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An unhealthy attitude? New insight into the modest effects of the NLEA

Mark Patterson[1]*, Saurabh Bhargava[1], George Loewenstein[1]

Abstract
We investigate the impact of the 1990 Nutrition Labeling and Education Act on attitudes and behaviors, using newly available survey data from several thousand consumers. Consistent with prior literature, we find that the introduction of the standardized labels only modestly affected purchasing behavior. However, we find that the limited success of the policy is not attributable to inattention to labels, or to the inability of consumers to act in accordance with their attitudes, but rather to the fact that the labels did not meaningfully shift consumer attitudes in favor of healthy eating. We interpret the failure of the labels to shift consumer attitudes as motivating the need for more psychologically informed labels or alternative policies that address the fundamental causes of poor diets.

JEL Classification: I18; K20; D03

Keywords
health policy — obesity — nutrition — information disclosure — health attitudes

[1] *Carnegie Mellon University, USA*
*__Corresponding author__: mpatters@andrew.cmu.edu

Introduction

For those interested in the impact of information on behavior, the Nutrition Labeling and Education Act (NLEA) of 1990 (implemented in May 1994) constitutes a superb test case. Enacting a dramatic increase in the availability, ubiquity and accuracy of information, the NLEA mandated standardized labeling of nutritional content –including calories, fat, cholesterol, fiber, protein, carbohydrate, sugars, sodium, calcium, iron, vitamin A, and vitamin C on all mass-produced, packaged foods sold in the United States[1]. If information provision has an impact on consumer behavior, the impact of the NLEA should be easy to observe.

Research documenting how the legislation influenced behavior, however, has found that the NLEA had at most a modest effect on purchasing and/or consumption patterns. In two widely cited examples, Abaluck (2011) and Variyam (2008) used consumer surveys to estimate the effect of the NLEA on food consumption through comparisons of groups likely to vary in their use of labels. Abaluck (2011) estimates a modest 50 - 90 calorie reduction per day for label users relative to non-users. Using a difference-in-difference design comparing consumption of labeled foods with those at restaurants, which were exempt from the NLEA labeling requirements, Variyam estimates small effects of label use for fiber and iron, and no differences for total consumption of calories, fat, saturated fat, cholesterol, sodium, calcium, or vitamins A or C.

Given growing concerns over diet-related public health challenges such as obesity and heart disease, understanding precisely why the NLEA failed to significantly change behavior is of considerable interest[2]. For example, policy-makers should draw vastly different lessons from the NLEA if the absence of a behavioral response was the result of consumer inattention to the labels, confusion about how to interpret them, or other factors. While the former two scenarios might embolden policy-makers to develop new, potentially more effective labels, alternative accounts based on, for example self-control problems or poor understanding of the long-term consequences of unhealthy eating[3], might instead point to the need for more structural solutions, such as those involving bans or taxes/subsidies on ingredients depending on their healthiness.

In this paper we organize explanations for the limited impact of the NLEA through a simple framework that captures policy-relevant connections between nutritional disclosure and consumer food purchases. We then use this framework to interpret new data which tracks the evolution of consumer beliefs and purchasing behavior starting from a period prior to when the NLEA labels were introduced. The exercise yields novel insights into the limited success of the NLEA and implies strategies for how to design future policies.

Our framework, depicted in the causal graph below, de-

[1] In addition to dramatically increasing the rate of labeling (from approximately 66% to 99% of prepackaged foods), the NLEA also included regulations imposed on the health and nutrition claims that could be made about foods.

[2] Labels may be an avenue through which policy-makers impact consumer choices. Some researchers may consider labels to fall under the broad description of nudges while others may not depending on their preferred definition.

[3] See Liu et al (2013) for a discussion.

