus are likely to appeal to different types of participants. People who never frequent a restaurant similar to the one represented by the Burgers setting may be regular customers of restaurants featuring menus like our Salad Bar. Selection effects become stronger when fewer people become customers, as for the Movie Theater menu. Customers in those settings may have more-intense preferences that are not affected by price or labels. And if preferences for food are strong, then even poor value, unattractive menus, or unhealthiness will not alter choices, and neither would calorie labels.

In this section, we first explore descriptively the participant characteristics that are associated with the self-reported measure of how frequently a participant visits a certain type of food outlet. At the end of each menu, we asked, "In a typical month, how often do you go to a restaurant of this type?"[5] We estimated the frequency of visits by menu and by respondent characteristics: the "any health-conscious" variable,[6] race, gender, and education. We present these results in a series of graphs. Second, we assessed whether frequency of visit is associated with our main measure of being a customer for a restaurant (whether participants provided a response to that menu or selected out of that menu [a binary dependent variable equal to one if participants chose any food, and equal to zero if they did not]). We then estimated logit regression models for being a "customer" on individual characteristics in a series of bivariate regressions for gender, race/ethnicity, age, college education, income greater than $75,000 per year, and the "any health-conscious" variable.

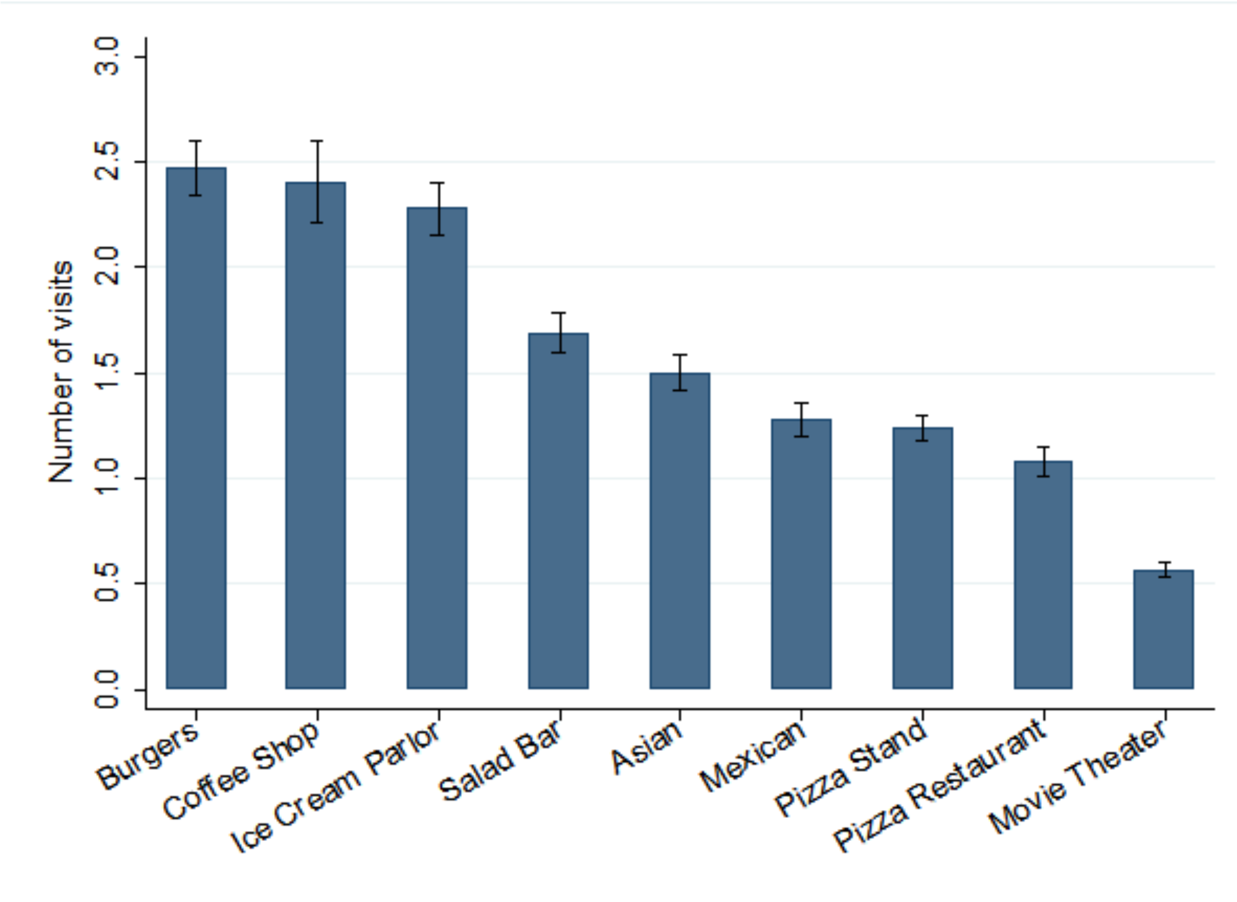
Figure 5.7 shows the mean number of visits in a typical month and 95-percent CIs in our study sample. Figure 5.8 shows the mean frequency, by sociodemographic variables. The Burgers and Coffee Shop outlets have the highest mean frequency of visits (at between two and three times per month) and the Movie Theater has the lowest frequency (about once every other month). In this study, being health-conscious is associated with visiting the Burgers outlet less often. Health-consciousness is also associated with visiting the Pizza Stand less often, but this is reversed for the Pizza Restaurant, which is frequented more by health-conscious participants. For some food outlets, race/ethnicity is also statistically significantly associated with frequency of visit; Hispanics and African-Americans in our sample visited Burger outlets more than whites and people who selected "other" for the race/ethnicity question. Relative to other racial/ethnic groups, whites visited the Ice Cream Parlor and Movie Theater, Mexican, and Pizza Stand outlets less frequently.

---

[5] For the Movie Theater and Ice Cream Parlor, we asked slightly different questions. For the Movie Theater, the question was in two parts: "How often in a typical month do you go to the movies?" followed by "When you go to the movies, how often do you order something from the snack bar? (Every time I go/ every other time/ one in three times/ less than one in three times)." Here, we code visit frequency as a multiplication between the two parts (e.g., for someone who reports going once a month, and then answers "every other time," the frequency is one-half). For the Ice Cream Parlor, we asked for the frequency of visits in a typical month in both a summer month and in a winter month. For our analysis we consider summer-month frequency, for simplicity.

[6] If an individual rated any of three items ("is low in calories," "keeps me healthy," "helps me control my weight") as very important, the individual was categorized as health-conscious.

Figure 5.7. Number of Visits in a Typical Month, by Menu



Males reported a higher average frequency of visits compared with females across all food outlets except the Ice Cream Parlor and the Movie Theater, though this difference is only statistically significant for the Salad Bar outlet. Having a college degree is also associated with less frequency of visits for Burgers, Pizza Stand, Ice Cream Parlor, and Movie Theater, and more-frequent visits for Asian, Pizza Restaurant, and Coffee Shop (though the Asian and Coffee Shop 95-percent CIs slightly overlap). See Figures 5.8 through 5.11 for visits by menu and sociodemographic characteristics.

Figure 5.8. Number of Visits in a Typical Month, by Menu and Health-Consciousness

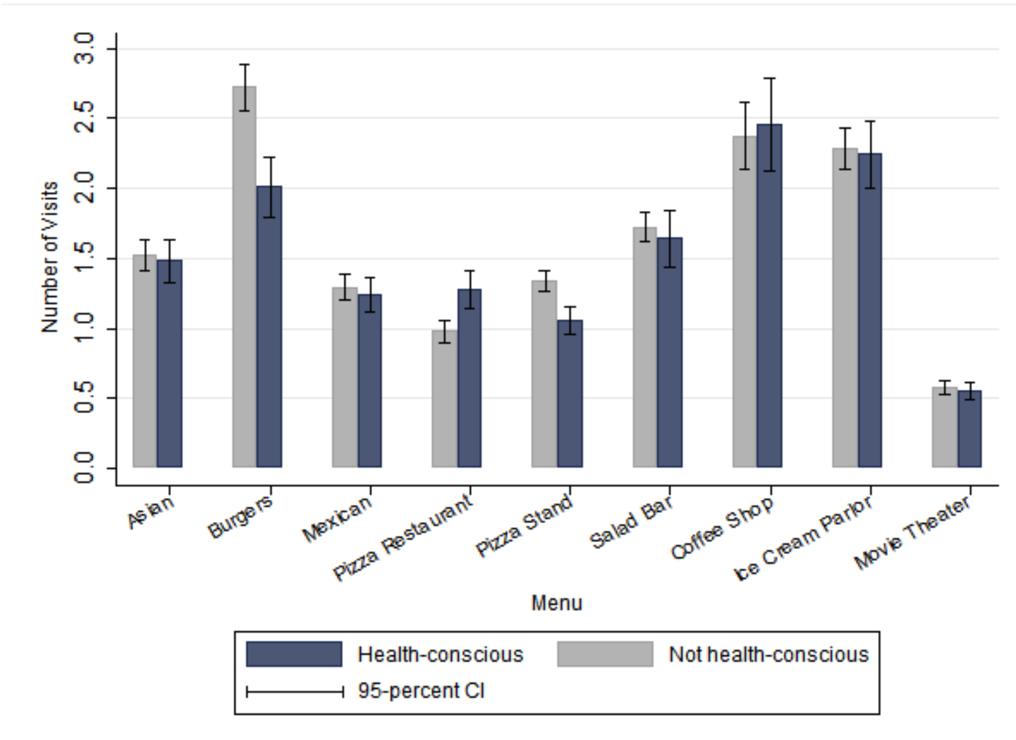


Figure 5.9. Number of Visits in a Typical Month, by Menu and Race/Ethnicity

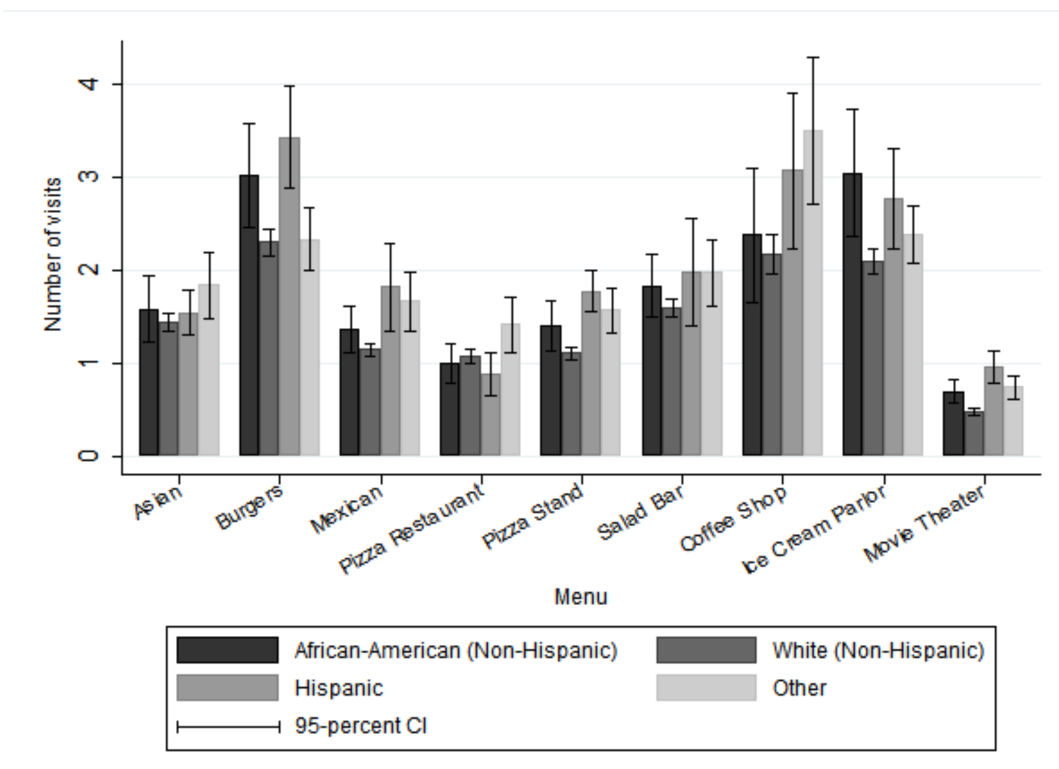


Figure 5.10. Number of Visits in a Typical Month, by Menu and Gender

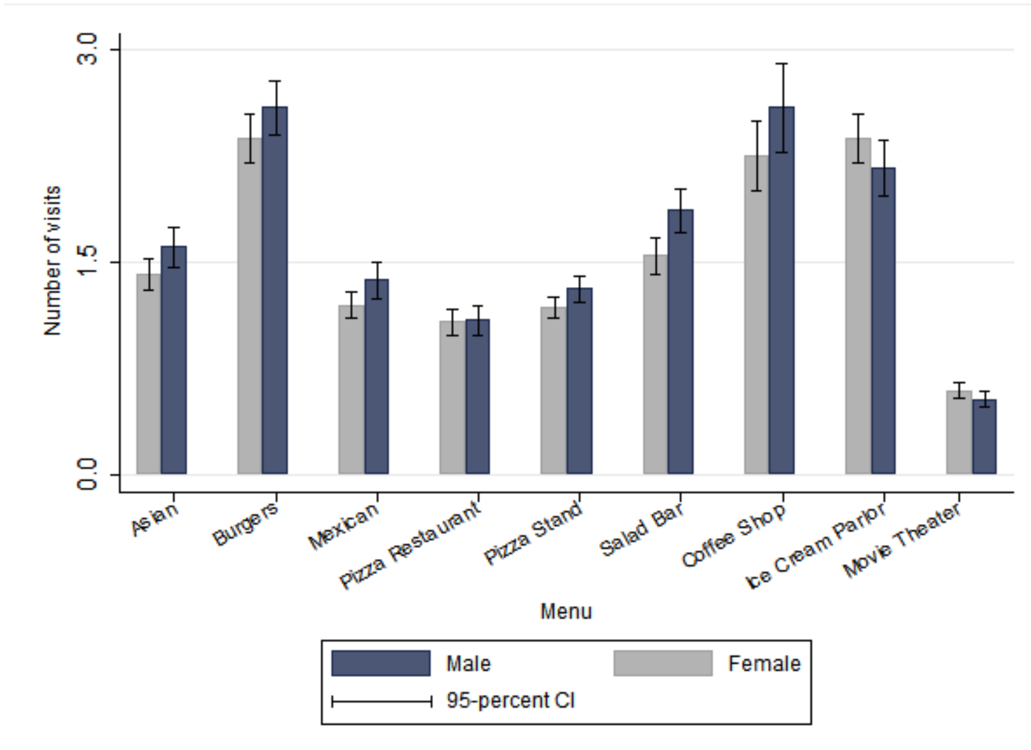


Figure 5.11. Number of Visits in a Typical Month, by Menu and Education Level

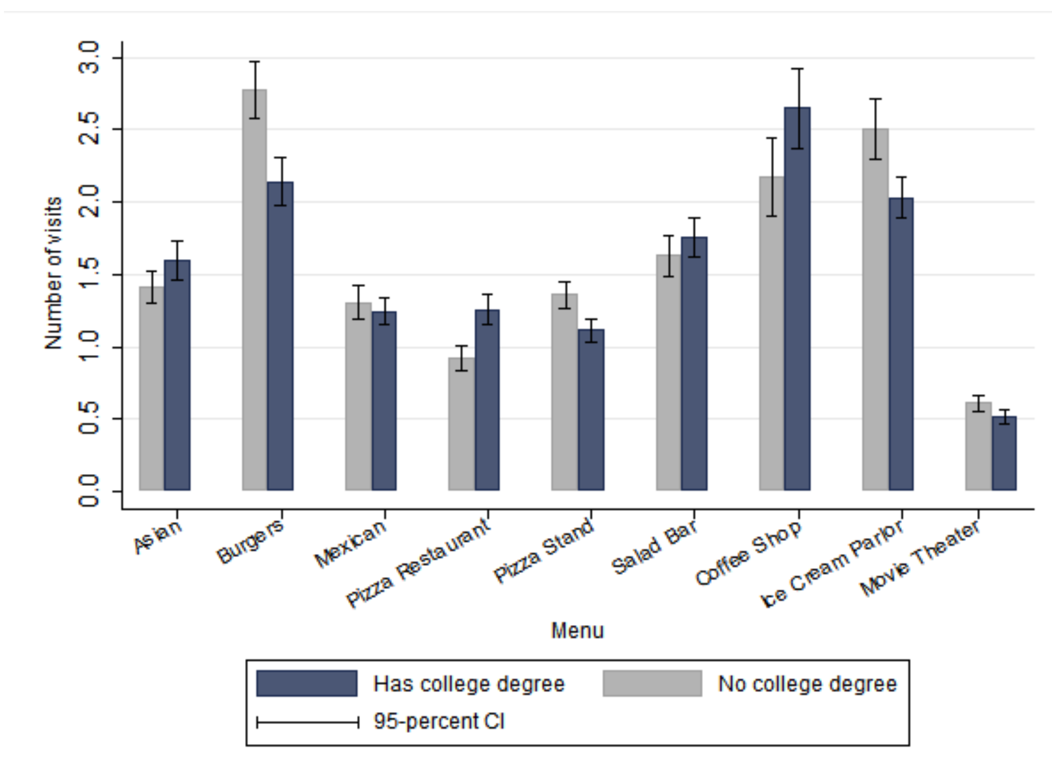
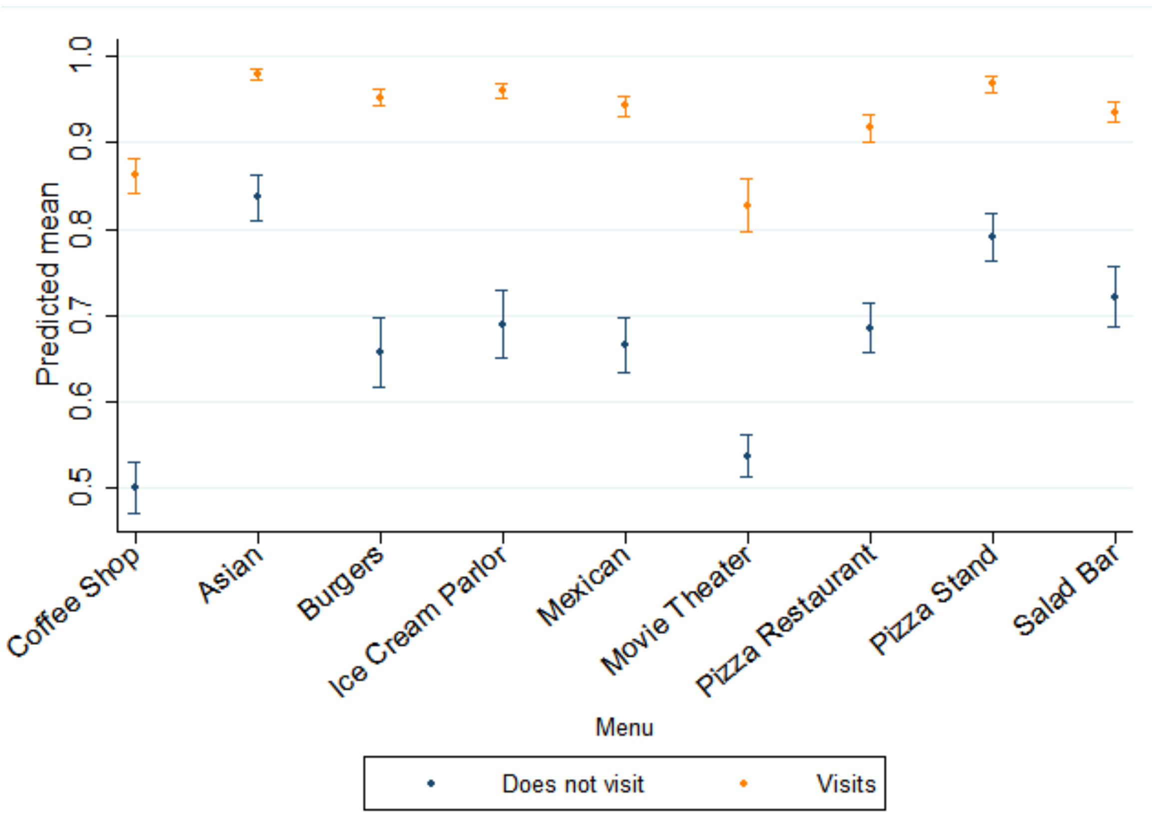


Figure 5.12 shows the relationship between frequency of visit and being a customer (in the experiment), where "visits in a typical month" equal one if visit frequency is equal to one or higher, and zero if the frequency is less than once per month (e.g., a few times a year, every other month). Visiting a restaurant once or more in a typical month is highly significantly predictive of a participant becoming a "customer" in this experiment by selecting an item from the menu across all nine settings. The predicted percentage of respondents is over 80 percent for those who typically go to this type of food outlet every month, whereas it is about 15 to 20 percentage points lower for those who do not visit at least once in a typical month. This suggests that visit frequency and selecting a choice from the menu presented are statistically related and jointly inform the question of customer selection at restaurants.

Figure 5.12. Probability of Ordering at a Restaurant, by Whether Respondent Visits in a Typical Month



Figures 5.13 through 5.18 show graphs of the predicted means by each menu for selected explanatory variables: health-consciousness, overweight status, race/ethnicity, gender, income, and education level.