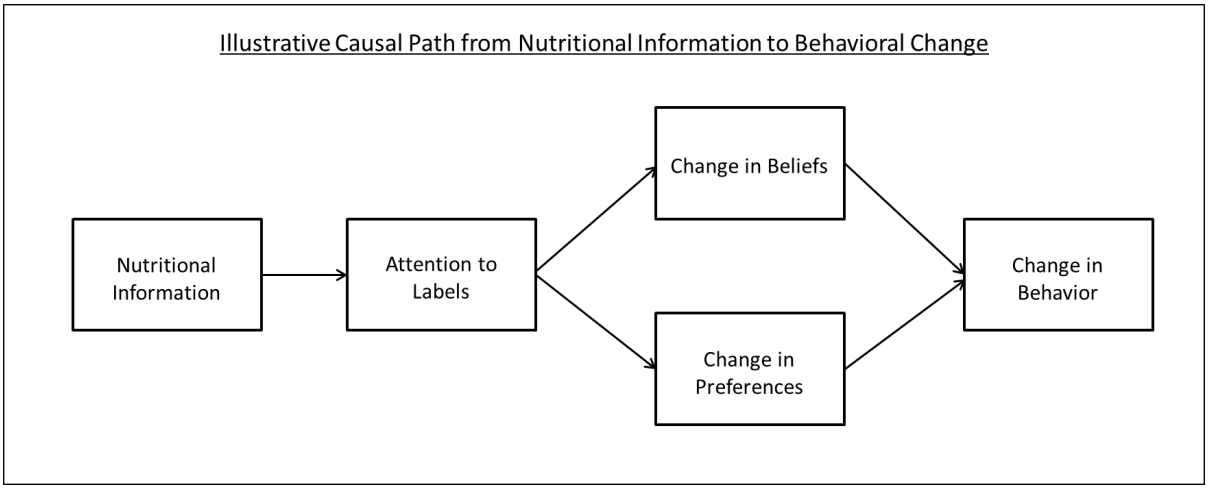

Figure 1

composes the link between labels and food consumption into pathways involving consumer attention, beliefs and/or preferences, and purchasing. The first pathway captures the critical need for consumers to pay attention to the labels in order for any behavior change to occur. Consumers might not attend to labels because they are too effortful or costly to read, the belief that such labels are not useful, because they might force consumers to confront the unpleasant consequences of diet choices that are unlikely to change, or in the long-run, because they've already updated their beliefs about what the nutritional content of what they eat. The second pathway reflects the possibility that even if consumers attend to labels, such labels may not change consumer beliefs (and/or preferences) about the relative healthiness of particular foods or the value of healthy eating over the long-run. A break in this second link might be expected, for example, if consumers do not know how to translate complicated labels into actionable insights about what foods to purchase or if consumers fail to understand the implications of high sugar or caloric intake. Finally, we note that even if the labels succeed in changing potentially inaccurate beliefs regarding the healthiness of particular foods, behavior may remain unchanged due to strong, pre-existing preferences (e.g., due to their convenience, taste, or price) or because of the aforementioned behavioral considerations (e.g., limited self-control, visceral factors such as hunger) that could lead to the impulsive purchasing.

Although the direct measure of beliefs, or preferences –alternatively described as "attitudes"– is not a typical focus of economists (perhaps in part because, unlike prices and purchases, they are not directly observable), psychologists, and in recent years, even some economists, have pointed to the potential usefulness of attitudes as a predictor of behavior and as an important mediating factor for understanding the impact, or lack of impact, of policies. Prina and Royer (2012), for example, point out the shortcomings of a restricted focus on behavioral measures: "Many informational interventions look at behaviors without documenting whether the information is absorbed and retained, making it then difficult to understand why the intervention was ineffective in the case of null results." In one of the more explored applications to date, prior work has shown that consumer attitudes regarding the dangers of marijuana use strongly predict its actual use by students (Bachman et al., 1988; Bachman, Johnston and O'Malley, 1998). A later study (Pacula et al., 2000), reached similar conclusions and actually found attitudinal measures more reliably predicted usage than variation in prices.

Guided by this framework, we examine the success of the NLEA with novel data from a market research firm (The NPD Group) that, beyond detailing the purchasing behavior of several thousand households, also captures self-reported attention to food labels and consumer attitudes towards several dimensions of healthy, and unhealthy, eating. We interpret these attitudes as largely reflecting consumer beliefs about the importance of healthy eating and taste of healthy foods, although such measures could also reflect consumer preferences for different food items. The NPD survey was administered across a lengthy time-period stretching across the implementation of the NLEA and therefore offers insights into consumer response over lengthier horizons than most prior studies. The data additionally permits an analysis across different types of foods as well as consumer sub-groups varying by potential dimensions of policy interest such as education and income.

Our analysis confirms prior research in finding only modest effects of the NLEA on patterns of purchasing behavior. We supplement this finding, however, with new findings. First, we find a moderate rise, of about 3 to 4 percent points, relative to a steady downward secular trend, in the rate at which consumers attend to food labels. This rise in relative attentiveness was restricted to the few-year period following the introduction of the labels, after which attention continued to decline. Second, while beliefs and preferences for healthy and unhealthy foods predict purchasing behavior, the NLEA failed to significantly shift consumer attitudes in favor of healthy foods, even in the period characterized by heightened attention. Moreover, in the longer-run, suggesting phenomena unrelated to labels, we observe that consumers adopt increas-

ingly negative attitudes towards healthier foods–including negative inferences about the taste of healthy foods. Finally, while we observe a rise in the share of consumers who pay attention to labels across all consumers, and find no statistically significant evidence for systematic shifts in behavior across sub-groups, we report suggestive evidence that lower-income households may have increased both favorable attitudes towards healthy foods and consumption of such products.