Figure 5.13. Probability of Ordering at a Restaurant, by Health-Consciousness

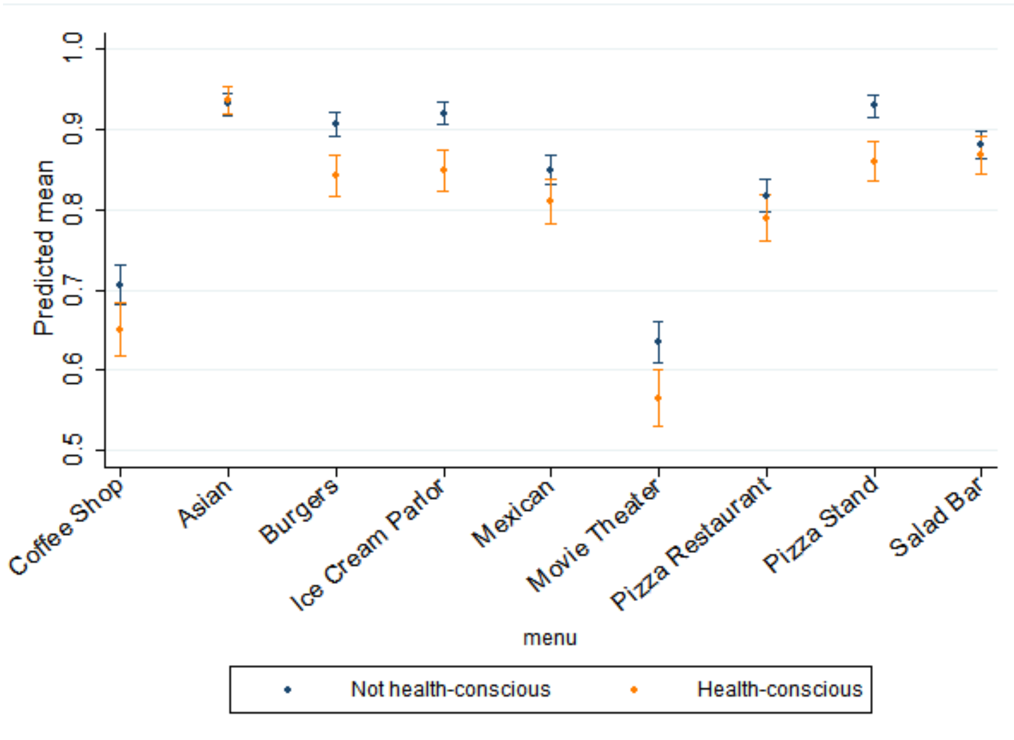


Figure 5.14. Probability of Ordering at a Restaurant, by Overweight Status

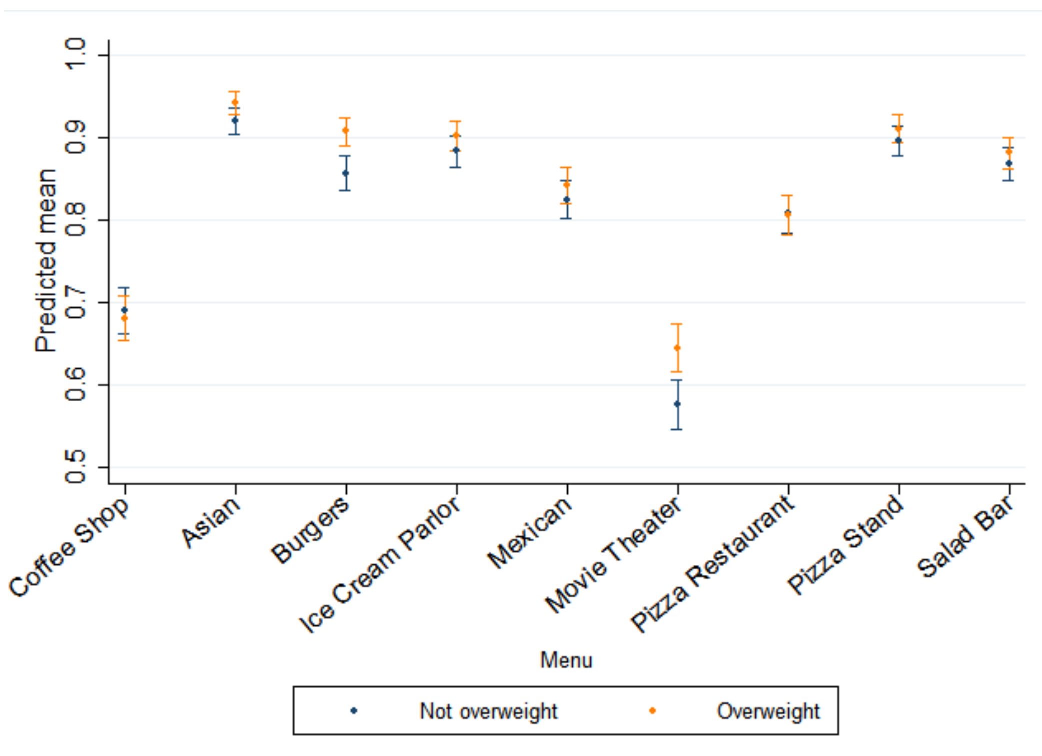


Figure 5.15. Probability of Ordering at a Restaurant, by Race/Ethnicity

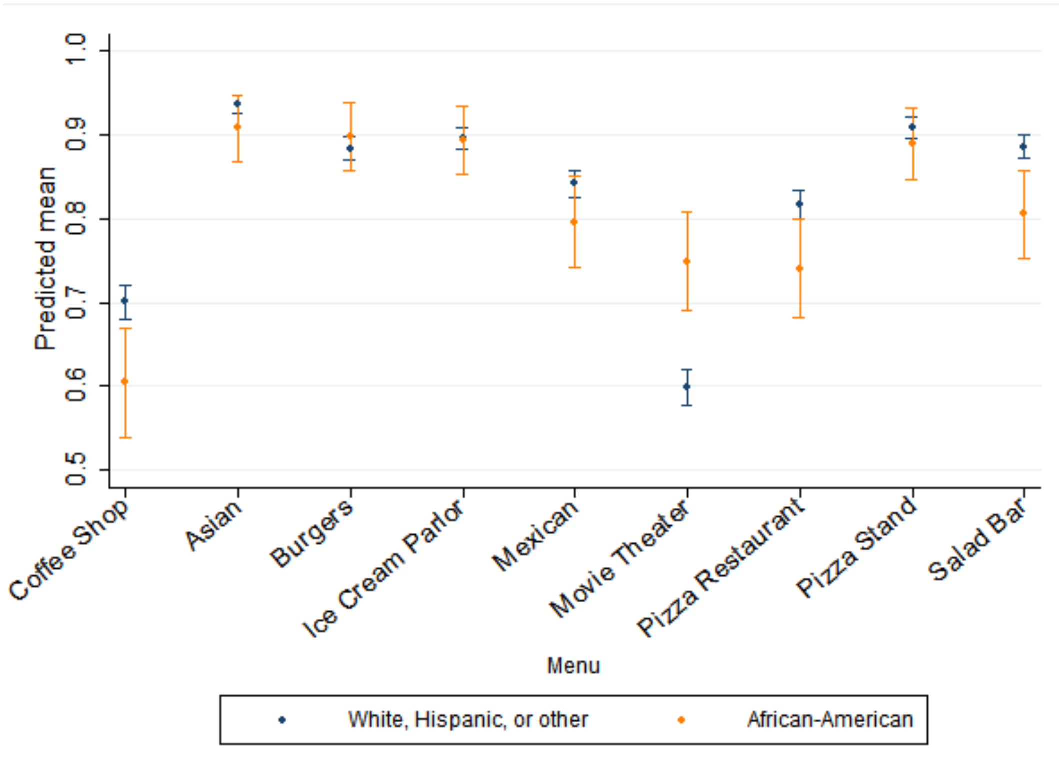


Figure 5.16. Probability of Ordering at a Restaurant, by Gender

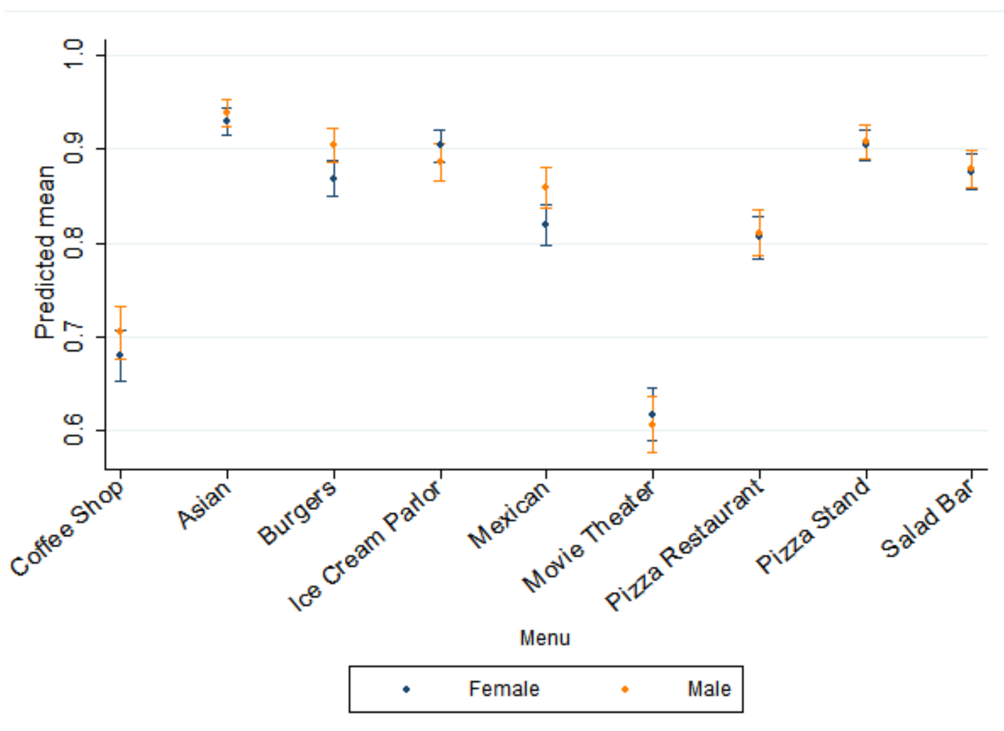


Figure 5.17. Probability of Ordering at a Restaurant, by Income

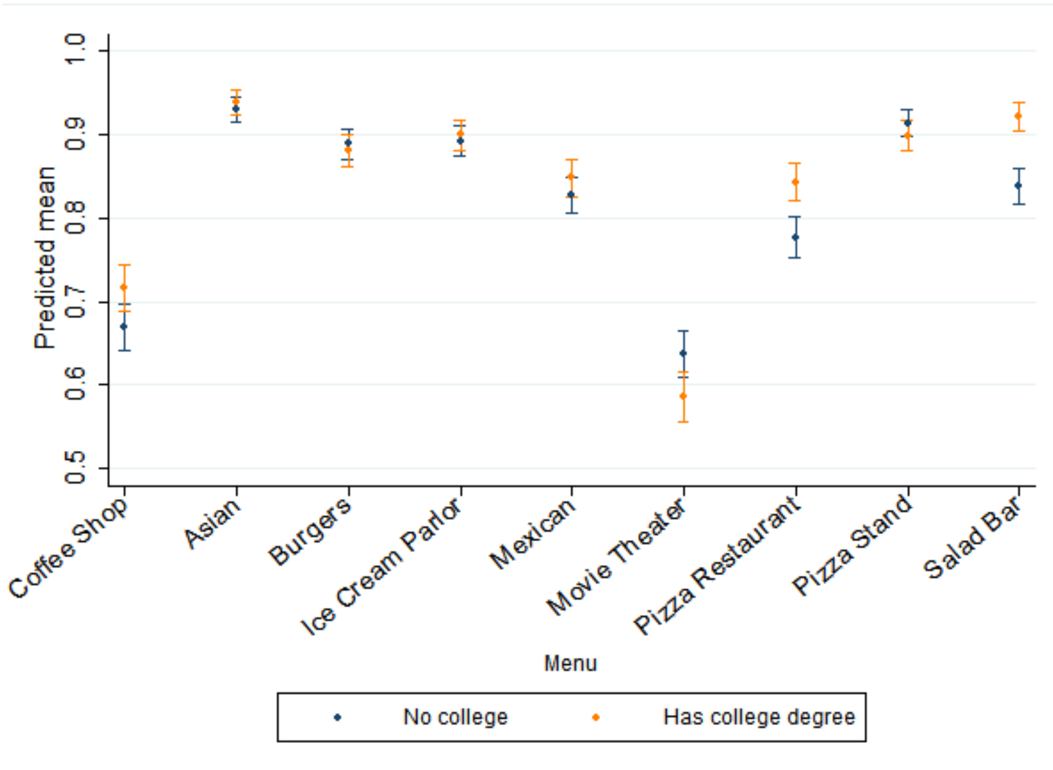
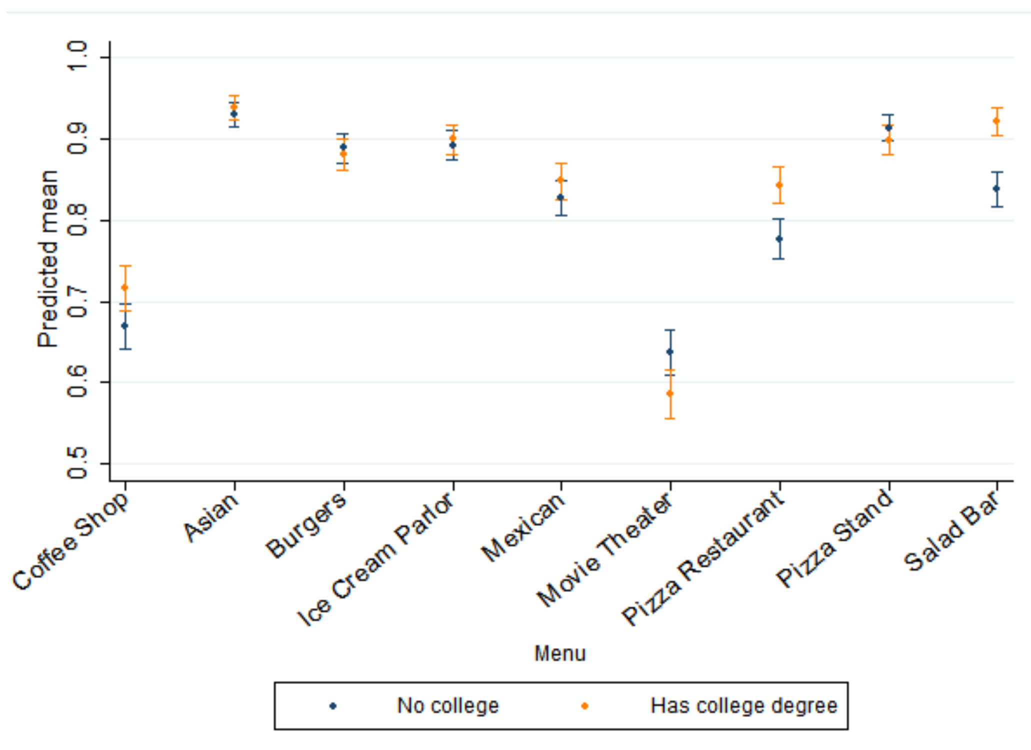


Figure 5.18. Probability of Ordering at a Restaurant, by Education Level



Health-consciousness is a significant predictor of response for Coffee Shop, Burgers, Ice Cream Parlor, Movie Theater, and Pizza Stand settings. People who are health-conscious have a lower predicted probability of ordering food in those settings than people who are not.

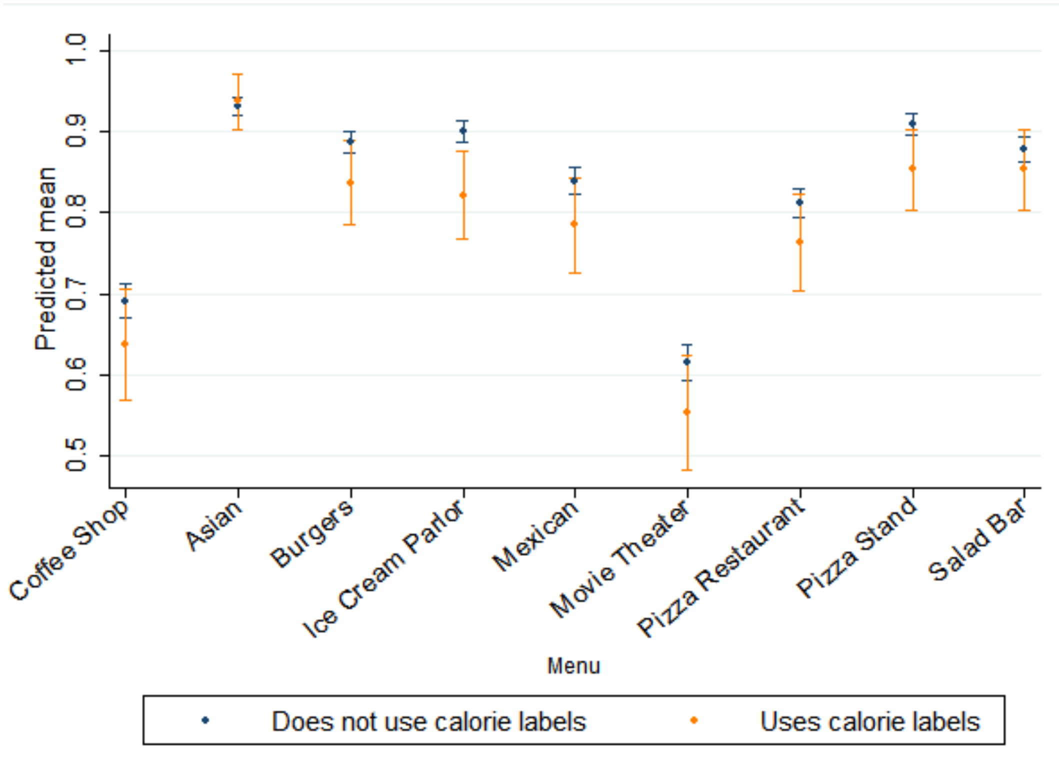
Figure 5.14 compares respondents who consider themselves to be overweight with those who responded "about the right weight." Those who consider themselves to be overweight also have a higher probability of ordering food in the Burgers and Movie Theater settings.

The remaining figures show comparison by demographic characteristics. African-Americans were more likely to order food in the Movie Theater outlet and less likely to order food in the Coffee Shop and Salad Bar settings than other racial/ethnic groups. Respondents with household income over $75,000 per year were more likely to order food from the organic Pizza Restaurant menu (with its $5 price per slice) and Salad Bar menu than those with lower incomes. College degree holders were also more likely to order food in the organic Pizza Restaurant and the Salad Bar setting compared with those with less than a college degree. The predicted proportion of respondents decreases with age in the Mexican and Movie Theater settings, and increases with age in the Salad Bar setting. There were no statistically significant differences across gender in any of the menus, though males tended to respond to the Burgers and Mexican menus more than females, with borderline significance (the confidence intervals barely overlap).

None of the respondent characteristics variables included were significant predictors for ordering food from the Asian Fast-Casual menu, which had the fewest nonresponses. Respondents rated it highly as healthy and having good value.

Figure 5.19 is an alternative specification to Figure 5.13. It compares respondents who say that they always use calorie labels when available against those that do not. It uses the same variables except that it replaces the health-consciousness variable with the use of a calorie label variable. There is a particularly pronounced difference by use of calorie information for the Ice Cream Parlor menu.

Figure 5.19. Probability of Ordering at a Restaurant, by Use of Labels



In summary, the average label effect across restaurants likely varied because they appealed to different customers. Health-conscious participants were less likely to order from the Burgers, Ice Cream Parlor, Movie Theater, or Pizza Stand menus (although they did order from the Pizza Restaurant menu, which offered essentially the same food as the Pizza Stand but framed with a very different-looking menu). African-Americans were overrepresented among Movie Theater customers, and people who considered themselves overweight disproportionately ordered food from the Burgers or the Movie Theater menus. These findings are based on hypothetical scenarios in an online experiment; whether or not they generalize to real-world settings is unknown.

Customer Characteristics and Responses to Calorie Information

Average treatment effects appear to differ across restaurant types, at least among the broad categories: Significant effects were seen among standard restaurants, but not among nonmeal settings (Movie Theater, Coffee Shop, Ice Cream Parlor). We cannot test whether this was the result of the framing of choices, but we can explore differences in the customer base further.

Table 5.1 relates responsiveness to calorie information to four measures of attitudes toward food and healthy behaviors. We regressed calories chosen on the labeling assignment (seeing the calorie information label or not), the attitude/behavior variable, the interaction between attitude/behavior and label, and we control for menu fixed effects and sociodemographic characteristics. The five attitude/behavior variables include: use of calorie information (defined as one if participant responds "always" to the question, "When calorie information is available in the restaurant, how often do you use this information to decide what to order?"); use of nutrition information (defined as one if participant responds "always" to the question, "When you shop at a supermarket, do you look at nutritional information when choosing between similar foods?"); a composite "any health-conscious" variable (coded as one if an individual rated any of three items as very important: "is low in calories," "keeps me healthy," or "helps me control my weight"). The last variable is a proxy for calorie knowledge, and is an indicator that equals one if the response to the question about the number of calories in a 12-ounce can of Coca-Cola was between 120 and 170.

Table 5.1. Pooled Model Estimated Effect on Calories Chosen, with Attitude/Behavior Variable Interactions

Variables	Use Calorie Information When Provided	Use Nutrition Labels	Any Health-Conscious	Reasonable Knowledge of Calories
Coefficient on calorie information	−28.154*** (4.996)	−27.169*** (5.283)	−22.951*** (5.842)	−32.478*** (5.421)
Coefficient on attitude/behavior variable (top of column)	−56.927*** (16.094)	−61.960*** (10.890)	−62.797*** (8.813)	−16.622* (9.669)
Interaction between attitude/behavior and calorie information	−42.305** (17.066)	−24.919** (12.182)	−25.304** (9.836)	0.926 (11.147)
Observations	15,947	15,947	15,934	16,061

NOTE: Demographic and menu fixed effects are included in all specifications but not shown. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The main effect of seeing calorie information is a reduction in calories ordered. The coefficient is significant at $p < 0.001$ in all specifications. In addition, the interaction between the attitude/behavior variable and calorie information is also negative and statistically significant at $p < 0.05$, except for the last column. For example, consider the second results column, which corresponds to the question, "When you shop at a supermarket, do you look at nutritional information when choosing between similar foods?" Individuals who say they use nutrition information when shopping at a supermarket order 62 kcal less than otherwise similar individuals who do not use nutrition information. Additionally, individuals who see calorie information on menus order about 27 kcal less than otherwise similar individuals who were not shown calorie information for that menu. Finally, individuals who are shown calorie information *and* who use nutrition information reduce the calorie content of menu items ordered by an additional 25 kcal.

While health behaviors and attitudes have a significant additional effect, knowledge of calories does not have a statistically significant effect when interacted with calorie labels.

The second source of potential treatment heterogeneity is along sociodemographic variables, including gender, race/ethnicity, education level, income, and an indicator for whether the participant considers him- or herself overweight (see Table 5.2). We run a similar regression of calories chosen on calorie information, sociodemographic variables, the interaction of the sociodemographic variable and calorie information shown, and we control for menu fixed effects.

Table 5.2. Pooled Model Estimated Effect on Calories Chosen, with Sociodemographic Variable Interactions

Variables	Male	African-American	Hispanic	Finished College	Income Greater Than $75,000 Per Year	Overweight
Coefficient on calorie information	−37.011*** (6.479)	−31.433*** (5.121)	−31.743*** (5.079)	−33.542*** (7.142)	−32.875*** (6.274)	−23.931*** (6.835)
Coefficient on demographic variable	59.073*** (8.777)	45.752*** (14.760)	61.310*** (14.092)	−69.194*** (8.700)	−42.557*** (8.824)	31.697*** (8.866)
Interaction between demographic variable and calorie information	14.272 (9.601)	6.848 (16.954)	7.338 (15.882)	4.853 (9.503)	5.114 (9.641)	−13.638 (9.635)
Observations	15,947	15,947	15,925	15,918	15,924	15,934

NOTE: *** $p < 0.01$.

While males, African-Americans, Hispanics, and overweight respondents order more calories, and college-educated and high-income respondents order less, there is no statistically significant interaction with the label variable (statistically significant at $p < 0.001$).

Chapter Six. 2010–2015 Changes in Menu Offerings Among Large Chain Restaurants

Rosanna Smart, Cameron Wright, Helen Wu, and Roland Sturm

The consumer choice experiment discussed in the previous chapters characterized the consumer response to providing calorie information directly on the menu. It is also important to consider the restaurant industry response to consumer demand by looking at how restaurant offerings have been changing.

Ideally, we would have liked to compare changes in menus over time between restaurants subject to local labeling regulations and restaurants not subject to such regulations, but available data only support a more-limited analysis. For this study, we were able to assemble data for many of the largest chains and analyze key changes between 2010 and 2015.

Data on Chain Restaurant Menus

In 2010, we began collecting data on restaurant menus by selecting the top 400 U.S. chain restaurants based on sales, according to the *Restaurants and Institutions Magazine* (2009) list. These 400 brands had a combined 206,750 U.S. locations, representing approximately one-third of the total number of U.S. restaurants in 2010. We then searched for nutrition information about their menus (usually on each restaurant's website), and if not available, requested it (Wu and Sturm, 2013). Data were collected from February to May 2010. We obtained some nutrition information from 213 restaurant brands, comprising a total of 155,021 U.S.-based restaurants, which represented approximately one-quarter of all U.S. restaurants operating in 2010.

In 2012, the New York City Department of Health and Mental Hygiene, with funding in part from the Centers for Disease Control and Prevention, started a similar data collection as part of the MenuStat project (undated). Initially MenuStat only collected data for the top 100 chain restaurants with publicly available nutrition data, and in 2012, the first year of collection, it only showed data for 66 restaurants. Starting in 2013, MenuStat expanded its set of restaurants to the top-200 list. In 2015, MenuStat incorporated our baseline data collection into its system, recoding the 2010 data as needed to ensure consistency across the two data sets.

Food Item Categories

Each menu item in MenuStat is coded into one of 12 mutually exclusive food or beverage categories. Items are coded such that similar foods are grouped in the same category regardless of where the item is categorized on the actual menu. For instance, MenuStat categorizes all nacho dishes in the "appetizers and sides" category, even if they were printed on the entrée section of a menu. When a restaurant lists nutrition information for components of a dish (e.g., sauce), those components are included separately in the "toppings and ingredients" category.

Nutrition information is entered as it appears on restaurant websites, even if such data appear incorrect (e.g., some soft drinks were reported as including fiber, but no sugar). Items with identical names and product descriptions that appear on menus across years are linked by a unique menu item ID number, which remains consistent for all years from 2010 to 2015. This allows analysis of potential reformulation of existing menu items. Generally, we can follow restaurants over time, but one national pizza delivery chain was excluded from our analysis of calorie changes due to a significant change in how nutrition information was reported between 2010 and 2015, which made information no longer compatible across years.

Most prior studies using MenuStat data treated each menu item as à la carte (i.e., main courses that are offered with a choice of sides are treated as stand-alone dishes). This eases analysis of the data, but may fail to properly reflect the way that dishes are served in many restaurants. Including calories of the main dish and the side choices together can thus provide a more-accurate depiction of the caloric content of a meal at many restaurants where customizing dishes is common. For this reason, we use the linked MenuStat files, which allow for both an analysis of à la carte items, to build on previous work, and an analysis that links side dishes to each main dish, for restaurants that listed nutrition information in this manner. For example, a customizable item is a burger with a choice of fries, onion rings, or side salad. Linkages between customizable main items and their potential accompaniments are identified in the MenuStat linked files by a customizable build ID variable.

Customization—i.e., substantial changes to a menu item for individual customers—poses a challenge when interpreting results. When the number of options increases, the average number of calories per item is no longer a meaningful representation of a typical dish. As we will see below, the increasing trend toward customization (even to the extent that there is no longer a meaningful main dish, but only a list of ingredients) affects both the analysis of calorie trends in menus for research and the practical use of menu information for customers.

Table 6.1 summarizes the extent of data collection for restaurant calorie information from 2010 to 2015. The count of restaurants included in each year represents the number of restaurants in the top 200, in terms of sales, that publically shared their nutrition information (except in 2012, when only restaurants in the top 100 were collected). The population of restaurants included in MenuStat has grown from 123 restaurants in 2010 to 152 restaurants in 2015. The number of menu items with posted calorie information has also increased over this period, with the mean number of items per restaurant rising from about 115 in 2010 to almost 160 in 2015. This increase is paralleled by growth in the average number of main dishes (entrées, burgers, sandwiches, pizza, and salads) with calorie information presented.

Table 6.1. Number of Restaurants and Menu Items Included in Data Collection, by Year

Year	Number of Restaurants in Database	Number of Restaurants Matched with 2010	Mean Number of Items Per Restaurant (All Restaurants)[a]	Mean Number of Main Dishes Per Restaurant
2010	123	Not applicable	114.9	73.8
2012	66	58	128.5	84.5
2013	136	116	154.9	101.7
2014	145	123	155.5	104.9
2015	152	117	159.8	102.7

[a] Excludes beverages, toppings, or ingredients and accompanying items. Main dishes include entrées, pizza, sandwiches, burgers, and salads that are not categorized under the "appetizers and sides" or "accompanying item" categories.

Measures

For the à la carte analysis, we use the calorie total for each individual item as reported for noncustomizable items and for the base "main item" of each customizable dish. The accompanying item information is not used in the à la carte analysis. For an analysis that utilizes the full breadth of data on customizable dishes, we first calculate average calories across the possible accompanying items and then add this to the main dish. This new calorie total for the main dish is the equivalent of a main dish along with the choice of one average-sized side dish. Ideally, calories of accompanying items could be weighted by their popularity, but the sales and ordering data necessary to weight these items are not available. The closest representation to the way these items are served that is feasible for us to construct is to use the number of calories of the average accompanying item and add this to the main item.

This approach worked for standard menus, but in recent years restaurants have changed their approach to customization from providing a choice of side items to go with a main dish, or à la carte options, to offering what we call "highly customizable" dishes. Some of those provide no meaningful main dish (e.g., a patty is not the same as a hamburger) or even have no base item in the MenuStat database (and therefore the main dish has no nutritional information recorded). The number of highly customizable dishes has increased dramatically over time from 17 main dishes that have no calorie information (but are linked to accompanying items) in 2010, to 492 dishes in 2015. As an extreme example of this form of customization, one Mexican chain provides nutritional values for each component of a dish separately (e.g., tortilla, beans, rice, salsa). Since MenuStat tries to translate the company's information directly, there are no calorie values for "main dishes" entered for this chain. Instead, the components for burritos, bowls, and tacos are listed individually under toppings and ingredients, but can be linked together to form a customized burrito or bowl. While one could resort to manually constructing a "typical" burrito from the list of accompanying items (as was done in Schoffman et al., 2016), this method involves subjective decisions about how to optimally aggregate ingredients to construct a typical entrée, limiting the value of any results. Highly customizable dishes have been excluded from this analysis, but they reflect a rapidly increasing type of menu item and merit future research.

For some dishes, calorie information was listed as a range of values (e.g., 100–250 calories, less than 50 calories). For items with only an upper-calorie bound, we assign calories using the upper cutoff value, as these items all had very low calorie counts (e.g., less than 8 calories), and thus the value chosen between zero and the maximum made no meaningful difference in our analyses. For items where the calorie information was listed as a range of positive values, we assign calories using the mean value (or midpoint) of the range. After excluding observations for which calorie information was not reported (n = 26,009; 8.3 percent of the sample), our final sample consists of 287,146 observations, representing 73,225 unique menu items from 164 restaurants and covering the years 2010 and 2012 to 2015.

Analysis Methods

MenuStat has categorized dishes as customizable "main dishes," "accompanying items" that are linked to main dishes, or as noncustomizable à la carte items. Accompanying items are not unique in the data set, and the same dish can be linked to multiple main items (i.e., the same option of side dishes may be offered across several different entrée items at a given restaurant). To examine trends in the offering of customizable options, we first calculated summary statistics on each of these three categories of dishes. Graphical evidence and linear regression models are used to assess trends in customization over the sample period.

Generalized linear models were then used to examine changes in calories at the menu item level in 2010 and 2015 for restaurants observed in our data set in both of these years. Two outcomes were assessed using this type of model: (1) the change in mean calories of menu items that existed on menus in both 2010 and 2015 (matched items), and (2) the change in mean calories of menu items that appear in 2015 only and items that appear in 2010 only (unmatched items). By examining changes in the calories of matched items over time, the first measure provides potential evidence of reformulation of existing dishes. The second measure assesses the role of adjustments to menu composition by examining differences in calorie content between items that were removed from the menu since 2010 and items that were new to the menu in 2015.

The baseline model in reduced form is specified as

$$y_{ij} = \theta I_{ij} + \beta X_{ij} + \omega_j + \varepsilon_{ij}$$

where y_{ij} represents the calorie total of each menu item, I_{ij} represents an indicator variable that denotes whether a menu item is from 2010 or 2015, and X_{ij} is a vector of menu-item level covariates. The subscript *i* indicates individual items, while *j* subscripts indicate the restaurant. Error terms at the restaurant level and menu-item level are represented by ω_j and ε_{ij}, respectively. The error terms are modeled with a clustered variance structure that allows for intragroup correlation of multiple observations from the same restaurant. This assumes that observations are independent between restaurants, but relaxes the assumption of independence for observations collected from the same restaurant, which are likely correlated due to restaurant-level policies and attributes. The coefficient of interest, θ, estimates the average difference in calories for an item being on a 2015 menu compared with a menu in 2010.

Regression models are stratified over customization status and food categories. We also provide two methodological approaches: (1) treating all items as à la carte, as in prior work, and (2) using accompanying item information to construct customized meals that more closely resemble how they are actually ordered by the customer. Two different models were estimated for each group of menu items of interest. The first model includes only matched items to examine evidence of reformulation of dishes over time. The second model includes only unmatched dishes to examine whether dishes added to the menu in 2015 were less caloric compared with dishes removed from the menu after 2010. Following Bleich, Wolfson, and Jarlenski (2015), all analyses control for whether the item was designated as a children's menu item, restaurant service type (fast-food, full service, or fast-casual), and whether a restaurant chain is national. An additional covariate is included to indicate whether the menu item was considered a meal combo or a shareable item.

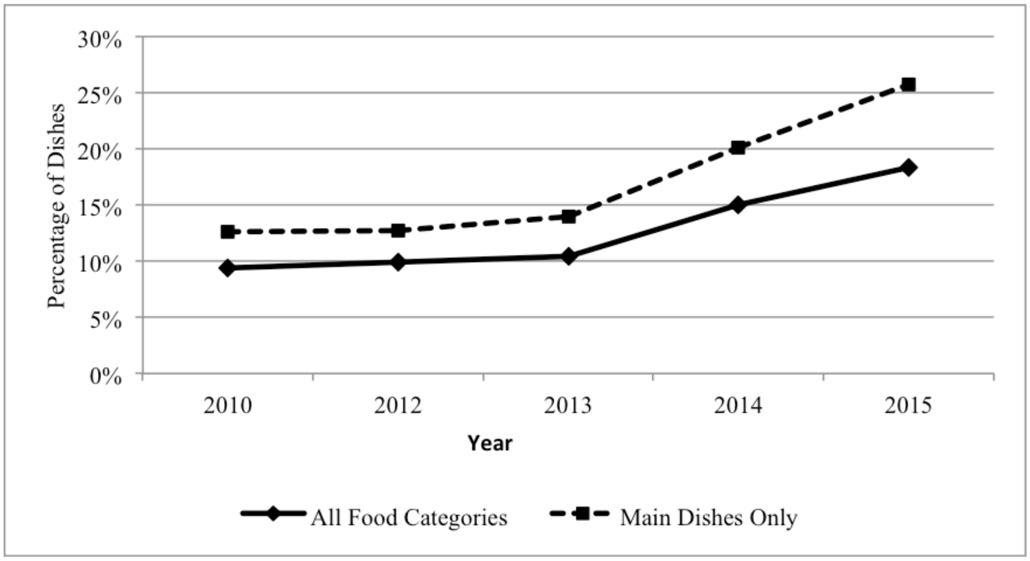
Results

The Increasing Role of Customization

Over time, there has been a growing trend toward customization. Figures 6.1 and 6.2 show trends in the share of dishes that are customizable for two groups of restaurants. Figure 6.1 includes menu items from all restaurants across each year of the sample, treating the data as cross-sectional. The "all food categories" series includes all menu items collected by MenuStat, excluding beverages and toppings or ingredients, and the "main dishes only" series includes only entrées, burgers, sandwiches, pizza, and salads not categorized by MenuStat in the "appetizers and sides" menu category. The share of menu items that are customizable increased from 9.4 percent in 2010 to 18.3 percent in 2015 for all food categories, and from 12.6 percent in 2010 to 25.7 percent when limiting the sample to main dishes only. Linear regression models showed that this increasing trend in customization was statistically significant at the 10-percent level for all food categories combined ($p = 0.05$) and for main dishes only ($p = 0.06$).