Collectively, these patterns suggest that the, at best, modest impact of the NLEA was not due to inattention to or unawareness of the new labels, or to deficits in self-control or otherwise impulsive purchasing, but to labels that did not successfully shift consumer attitudes away from unhealthy eating. If anything, over very long-run horizons, we observe shifts towards more positive attitudes towards unhealthier foods which may have overwhelmed any beneficial effects of the labels themselves (or may have, perversely, been encouraged by such labels). Returning to the framework, the evidence is consistent with the possibility that alternative disclosures may be more successful at educating and persuading consumers about the longer-run benefits and costs associated with eating. This interpretation is consistent with the efficacy of simple, vivid labels, such as those that include traffic lights (e.g., VanEpps et al. forthcoming; Enax et al. 2015)[4].

Alternatively, the ineffectiveness of the labels in changing attitudes, and reversing broader trends, might suggest the need for policies that go beyond information disclosure to those that might affect the price, convenience, and availability of food. If true, there is reason to believe that the recently announced revisions to nutritional labels by the FDA may not lead to the massive changes to behavior intended by policy-makers[5].

Description of the data

The empirical analysis is based on a household-level data set consisting of 10,755 households, collected between 1989 and 2000. The analysis involves behavioral, attitudinal, and demographic data from three distinct surveys linked by household and collected by the NPD group's Food Service Division. The data are collected in an unbalanced panel, with approximately 63% of households (n=6806) observed for a single year, 15% of households (n=1628) observed in two years, and 22% (2321) of households observed in three or more years[6]. Subject demographic characteristics are summarized in Table 1.

Table 1. *Demographics and Behaviors: Summary*

Panel A: Household Characteristics

	Mean	SD	N
Age	46.35	15.26	10755
Income	43.50	33.25	10755
Male	0.46	-	10755
White	0.88	-	10755
Black	0.08	-	10755
Asian	0.01	-	10755
Other race	0.02	-	10755
Some high school	0.08	-	10731
High school graduate	0.27	-	10731
Some college	0.27	-	10731
College graduate	0.39	-	10731
No children	0.61	-	10755
Married	0.67	-	10755
Divorced	0.09	-	10755
Single	0.18	-	10755
Widowed	0.60	-	10755

Panel B: Behavioral Measures

	Mean	SD	N
Label Reading	0.62	0.48	18390
Milk Fat	3.8	2.68	17250
Cereal Calories	357	28.78	11056
Cereal Fiber	7.88	6.7	11056
Cereal Sugar	16.95	11.07	11056
Snack Pct	0.06	0.08	20062
Vegetable Pct	0.20	0.21	20073
Wheat Bread Pct	0.41	0.45	15704

Notes: Household characteristics are reported for the first observation from each household in the dataset. Income measured in thousands of dollars, adjusted for inflation to 1999 dollars. Geographic state is measured and included in the regressions, but not reported in the table.

Our data on consumer purchasing comes from a set of food diaries that capture household consumption of food over two-week periods[7]. For tractability, we focus on several distinct categories of consumption that indicate healthy or unhealthy consumption: Milk Fat, which is the average fat content measured in grams per cup of the white milk individuals consume, cereal sugar and cereal fiber content per 100 grams of cereal consumed, snacking behavior, measured by the share of food consumption instances which occur between meals, vegetable consumption, which reports the proportion of diary days on which an individual documents at least three servings of vegetables, and wheat bread, which reports the share of bread consumed which is wheat (out of all wheat and white consumption)[8].

[4] This interpretation is supported by recent demonstrations of how simplification in disclosures shapes behavior across a variety of important policy domains ranging from educational choice (e.g., Hastings and Weinstein, 2008), health care (e.g., Kling et al., 2012, Bhargava, Loewenstein, and Sydnor forthcoming), retirement savings (e.g., Beshears et al. 2013), and to the take-up of government benefits (e.g., Bhargava and Manoli 2015).

[5] As reported by the FDA on May 20, 2016: http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm502182.htm.