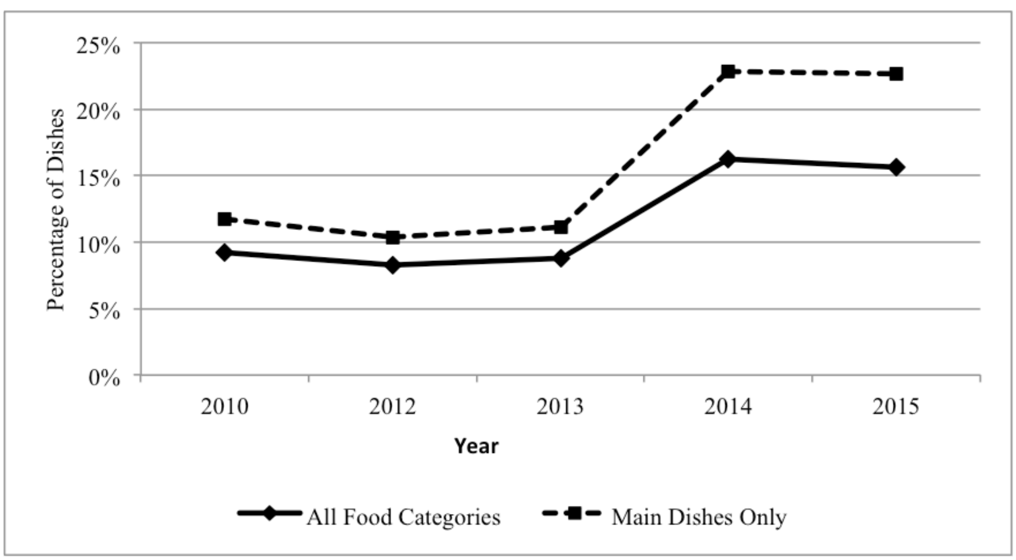
Figure 6.2 restricts the sample to the 55 restaurants that had data in all five years of MenuStat collections, allowing a balanced panel structure that is not confounded by changes in the restaurant sample over time. The share of "all food categories" dishes that are customizable in this stable restaurant sample grew from 9.2 percent in 2010 to 15.7 percent in 2015, and from 11.7 percent in 2010 to 22.6 percent in 2015 for main dishes only. While this five-year trend was not statistically significant at conventional levels ($p = 0.13$ for all food categories; $p = 0.12$ for main dishes only), the near doubling of customizable dishes from 2010 to 2015 in the matched sample is a trend suggesting that making menu items more customizable over time is not entirely driven by changes to the restaurants in business.

Figure 6.1. Percentage of Total Dishes That Are Customizable, All Restaurants



NOTE: “All food categories” includes all menu categories except beverages and toppings or ingredients. The figure includes data from 164 restaurants.

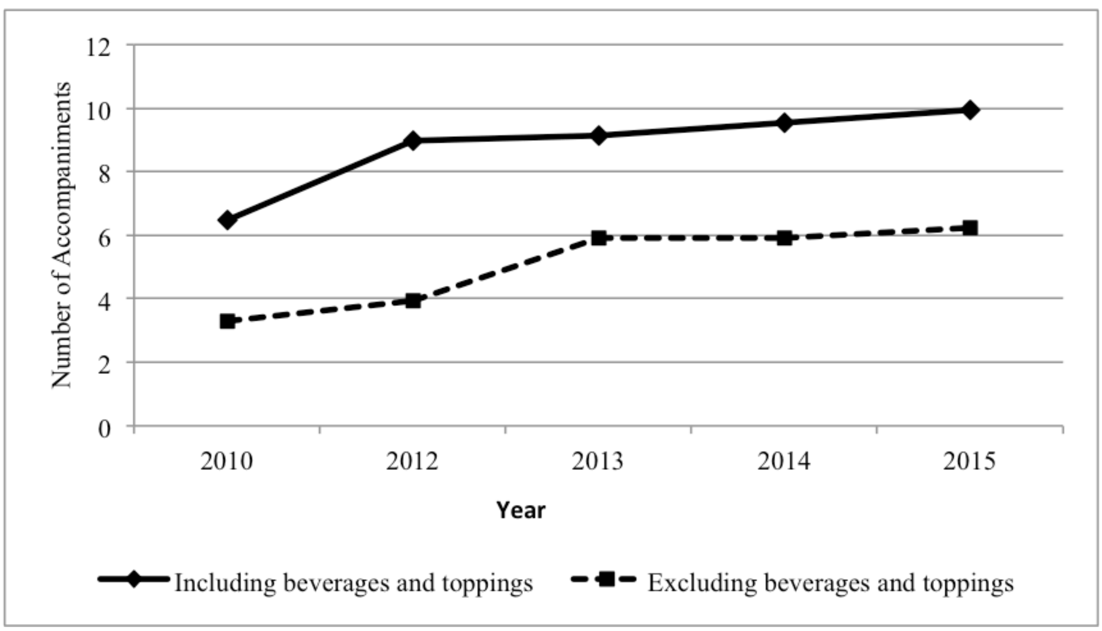
Figure 6.2. Percentage of Total Dishes That Are Customizable, Matched Restaurants



NOTE: “All food categories” includes all menu categories except beverages and toppings or ingredients. The figure includes 55 restaurants with data in all five years of MenuStat collection.

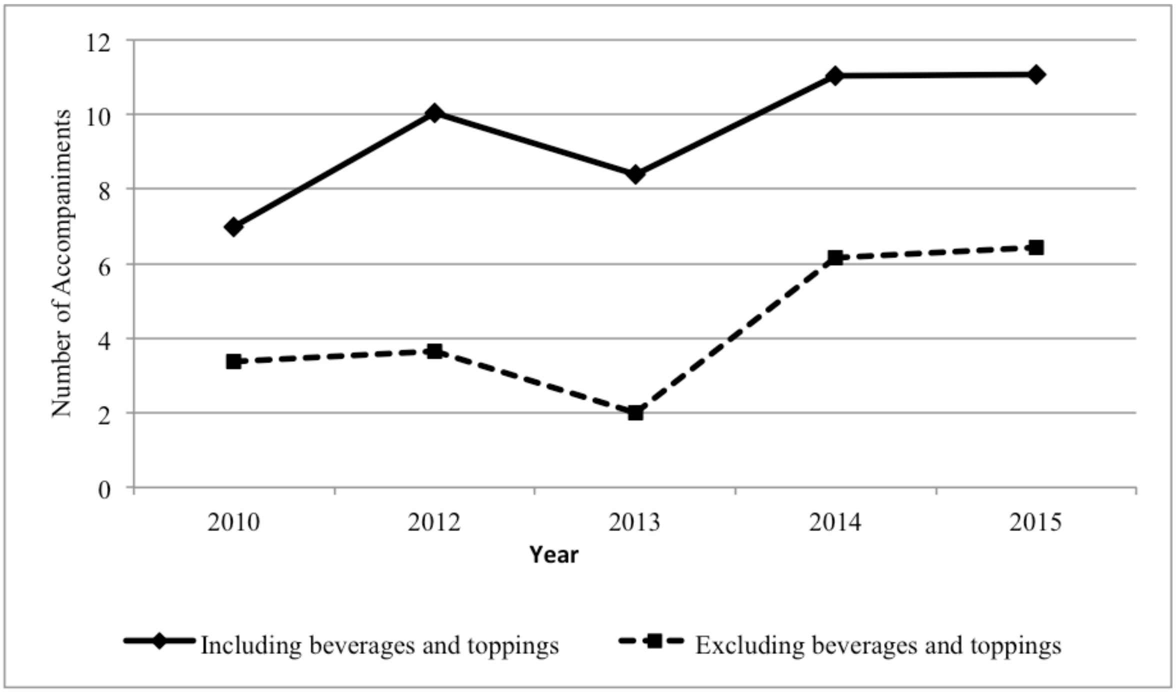
This growth in customization is not limited to the number of customizable dishes, but is similarly reflected in a trend toward offering a larger number of accompanying item choices in the customization of each dish. Figures 6.3 and 6.4 depict trends in the average number of accompanying options per customizable dish from 2010 to 2015. Figure 6.3 includes all restaurants in the MenuStat sample, while Figure 6.4 again restricts the sample to those 55 restaurants that were included in all five years of MenuStat collections to control for the changing MenuStat restaurant sample over time. In Figure 6.3, the average number of available options, including beverages and toppings, for each dish grew from 6.5 in 2010 to 10.0 in 2015. Linear regression models found that the positive trend in customization options was statistically significant at the 5-percent level ($p = 0.02$). In the matched restaurant sample (Figure 6.4), the average number of available choices, including beverages and toppings, for each customizable dish grew from 7.0 in 2010 to 11.1 in 2015. This overall positive trend from 2010 to 2015 was only statistically significant at $p = 0.07$, but lost all significance when beverages and toppings or ingredients were excluded as accompanying items ($p = 0.24$).

Figure 6.3. Average Number of Accompaniments Per Main Dish, All Restaurants



NOTE: This figure includes data from 164 restaurants.

Figure 6.4. Average Number of Accompaniments Per Main Dish, Matched Restaurants



NOTE: This figure includes 55 restaurants with data in all five years of MenuStat collection.

Characteristics of Menu Items over Time

Table 6.2 reports characteristics of menu items offered on menus in 2010 and 2015 for the sample of 117 restaurants that were present in the MenuStat data for both years. Of the 46,866 items offered on menus in 2010 and 2015, over half were newly introduced by 2015, almost 25 percent were on the menu in both years, and about 25 percent were on the menu in 2010 but had been removed by 2015. The majority of combo/shareable items on the menu in 2015 (82.7 percent) were added after 2010, whereas soups appear to be the most stable menu category, with 42.1 percent of soup items offered in both 2010 and 2015. Within the food category (54.6 percent of all menu items), main dishes make up 64.8 percent of items, with appetizers, side dishes, soups, desserts, and other baked goods constituting the remainder. Almost 17 percent of food offerings are designated as customizable main items, with the highest incidence of customization in the salad, entrée, and sandwich categories. Toppings and ingredients are the most common accompanying item, followed by fried potatoes, appetizers or sides, and soups.

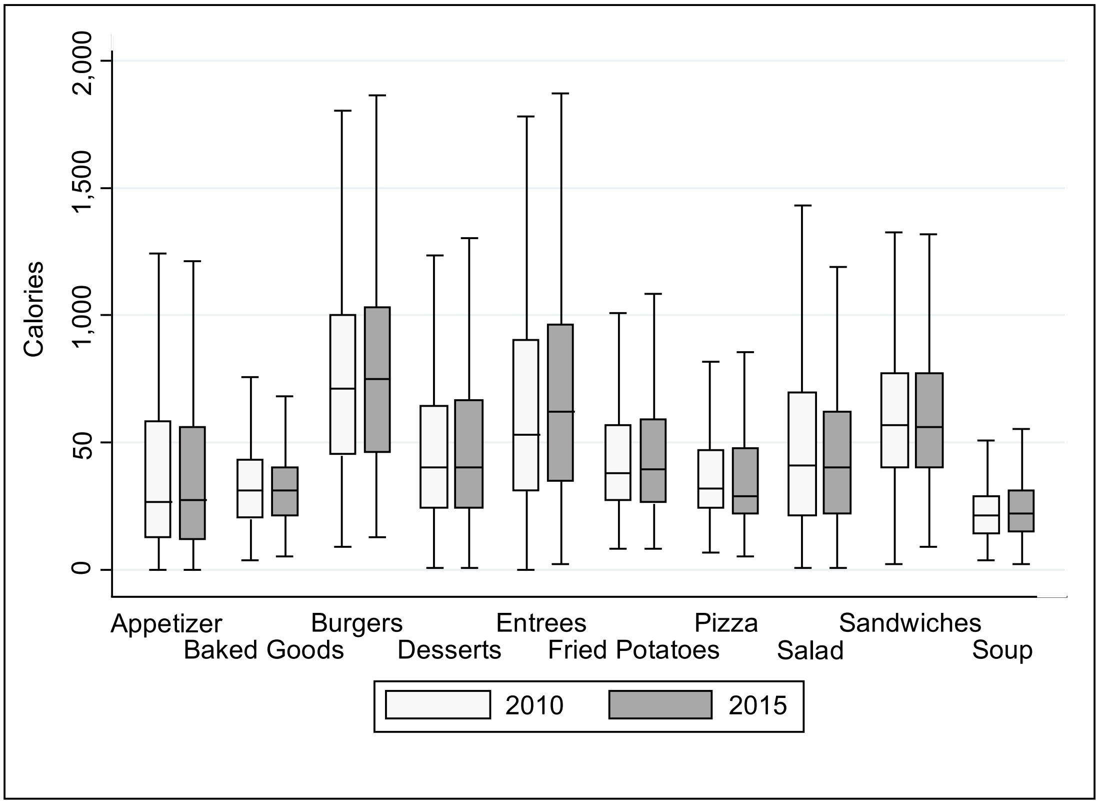
Table 6.2. Menu-Item Characteristics for Restaurants in 2010 and 2015

Menu Category	Number of Items	Offered Both Years (%)	Newly Introduced by 2015 (%)	Children's Menu (%)	Customizable	
					Main Item (%)	Accompanying Item (%)
Overall	46,866	24.7	54.7	5.8	11.3	12.4
Food[a]	25,573	30.4	44.8	6.2	16.9	7.8
Appetizers/sides	2,748	27.4	46.1	10.0	9.1	22.1
Fried potatoes	461	38.8	39.7	14.5	5.9	25.8
Entrées	6,399	23.6	46.8	9.3	25.5	3.5
Pizza	2,617	28.4	57.0	4.0	7.7	0.7
Sandwiches	4,824	33.0	42.6	4.7	25.3	5.6
Burgers	974	28.3	46.8	9.9	24.3	6.1
Salads	1,769	25.8	45.7	2.1	31.8	10.8
Soups	1,348	42.1	33.4	2.7	4.6	15.4
Desserts and baked goods	4,433	38.0	40.8	3.1	2.9	6.7
Beverages	14,514	15.8	69.5	5.1	6.6	3.5
Toppings and ingredients	6,779	22.1	60.5	5.8	0.0	49.2
Children's menu	2,709	29.5	55.1	100.0	10.7	2.6
Combo/shareable	1,076	8.6	82.7	9.9	12.6	0.2

[a] Food includes all menu categories, excluding beverages and toppings or ingredients.

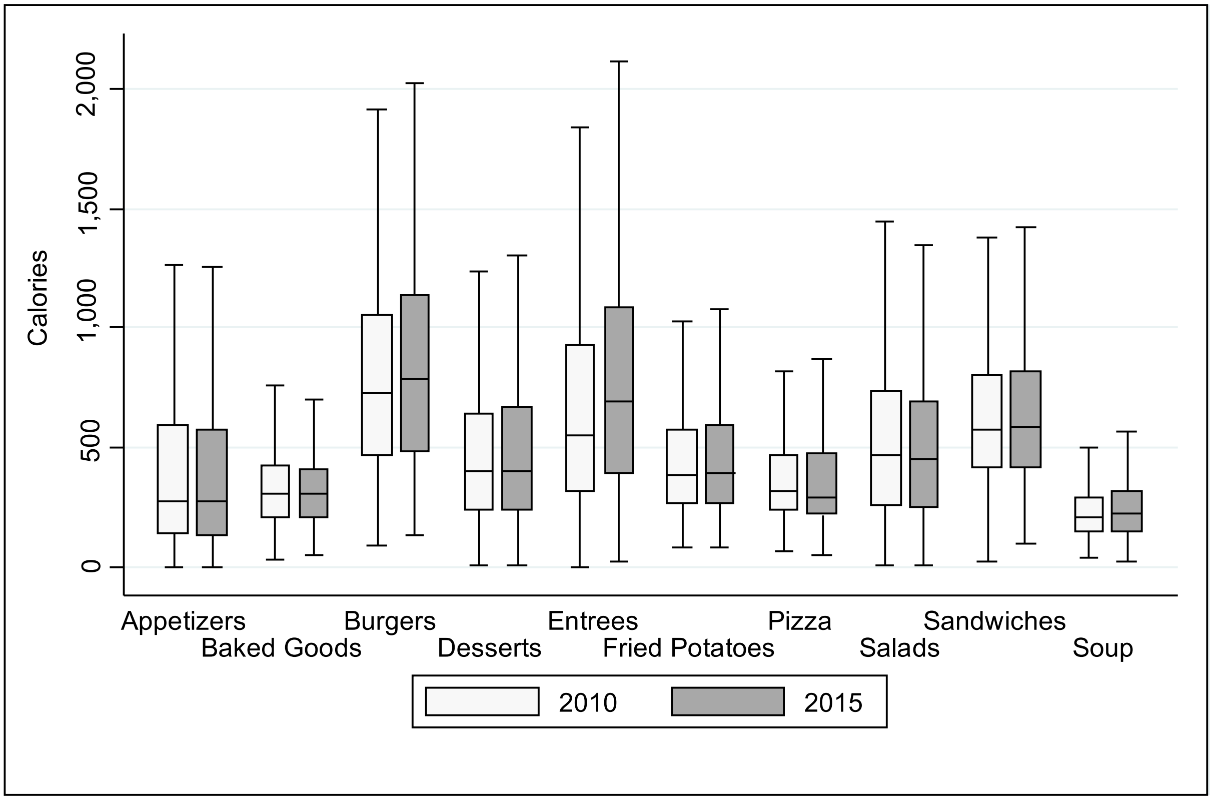
The distributions of calorie statistics across different food categories for this set of restaurants are presented in Figures 6.5 and 6.6. Figure 6.5 treats all items as à la carte, whereas Figure 6.6 incorporates calorie information from accompanying items for customizable dishes. The box plots show the median value, the range between the 75th and 25th percentiles, and the upper and lower adjacent values of the calorie range. In both figures, burgers and entrées are the most-caloric categories, with a significant portion of menu items in these categories containing over 1,000 calories. Soup is the least-caloric food category, with the vast majority of items consisting of fewer than 500 calories. Comparing the calorie distributions across years suggests that calorie distributions are relatively stable between 2010 and 2015 when customization is not considered (Figure 6.5). When calories are incorporated from accompanying items for customizable dishes (Figure 6.6), the graphical evidence suggests a potential shift toward increased calories for entrées.

Figure 6.5. Calories by Food Category, All Items à la Carte



NOTE: This figure includes only restaurants present in both the 2010 and 2015 data. A national pizza chain is excluded due to a significant change in how nutritional information was reported between 2010 and 2015. The box shows the interquartile range (first to third quartile, Q1–Q3), the whiskers are upper adjacent value and lower adjacent value as defined by Tukey (1977). The upper adjacent value is the most extreme value within Q3+1.5* (Q3–Q1), and the lower adjacent value is the most extreme value within Q1–1.5* (Q3–Q1).

Figure 6.6. Calories by Food Category, Including Accompanying Items



NOTE: Includes only restaurants present in both the 2010 and 2015 data. A national pizza chain is excluded due to a significant change in how nutritional information was reported between 2010 and 2015. The box shows the interquartile range (first to third quartile, Q1–Q3), the whiskers are upper adjacent value and lower adjacent value as defined by Tukey (1977). The upper adjacent value is the most extreme value within Q3+1.5* (Q3–Q1), and the lower adjacent value is the most extreme value within Q1–1.5* (Q3–Q1).

Changes in Calories: Regression Results from the Generalized Linear Model

To more precisely characterize how the calorie content of restaurant menu items has changed over time, Tables 6.3 and 6.4 present results from the generalized linear model outlined in the equation earlier in this chapter. Table 6.3 shows regression results for matched items offered on the menu in both 2010 and 2015. Changes in estimated average calories are shown separately for all food categories and for main dishes only, with Panel A presenting results for all dish types, Panel B restricting the analyses to noncustomizable items, and Panel C restricting the analyses to dishes that were customizable in either 2010 or 2015. For the models treating all menu items as à la carte (column 2), the point estimates for calorie changes from 2010 to 2015 are mostly negative, but none were statistically significant. In contrast, in models that incorporate the calories of accompanying items into the total calories of customizable items (column 3), there is some evidence of a statistically significant increase in calorie levels. For main dishes, the estimate shows an increase per dish of 19.12 mean calories between 2010 and 2015 for main dishes (an increase of about 3.1 percent). This effect is driven by an increase in calories among matched customizable dishes, which on average had 55.10 more calories in 2015 compared with 2010 for all food items, and 54.05 more calories for main dishes only (an increase of between 6 and 7 percent).

Table 6.4 presents analogous results for unmatched items. The results are qualitatively unchanged from Table 6.3 but none of the estimates are statistically significant at conventional levels.

Table 6.3. Mean Calorie Changes from 2010 to 2015 for Matched Items

Menu Category	(1) Number of Dishes	Estimated Mean Calorie Change (θ) (2) Exclude Accompanying Items	(3) Include Accompanying Items
Panel A: All Dish Types			
All food	15,226	−4.27 (7.69)	10.26 (7.24)
Main dishes only	9,035	−4.93 (10.96)	19.12* (9.87)
Panel B: Noncustomizable Dishes Only			
All food	12,078	−0.83 (6.93)	Not applicable
Main dishes only	6,252	2.14 (10.61)	Not applicable
Panel C: Customizable Dishes Only			
All food	3,148	−16.39 (16.85)	55.10*** (20.08)
Main dishes only	2,783	−22.50 (18.66)	54.05** (22.27)

NOTE: Results are from the generalized linear model with standard errors clustered at the restaurant level. All models include the following covariates: indicator for children's menu item, indicator for combo/shareable, indicator for national restaurant chain, and indicators for service type. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 6.4. Mean Calorie Changes from 2010 to 2015 for Unmatched Items

Menu Category	(1) Number of Dishes	Estimated Mean Calorie Change (θ): (2) Exclude Accompanying Items	(2) Include Accompanying Items
Panel A: All Dish Types			
All food	17,441	5.44 (30.34)	29.47 (34.30)
Main dishes only	11,754	9.19 (35.10)	42.45 (41.06)
Panel B: Noncustomizable Dishes Only			
All food	14,716	−3.54 (32.22)	Not applicable
Main dishes only	9,307	−2.20 (38.34)	Not applicable
Panel C: Customizable Dishes Only			
All food	2,725	17.51 (55.30)	58.47 (63.06)
Main dishes only	2,447	37.02 (58.95)	70.95 (68.68)

NOTE: Results are from the generalized linear model with standard errors clustered at the restaurant level. All models include the following covariates: indicator for children's menu item, indicator for combo/shareable, indicator for national restaurant chain, and indicators for service type.

Discussion

The two main findings from the restaurant menu analysis are:

1. Customization has increased substantially. In particular, there is a growth of highly customizable offerings where a main dish itself is no longer identified clearly, and only its component ingredients are listed in MenuStat.
2. We cannot confirm the hypothesis that restaurants have reduced the calorie content of menu items from 2010 to 2015, a suggestion made by Bleich, Wolfton, and Jarlenski (2015, 2016) in a series of papers based on a subset of the MenuStat data. Instead, once the calories of accompanying customizable items are taken into account, the average calorie content has increased in the time period studied.

Across all analyses, we find no evidence that new items being added to menus are less caloric than those that have been removed. Additional restaurants voluntarily added calorie labeling to their menus between 2010 and 2015.

There are several limitations to this analysis. First, nutrition information was not subject to regulation or standardization requirements during data entry. All information in MenuStat is self-reported by restaurants and is thus subject to the accuracy of each restaurant's measurement and reporting. These data do not reflect the popularity of each menu item, which would offer a clearer picture of what is most often ordered and consumed. Addressing this shortcoming would require proprietary sales data from each restaurant to weight each item by sales, which is likely infeasible to acquire. Furthermore, while accommodating customizable dishes into the analyses was important to more accurately represent restaurant dishes as they are served to customers, our method for constructing main dish/side dish combinations assumed that reporting of customizable dishes was consistent across restaurants over time. While our analysis offers a standardized and replicable method for including side dishes or sauces with main items, other approaches, such as text analysis or site visits to each restaurant, may prove to be more accurate in constructing calorie counts for item combinations.

Going forward, it will be crucial to determine an appropriate and standardized method to handle customizable dishes in MenuStat because the prevalence of customizable menu items is significantly increasing. For the more than 100 restaurants included in the main analysis, there were approximately twice as many customizable main dishes in 2015 compared with 2010. There was also a 65-percent increase in the number of accompaniments listed with each main item over that time period. If this trend continues, future work investigating calorie trends will need to carefully consider the issue of menu customization.

Of equal importance, greater degrees of customization could undermine many of the informative effects of the FDA's upcoming menu-labeling regulation. One of the goals of labeling menus with calorie information is to provide clear and concise information for consumers to use in making food decisions. Menus heavy on customizable dishes will increase the cognitive burden on consumers by forcing them to find components and add together multiple calorie labels to calculate the final calorie total for an individual choice. This additional burden could make consumers less likely to use the calorie information or perhaps lead them to concentrate only on the calorie total of the "base" dish (if there is one), leading to an underestimation of the true calories of the dish. Consumer education may be necessary to raise awareness of the new trend and enable consumers to properly use the nutrition information as it is (and will be) displayed across different restaurants.

Chapter Seven. Conclusion

Labeling menus with calorie information affects the behavior of both consumers and restaurants. There have been numerous studies of consumer responses to such labeling, but results have been mixed and sometimes contradictory. Our experiment, while limited to a virtual setting, provides new results specific to labels that meet the requirements of the 2014 FDA menu-labeling regulations, and suggests reasons for the diversity in results. We observed a stronger response in traditional restaurant settings than in settings that primarily offer snacks and treats (represented by our Movie Theater, Ice Cream Parlor, and Coffee Shop menus).

Few studies have been done to determine restaurant trends, and the available data limited our study to an analysis of trends in menu offerings for large chains. We observed a rapid change over five years toward customizable dishes, an important industry change that has not received much attention in discussions of menu labeling, but which may affect the usability of calorie labels and informational tools, such as the New York City Department of Health and Mental Hygiene's MenuStat.

In the experimental portion of our study, participants who viewed menus with calories labeled ordered items with fewer calories—by 30 kcal (Table 4.7; 38 kcal without sociodemographic adjustments as in Table 4.1) across all settings—than participants in the control group. This corresponds to a decrease of 7 percent, a substantial effect considering that the average American consumes one-third of his or her food calories away from home. We also tested whether accentuating the calorie information on the labeled menus would have an effect on calories ordered, but we found no substantial or statistically significant difference between regular and bold labels (although the mean decrease was often slightly higher for bold labels). In addition, we examined whether labeling menus with calorie information affects the probability of placing an order; it did not.

In this study, the effect of providing calorie information through labels on the menu differed by type of setting. In meal-type restaurants, providing calorie information through menu labels reduced the amount of calories ordered, but in nonmeal settings (Movie Theater, Ice Cream Parlor, and Coffee Shop) calorie information had no statistically significant effect. While we cannot pinpoint a reason for this difference, it is most likely a combination of framing effects in different settings and different customer bases, as measured through answers to follow-up questions on demographic and individual characteristics, and attitudes toward food and nutritional labeling. Participants who indicated "health-consciousness," for example, were less likely to be "customers" of our Burger, Ice Cream Parlor, Movie Theater, and Pizza Stand settings (which includes three of the four settings for which we saw no average response to labels). Although the effect of providing calorie-labeled menus does differ by attitudes about food (health-consciousness) and self-reported label use (while shopping for groceries or in restaurants), we see no strong evidence that the effect of menu labeling itself differs by race/ethnicity or other sociodemographic characteristics. We did see associations between participant characteristics and their likelihood of ordering from types of food outlets, however. Respondents who considered themselves overweight, for example, had a higher probability of ordering food in the Burgers and Movie Theater settings (this is also true for respondents who would be classified as overweight/obese based on self-reported height/weight). A particularly pronounced effect related to race/ethnicity was that non-Hispanic African-Americans and Hispanics were more likely to order food in Movie Theater settings than other racial or ethnic groups.