[6] Resampling is contingent on several criteria –NPD uses a balancing algorithm (across demographic features.) to select a subset of the completed cases for analysis; for the present study, we predominantly treat the data as a repeated cross section, clustering on household identifiers where observations are repeated.

[7] Subjects maintain diaries for one 14-day period per year of study participation. Household participation duration varies. Approximately 63% of households are observed for a single year, 15% of households are observed in two years, and 22% of households are observed in three or more years.

[8] The use of average health characteristics among reported consumption is additionally beneficial as a strategy for avoiding biased estimates due to

Attitudinal data were obtained from two surveys administered yearly in March and then September. These surveys captured general health attitudes (e.g. "Household meals should be planned in order to make sure they are nutritious"; "How food tastes is more important than how nutritious it is"), attitudes towards specific food items (e.g., "I encourage the drinking of whole milk") or types of preparation, (e.g., "I try to avoid fried food", and "A person should be very cautious in serving foods with cholesterol"), as well as propensity to read nutritional labels (e.g., "I frequently check labels to determine whether foods I buy contain anything I'm trying to avoid").

Due to the large number of attitudinal variables in our data, we statistically isolated a set of first looked for underlying structure in attitudes through the use of factor analyses, a technique commonly used by researchers to reduce dimensionality. We extract five factors from each of the surveys and describe these in Table 2[9]. These factors explain a total of 47% of the variance of the items on the March instrument, and 41% of the variance of the items on the September instrument. From the first survey, the first factor was labeled "Caution with unhealthy nutrients", reflecting the high loading scores for caution with cholesterol, fat, sugar, and preservatives. The second factor was labeled "Active Dieting", reflecting conscious efforts to reduce fat and cholesterol intake. Label reading, meal planning, and avoidance of fried foods all load strongly on this factor. The third factor was labeled "Encouragement of Unhealthy Foods" to reflect strong loadings from items related to the intake of butter, bacon, whole milk, and gravy. Of note, larger values on this factor reflect greater encouragement of such unhealthy foods. The fourth factor was labeled "Encouragement of Substitutes" to reflect strong loadings from items related to the encouragement of equal, diet margarine, and diet carbonated soft drinks. The final factor from the first survey was labeled "Encouragement of Healthy Foods" to reflect strong encouragement of two healthy foods (oatmeal and turkey), and negative loadings for the value of taste over nutritional content, and food convenience.

The factors extracted from the second survey instrument (administered in September and January) are generally similar. We find general factors for caution as well as encouragement of both healthy and unhealthy foods. Unique to the September survey are general attitudes toward meal planning, reflecting strong loadings from items such as consciousness of calories, confidence in nutritional knowledge, etc., and a factor reflecting the belief that healthy foods do not taste good. By construction, the factors have mean zero; the standard deviation for the extracted sample ranges from 0.74 (Importance of Taste) to 0.94 (Caution with unhealthy nutrients).

under-reporting of total consumption (e.g. Sawaya et al. 1996 demonstrate that subjects may under-report consumption in food diaries by as much as 10%).

[9]We conducted the Factor analysis using varimax rotation on listwise complete observations. Fifty-one items relating to attitudes toward health, 22 from the March instrument, and 29 from the September instrument, were factor analyzed. Factor loadings are used to generate attitudinal measures by taking the dot product of the loadings for a factor with individual item responses.

Empirical analysis

i. Empirical Strategy

Our empirical approach involves examining residual plots of behavioral measures and attitudinal factors, after controlling the demographic characteristics of respondents, before and after the May 1994 introduction of labels. We also explicitly estimate the change in outcomes across windows of varying length, estimating a regression of the following form for each behavioral and attitudinal measure of interest:

$$Y_i^k = \alpha + \gamma POST_i + \lambda YEAR_i + \beta X_i + \varepsilon_i \quad (1)$$

The regressions include controls for linear time trends by year and a vector of demographic characteristics (X_i)[10]. The coefficient of primary interest is POST, an indicator for whether an observation occurred after the presumed introduction of the labels. We estimate this model for windows of varying lengths of two, three and four years, around the introduction of the labels to understand both the immediate reaction to the legislation as well as longer-run dynamics. We caution, however, that an inspection of the figures suggests that the linear time-trend assumed in the model fails to capture the shape of long-run change for some of the measures.