Other potential contributors to decisions of whether to order something from a restaurant, and what to order, likely include framing effects and cultural norms (e.g., individuals associating going to movie theaters with ordering popcorn). We asked participants to rate their satisfaction with their orders and their perceptions of each restaurant outlet's offerings, in terms of healthfulness and value. Respondents rated our Movie Theater menu as being of poor value and unhealthy. Yet, that did not prevent many from ordering food and selecting, on average, the highest number of calories of any setting. This could reflect an automatic behavior or social norm of buying certain foods in certain settings. If effects are that strong in an online experiment, then cues in a real setting—such as smells or other people eating—are likely to exacerbate differences observed in an online experiment, in which choices would be expected to be more "rational."

Because individual preferences for food and restaurant types can be variable, the concept of an average treatment effect of providing calorie information is incomplete. We observed substantial heterogeneity when we considered the distribution of food choices rather than an average. Graphical representation of the data showed that, instead of simply shifting the distribution (which would have happened if the average treatment effect applied to everybody), the shape of the distribution changed and new or more-pronounced modes were visible for some lower-calorie items. Generally, we seem to find little change at the ends of the distribution, but quite a bit of change in the middle.

There are countless potential subgroup analyses that could be conducted, and we would like to understand subgroup behavior at a more-granular level, but the probability of false positives would increase rapidly with multiple comparisons. We therefore only considered a limited set of variables that could be potentially related to calorie-labeled menus, namely variables we know to be associated with restaurant selection or calories chosen.

The secondary objective of our study was to evaluate trends in menu offerings at restaurants. Ideally, we would have liked to determine whether there are differential changes over time for restaurants subject to labeling rules and establishments in comparison to restaurants outside jurisdictions that have labeling requirements. But data are much more limited than we had hoped, so we focused our analysis on how menus of major chain restaurants have changed from 2010 to 2015.

Two main findings emerged from this research. First, if we take into account the combination of a main item and its side dishes (rather than only considering the main item), calories in restaurant offerings seem to have increased, rather than decreased, in recent years. Second, the prevalence of customizable menu items is growing rapidly. Establishing an appropriate and standardized method to determine calorie amounts for customizable dishes will be important if researchers and policymakers want to analyze calorie content in restaurant food in the future.

It is important to note that greater degrees of customization could undermine the informative effects of menu labeling regulations. One of the goals of such labeling is to provide clear and concise information for consumers to use in making food decisions. Menus heavy on customizable dishes will be more difficult for the consumer to navigate, in terms of determining calorie content, because they will have to find and add together multiple calorie labels to calculate the final calorie total for an individual choice. This is a heavy cognitive burden for consumers to face at the point of sale. Consumer education may be necessary to raise awareness of the new trend in customized restaurant items and enable consumers to properly use the nutrition information in restaurants.

Appendix

Menus

Figure A.1. Mexican Menu, with Regular Label

Figure A.2. Asian Menu, with Regular Label

Figure A.3. Burgers Menu, with No Label

Figure A.4. Pizza Restaurant Menu, with Bold Label

Figure A.5. Pizza Stand Menu, with Regular Label

Figure A.6. Coffee Shop Menu, with Regular Label

Figure A.7. Ice Cream Parlor Menu, with Regular Label

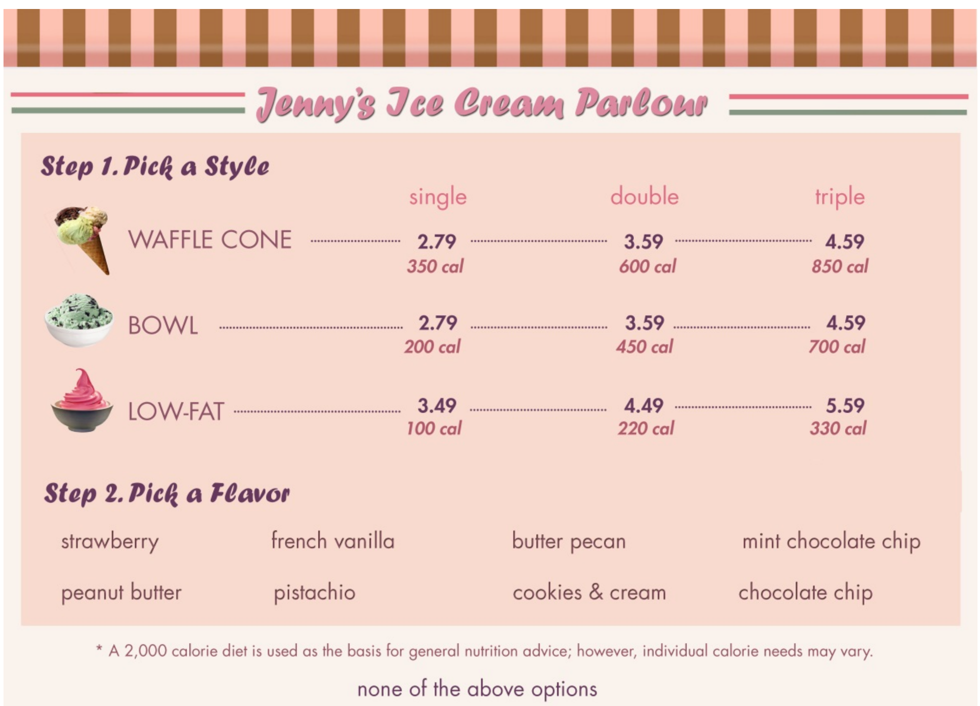


Figure A.8. Movie Theater Menu, with Regular Label

Figure A.9. Salad Bar Menu, with Bold Label

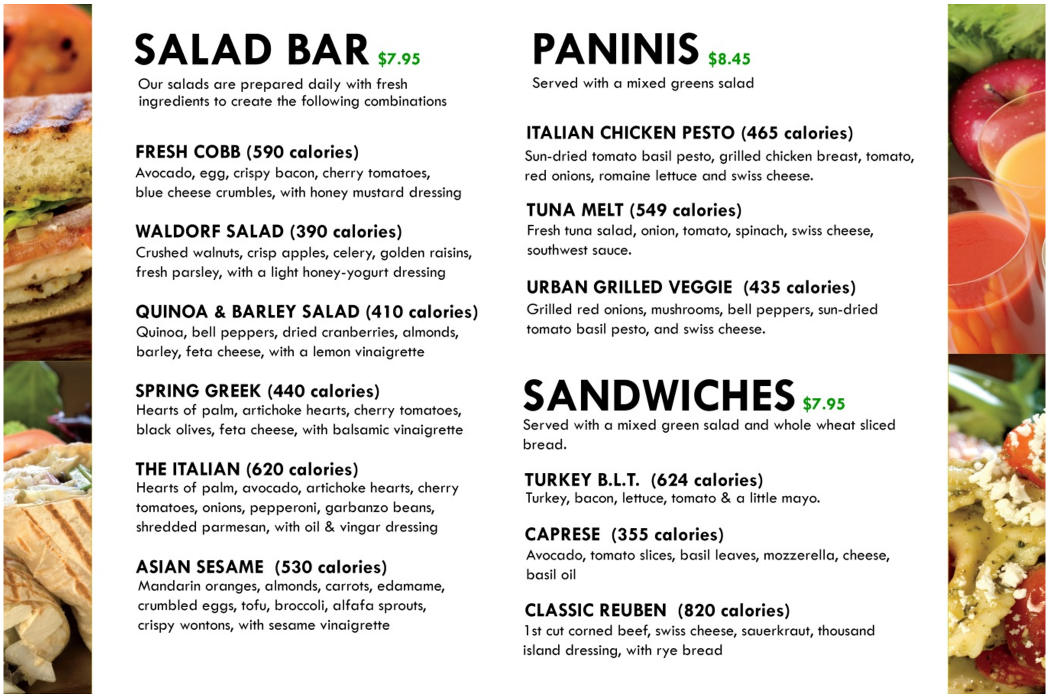


Table A.1. Burger Menu, Price Variations

Number	Type	Item	Price (Regular)	Calories (Lower Range for Combos)	Calories (Upper Range for Combos)	Price (Calorie Tax)	Price (Health Subsidy)
1	Small combo	1/4 lb. Single	4.59	780	930	5.51	4.59
2	Sandwich	1/4 lb. Single	2.59		430	2.59	2.07
3	Small combo	1/2 lb. Double w/ cheese	5.59	1,050	1,200	6.71	5.59
4	Sandwich	1/2 lb. Double w/ cheese	3.89		700	3.89	3.89
5	Small combo	3/4 lb. Triple w/ cheese	6.69	1,330	1,480	8.03	6.69
6	Sandwich	3/4 lb. Triple w/ cheese	4.89		980	5.87	4.89
7	Small combo	Homestyle Chicken	5.19	750	900	6.23	5.19
8	Sandwich	Homestyle Chicken	3.49		480	3.49	2.79
9	Small combo	Grilled Chicken	5.59	660	810	5.59	5.59
10	Sandwich	Grilled Chicken	3.89		350	3.89	3.11
11	Small combo	Asiago Ranch Chicken Club	6.69	1,080	1,230	8.03	6.69
12	Sandwich	Asiago Ranch Chicken Club	4.89		890	4.89	4.89
13	Full	Chicken Caesar Salad	5.49		580	5.49	5.49
14	Half	Chicken Caesar Salad	3.49		260	3.49	2.79
15	Full	Fresh Quinoa and Roasted Corn Salad	4.49		360	4.49	3.59
16	Half	Fresh Quinoa and Roasted Corn Salad	2.49		180	2.49	1.99

Results with Weights for Representativeness

Results reported in the main document refer to study participants only. As with all surveys, the composition of participants differs from the population composition. Randomization only ensures that there is no differential bias between groups in different arms of the experiment.

The online experiment was conducted using the RAND American Life Panel and one advantage is that weights are available to make the descriptive statistics representative of the U.S. population. The benchmark distributions against which the ALP is weighted are derived from the Current Population Survey. Documentation is available at ALP (undated).

The Office of Management and Budget approved this study as an experiment, but not as a nationally representative study. All main results, therefore, refer to study participants only. This appendix provides additional weighted results for the purpose of a sensitivity analysis.

Table A.2 uses weights, and the resulting descriptive statistics correspond to the U.S. adult population in the Current Population Survey. In contrast, Table 3.1 in the main text shows the descriptive statistics for study participants.

Table A.2. Sample Sociodemographic Characteristics, Weighted

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Non-Hispanic African-American	2,220	0.12		0	1
Non-Hispanic White	2,220	0.65		0	1
Asian or Pacific Islander	2,220	0.03		0	1
Other race	2,220	0.01		0	1
Hispanic	2,220	0.19		0	1
Income	2,213	67.99	54.85	2.5	250
Male	2,220	0.48		0	1
Age	2,220	47.67	16.51	20	93
Years of education	2,220	13.84	2.35	6	18
Finished high school	2,220	0.91		0	1
Some college	2,220	0.58		0	1
College degree	2,220	0.30		0	1
Employed	2,220	0.63		0	1
Number of other people in household	2,220	1.33	1.48	0	10

NOTE: Sample characteristics (unweighted) are shown in Table 3.1 in the main text.

Table A.3 shows the main regression results using analytic weights. This compares to Table 4.7 in the main analysis.

Table A.3. Total Calories on Treatment and Demographic and Health Covariates, Weighted

Variables	Asian	Burgers	Mexican	Pizza Restaurant	Pizza Stand	Salad Bar	Coffee Shop	Ice Cream Parlor	Movie Theater
Any label	−44.094*** (11.968)	−28.923** (13.680)	3.979 (17.009)	−32.039** (16.294)	−30.577* (17.798)	−16.740*** (6.339)	−21.622** (9.305)	4.260 (8.029)	−40.723 (26.980)
African-American	6.688 (19.246)	−76.374*** (22.758)	24.249 (29.344)	24.895 (28.363)	8.288 (28.277)	−3.963 (10.334)	56.065*** (16.268)	12.576 (13.190)	57.616 (42.002)
Hispanic	30.463* (15.777)	−54.898*** (19.220)	34.145 (23.671)	−24.895 (22.490)	55.310** (23.163)	−26.949*** (8.584)	46.960*** (13.050)	−9.902 (11.231)	91.122** (36.487)
White (reference category)									
Income	0.071 (0.121)	−0.417*** (0.148)	−0.475*** (0.178)	0.114 (0.163)	−0.238 (0.176)	−0.274*** (0.064)	−0.204** (0.098)	0.479*** (0.085)	−1.176*** (0.281)
Male	41.752*** (11.396)	145.533*** (13.904)	166.479*** (17.244)	83.336*** (16.204)	165.439*** (16.829)	54.696*** (6.113)	−39.311*** (9.469)	27.456*** (8.121)	82.519*** (26.887)
Age	−1.691*** (0.421)	−5.656*** (0.510)	−0.015 (0.643)	−0.790 (0.586)	−2.804*** (0.620)	0.837*** (0.227)	−1.112*** (0.356)	−1.383*** (0.295)	−1.621 (1.013)
Years of education	−0.489 (2.774)	−8.775** (3.435)	−22.404*** (4.197)	−22.855*** (3.936)	−20.196*** (4.169)	−6.658*** (1.464)	−4.991** (2.293)	−6.111*** (2.013)	−53.258*** (6.837)
Employed	10.532 (13.514)	26.787 (16.336)	−12.359 (20.266)	−43.147** (19.246)	−5.049 (19.995)	−0.236 (7.241)	−22.883** (10.893)	−10.061 (9.501)	83.862*** (31.510)
Number of other people in household	−6.041 (4.392)	−0.770 (5.263)	26.951*** (6.731)	3.476 (6.134)	−6.663 (6.301)	5.750** (2.346)	6.492* (3.560)	−3.155 (3.050)	44.873*** (9.705)
BMI	1.821** (0.869)	5.256*** (1.041)	−1.686 (1.308)	0.276 (1.236)	6.054*** (1.250)	1.504*** (0.459)	0.993 (0.696)	1.976*** (0.604)	−0.892 (1.977)
Hunger	2.182 (2.455)	12.864*** (3.014)	16.656*** (3.819)	12.274*** (3.523)	5.132 (3.666)	−1.080 (1.361)	4.655** (2.073)	9.310*** (1.745)	16.759*** (5.936)
Any health-conscious	−106.546*** (12.024)	−143.565*** (14.769)	6.613 (18.208)	−22.182 (17.089)	−39.878** (18.107)	−51.008*** (6.382)	−7.241 (10.209)	−78.772*** (8.648)	−30.445 (28.955)
Observations	1,980	1,878	1,765	1,691	1,893	1,870	1,468	1,904	1,298
R-squared	0.080	0.227	0.108	0.056	0.119	0.132	0.085	0.093	0.164

NOTE: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In Table A.4, we compare the estimates of the label effect between these two approaches. In both cases, there are no significant label effects in the Ice Cream Parlor or Movie Theater settings, but there are significant label effects in most regular meal settings. Estimated label effects are fairly similar in magnitude for most settings, but with a noticeable change in three: Weighted estimates are smaller for the Mexican and Pizza Restaurants, and larger for the Pizza Stand.

Qualitative changes are as follows:

- For the Mexican restaurant, the estimated effect in the unweighted regression is significant, but it is very small and statistically insignificant in the weighted regression.
- For the Pizza Stand, the estimated effect in the unweighted regression was insignificant, but it is larger in the weighted regression and statistically significant.
- For the Pizza Restaurant, the estimate in the weighted regression is half the size of the unweighted regression.
- For the Coffee Shop menu, the estimate in the weighted regression becomes statistically significant, although the increase in magnitude is small.

Table A.4. Comparison of Estimated Effects of Labeling on Calories Selected, Using Unweighted or Weighted Regression

Variables	Asian	Burgers	Mexican	Pizza Restaurant	Pizza Stand	Salad Bar	Coffee Shop	Ice Cream Parlor	Movie Theater
Any label (unweighted, as in Table 4.7)	−56.534*** (11.786)	−26.567** (13.085)	−34.072** (16.281)	−13.833 (15.585)	−60.173*** (16.063)	−25.331*** (6.435)	−13.557 (9.113)	0.078 (7.717)	−38.017 (25.870)
Any label (analytic weights, as in Table A.3)	−44.094*** (11.968)	−28.923** (13.680)	3.979 (17.009)	−32.039** (16.294)	−30.577* (17.798)	−16.740*** (6.339)	−21.622** (9.305)	4.260 (8.029)	−40.723 (26.980)

NOTE: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Bibliography

ALP—*See* RAND American Life Panel.

Auchincloss, Amy H., Giridhar G. Mallya, Beth L. Leonberg, Andrew Ricchezza, Karen Glanz, and Donald F. Schwarz, "Customer Responses to Mandatory Menu Labeling at Full-Service Restaurants," *American Journal of Preventive Medicine*, Vol. 45, No. 6, December 2013, pp. 710–719.

Backstrand, J. R., M. G. Wootan, L. R. Young, and J. Hurley, *Fat Chance: A Survey of Dietitians' Knowledge of the Calories and Fat in Restaurant Meals*, Washington, D.C.: Center for Science in the Public Interest, 1997.

Bleich, S. N., J. A. Wolfson, and M. P. Jarlenski, "Calorie Changes in Chain Restaurant Menu Items: Implications for Obesity and Evaluations of Menu Labeling," *American Journal of Preventive Medicine*, Vol. 48, No. 1, January 2015, pp. 70–75.

———, "Calorie Changes in Large Chain Restaurants: Declines in New Menu Items but Room for Improvement," *American Journal of Preventive Medicine*, Vol. 50, No. 1, January 2016, pp. e1–e8.

Bollinger, Bryan, Phillip Leslie, and Alan Sorensen, "Calorie Posting in Chain Restaurants," *American Economic Journal: Economic Policy*, Vol. 3, No. 1, 2011, pp. 91–128.

Bureau of Labor Statistics, "Consumer Expenditures—2015," Economic News Release, August 30, 2016. As of February 13, 2017:
https://www.bls.gov/news.release/cesan.nr0.htm

Centers for Disease Control and Prevention, "Healthy Weight, Overweight, and Obesity Among U.S. Adults," National Health and Nutrition Examination Survey, 2016. As of July 6, 2017:
https://www.cdc.gov/nchs/data/nhanes/databriefs/adultweight.pdf

Cutler, David M., Amber Jessup, Donald Kenkel, and Martha A. Starr, "Valuing Regulations Affecting Addictive or Habitual Goods," *Journal of Benefit-Cost Analysis*, Vol. 6, No. 2, June 2015, pp. 247–280.

Dumanovsky, Tamara, Christina Y. Huang, Cathy A. Nonas, Thomas D. Matte, Mary T. Bassett, and Lynn D. Silver, "Changes in Energy Content of Lunchtime Purchases from Fast Food Restaurants After Introduction of Calorie Labelling: Cross Sectional Customer Surveys," *BMJ*, July 26, 2011.

Elbel, Brian, "Consumer Estimation of Recommended and Actual Calories at Fast Food Restaurants," *Obesity*, Vol. 19, No. 10, October 2011, pp. 1971–1978.

Elbel, Brian, Rogan Kersh, Victoria L. Brescoll, and L. Beth Dixon, "Calorie Labeling and Food Choices: A First Look at the Effects on Low-Income People in New York City," *Health Affairs*, Vol. 28, No. 6, November–December 2009, pp. 1110–1121.

Elbel, Brian, Tod Mijanovich, L. Beth Dixon, Courtney Abrams, Beth Weitzman, Rogan Kersh, Amy H. Auchincloss, and Gbenga Ogedegbe, "Calorie Labeling, Fast Food Purchasing and Restaurant Visits," *Obesity*, Vol. 21, No. 11, November 2013, pp. 2172–2179.

Ellison, Brenna, Jayson L. Lusk, and David Davis, "Looking at the Label and Beyond: The Effects of Calorie Labels, Health Consciousness, and Demographics on Caloric Intake in Restaurants," *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 10, No. 21, February 8, 2013.

FDA—*See* U.S. Food and Drug Administration.

Fernandes, Ana C., Renata C. Oliveira, Rossana P. C. Proença, Cintia C. Curioni, Vanessa M. Rodrigues, and Giovanna M. R. Fiates, "Influence of Menu Labeling on Food Choices in Real-Life Settings: A Systematic Review," *Nutrition Reviews*, August 2016, Vol. 74, No. 8, pp. 534–548.

Finkelstein, Eric A., Kiersten L. Strombotne, Nadine L. Chan, and James Krieger, "Mandatory Menu Labeling in One Fast-Food Chain in King County, Washington," *American Journal of Preventive Medicine*, February 2011, Vol. 40, No. 2, pp. 122–127.

Hall, Kevin D., Gary Sacks, Dhruva Chandramohan, Carson C. Chow, Y. Claire Wang, Steven L. Gortmaker, and Boyd A. Swinburn, "Quantification of the Effect of Energy Imbalance on Bodyweight," *Lancet*, Vol. 378, No. 9793, August 27, 2011, pp. 826–837.

Hammond, David, Samantha Goodman, Rhona Hanning, and Samantha Daniel, "A Randomized Trial of Calorie Labeling on Menus," *Preventive Medicine*, Vol. 57, No. 6, December 2013, pp. 860–866.

Harnack, Lisa J., and Simone A. French, "Effect of Point-of-Purchase Calorie Labeling on Restaurant and Cafeteria Food Choices: A Review of the Literature," *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 5, No. 51, October 26, 2008.

Harnack, Lisa J., Simone A. French, J. Michael Oakes, Mary T. Story, Robert W. Jeffery, and Sarah A. Rydell, "Effects of Calorie Labeling and Value Size Pricing on Fast Food Meal Choices: Results from an Experimental Trial," *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 5, No. 63, December 5, 2008.

Haws, Kelly L., and Peggy J. Liu, "Half-Size Me? How Calorie and Price Information Influence Ordering on Restaurant Menus with Both Half and Full Entrée Portion Sizes," *Appetite*, Vol. 97, February 1, 2016, pp. 127–137.

Krieger, James W., Nadine L. Chan, Brian E. Saelens, Myduc L. Ta, David Solet, and David W. Fleming, "Menu Labeling Regulations and Calories Purchased at Chain Restaurants," *American Journal of Preventive Medicine*, Vol. 44, No. 6, June 2013, pp. 595–604.

Lin, Biing-Hwan, and Joanne Guthrie, *Nutritional Quality of Food Prepared at Home and Away From Home, 1977–2008*, Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, Economic Information Bulletin No. 105, December 2012.

Lin, Biing-Hwan, Joanne F. Guthrie, and Elizabeth Frazão, "Nutrient Contribution of Food Away From Home," in *America's Eating Habits: Changes and Consequences*, Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, Food and Rural Economics Division, Agriculture Information Bulletin No. 750, January 1999, pp. 213–242.

Long, M. W., D. K. Tobias, A. L. Cradock, H. Batchelder, and S. L. Gortmaker, "Systematic Review and Meta-Analysis of the Impact of Restaurant Menu Calorie Labeling," *American Journal of Public Health*, Vol. 105, No. 5, May 2015, pp. e11–e24.

MenuStat, "Interactive Restaurant Nutrition Database," home page, undated. As of June 26, 2017:
http://menustat.org/#/home

Namba, Alexa, Amy Auchincloss, Beth L. Leonberg, and Margo G. Wootan, "Exploratory Analysis of Fast-Food Chain Restaurant Menus Before and After Implementation of Local Calorie-Labeling Policies, 2005–2011," *Preventing Chronic Disease*, Vol. 10, June 20, 2013.

Newman, Andrew A., "How the Build-Your-Own Meal Craze Is Reshaping Restaurants," *Brand Marketing,* June 7, 2015. As of June 20, 2017:
http://www.adweek.com/brand-marketing/how-build-your-own-meal-craze-reshaping-restaurants-165206/

NPD Group, "Five Consumer Trends Shaping the Future of the Food and Foodservice Industries," press release, Chicago, May 7, 2015.

Open Science Collaboration, "Estimating the Reproducibility of Psychological Science," *Science*, Vol. 349, No. 6251, August 28, 2015.

Perkins, Kate Louise, "Nutrition Knowledge of Consumers and Health Professionals and the Use of Menu Calorie Labeling," *Theses and Dissertations—Dietetics and Human Nutrition*, University of Kentucky, 2012.

RAND American Life Panel, homepage, undated. As of June 20, 2017:
https://alpdata.rand.org/

Restaurants and Institutions Magazine, "2009 Top 400 Restaurant Chains," July 15, 2009. As of June 26, 2017:

https://www.rolypoly.com/news/articles/R&I%202009%20Top%20400%20Restaurant%20Chains.pdf

Roberto, Christina A., Peter D. Larsen, Henry Agnew, Jenny Baik, and Kelly D. Brownell, "Evaluating the Impact of Menu Labeling on Food Choices and Intake," *American Journal of Public Health*, Vol. 100, No. 2, February 2010, pp. 312–318.

Roseman, Mary G., Kimberly Mathe-Soulek, and Joseph A. Higgins, "Relationships Among Grocery Nutrition Label Users and Consumers' Attitudes and Behavior Toward Restaurant Menu Labeling," *Appetite*, Vol. 71, December 2013, pp. 274–278.

Sarink, D., A. Peeters, R. Freak-Poli, A. Beauchamp, J. Woods, K. Ball, and K. Backholer, "The Impact of Menu Energy Labelling Across Socioeconomic Groups: A Systematic Review," *Appetite*, Vol. 99, April 1, 2016, pp. 59–75.

Schoffman, Danielle E., Charis R. Davidson, Sarah B. Hales, Anthony E. Crimarco, Alicia A. Dahl, and Gabrielle M. Turner-McGrievy, "The Fast-Casual Conundrum: Fast-Casual Restaurant Entrées Are Higher in Calories Than Fast Food," *Journal of the Academy of Nutrition and Dietetics*, Vol. 116, No. 10, 2016, pp. 1606–1612.

Sinclair, S. E., M. Cooper, and E. D. Mansfield, "The Influence of Menu Labeling on Calories Selected or Consumed: A Systematic Review and Meta-Analysis," *Journal of the Academy of Nutrition and Dietetics*, Vol. 114, No. 9, September 2014, pp. 1375–1388.e15.

Specter Michael, "Freedom from Fries: Can Fast Food Be Good for You?" *The New Yorker*, November 2, 2015. As of June 20, 2017: http://www.newyorker.com/magazine/2015/11/02/freedom-from-fries

Sturm, Roland, Ruopeng An, Darren Segal, and Deepak Patel, "A Cash-Back Rebate Program for Healthy Food Purchases in South Africa: Results from Scanner Data," *American Journal of Preventive Medicine*, Vol. 44, No. 6, June 2013, pp. 567–572.

Swartz, J. J., D. Braxton, and A. J. Viera, "Calorie Menu Labeling on Quick-Service Restaurant Menus: An Updated Systematic Review of the Literature," *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 8, No. 135, 2011.

Tukey, J. W., *Exploratory Data Analysis*, Reading, Mass.: Addison-Wesley, 1977.

U.S. Department of Agriculture, "Food Away from Home," web page, December 30, 2016. As of June 20, 2017: https://www.ers.usda.gov/topics/food-choices-health/food-consumption-demand/food-away-from-home.aspx

U.S. Food and Drug Administration, "Food Labeling; Nutrition Labeling of Standard Menu Items in Restaurants and Similar Retail Food Establishments," *Federal Register*, Vol. 79, No. 230, December 1, 2014, pp. 71155–71259. As of June 13, 2017:

https://www.federalregister.gov/documents/2014/12/01/2014-27833/food-labeling-nutrition-labeling-of-standard-menu-items-in-restaurants-and-similar-retail-food

———, "How to Understand and Use the Nutrition Facts Label," web page, February 10, 2017. As of June 20, 2017: https://www.fda.gov/food/ingredientspackaginglabeling/labelingnutrition/ucm274593.htm#calories

VanEpps, E. M., C. A. Roberto, S. Park, C. D. Economos, and S. N. Bleich, "Restaurant Menu Labeling Policy: Review of Evidence and Controversies," *Current Obesity Reports*, Vol. 5, No. 1, March 2016, pp. 72–80.

World Health Organization, "Body Mass Index (BMI) Classifications," web page, 2006. As of June 26, 2017: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html

Wu, Helen, and Roland Sturm, "What's on the Menu? A Review of the Energy and Nutritional Content of U.S. Chain Restaurant Menus," *Public Health Nutrition*, Vol. 16, No. 1, January 2013, pp. 87–96. As of June 20, 2017: https://www.rand.org/pubs/external_publications/EP201200113.html

———, "Changes in the Energy and Sodium Content of Main Entrées in U.S. Chain Restaurants from 2010 to 2011," *Journal of the Academy of Nutrition and Dietetics*, Vol. 114, No. 2, February 2014, pp. 209–219.