As an additional test of the effect of NLEA labeling on behavior, we present a case study of cereals, a product category for which we can clearly identify healthy and unhealthy exemplars. We examine differences in the consumption of the five healthiest and five least healthy cereals among the thirty most commonly consumed in our data. Finally, to assess the relationship between attitudes and behaviors, we present a series of bivariate correlations for households for which there is available data.

ii. Effect of NLEA on behavior and attitudes

We first document the effect of the NLEA on the self-reported propensity to read labels (Table 3 and Figure 2). The surveys indicate that consumers were about 3 to 4 percentage points more likely to read labels relative to a general decreasing baseline trend in label reading, over the +/- 3 year and +/- 4 year windows. As one interpretation of the magnitude of this effect, the observed increase in reading labels following the NLEA offsets is large enough to offset the secular downward trend by approximately 2 years.

The moderate increase in attention to labels was not long-lived. By 1998 label reading returned to the level suggested by the pre-1994 temporal trend. Aggregate survey measures, reported by the NPD Group, using its National Eating Trends product, suggest similar patterns. The survey, which documents label reading propensity among homemakers, found that the likelihood of "frequently" checking labels after 1990

[10]The models for behavioral data additionally include fixed effects for the month of the year in which a data diary was completed. To accommodate a small number of households with multiple observations, we cluster robust standard errors at the household level.

Table 2. *Attitudinal Factor Loadings*

Panel A: Variables from March attitudinal survey (NPD)

	Extracted Factors				
	Caution	Dieting	Unhealthy	Substitutes	Healthy
Caution with salt	0.8				
Caution with cholesterol	0.79				
Caution with fat	0.76	0.3			
Caution with sugar	0.67				
Caution with preservatives	0.66				
Dieting directed at fat reduction		0.84			
Dieting directed at cholesterol reduction	0.34	0.72			
Label reading frequency		0.53			
Value of meal planning		0.37			0.34
Avoidance of fried foods	0.3	0.37	-0.3		
Encouragement of butter			0.69		
Encouragement of bacon			0.67		
Encouragement of whole milk			0.64		
Encouragement of gravy			0.58		
Belief that best known brands are highest quality					
Encouragement of equal				0.72	
Encouragement of diet margarine				0.62	
Encouragement of diet carbonated soft drinks				0.61	
Encouragement of oatmeal					0.54
Encouragement of turkey					0.49
Value of taste over nutritional content					-0.33
Value of food convenience					-0.35
Proportion of Variance	0.15	0.1	0.1	0.07	0.05
Cumulative Variance	0.15	0.25	0.34	0.41	0.47

Panel B: Variables from September attitudinal survey (NPD)

	Extracted Factors				
	Unhealthy	Caution	Planning	Healthy	Taste
Encouragement of french fries	0.78				
Encouragement of fried chicken	0.7				
Encouragement of lunchmeat	0.67				
Encouragement of pizza	0.63				
Encouragement of tacos	0.62				
Encouragement of hot dogs	0.59				
Encouragement of white bread	0.53				0.33
Encouragement of whole milk	0.5			-0.4	
Encouragement of pre-sweetened cereal	0.5				
Caution with additives		0.83			
Caution with preservatives		0.81			
Caution with fat		0.76			
Caution with salt		0.76			
Caution with cholesterol		0.74			
Caution with sugar		0.64			
Value of meal planning			0.68		
Consciousness of calories			0.5		
Confidence in nutritional knowledge			0.41		-0.38
Belief that healthy foods must have body-building ingredients			0.37		
Value of eating regular meals			0.36		
Snack avoidance			0.34		
Hesitation with giving children sweets			0.3		
Encouragement of granola					
Encouragement of skim milk				0.68	
Encouragement of turkey			0.3	0.44	
Encouragement of rice				0.36	
Encouragement of margarine				0.35	
Belief that healthy foods do not taste good					0.32
Desire to lose weight					
Proportion of Variance	0.13	0.13	0.07	0.05	0.03
Cumulative Variance	0.13	0.26	0.33	0.38	0.41

Note: Extraction method: principal axis, loadings below 0.3 are suppressed.

Table 3. *The Impact of the NLEA on Behavior*

	Post coefficients for windows surrounding the NLEA (OLS)			
	+/- 2 years 1992 - 1996 (1)	+/-3 years 1991 - 1997 (2)	+/-4 years 1990 - 1998 (3)	Full Dataset 1989 - 2000 (4)
Label Reading	0.005	0.035**	0.038**	0.033**
	(0.02)	(0.016)	(0.015)	(0.013)
Milk Fat	0.106	0.117	0.006	-0.05
	(0.114)	(0.091)	(0.081)	(0.074)
Cereal Calories	0.157	0.133	-0.294	0.147
	(1.86)	(1.405)	(1.199)	(1.041)
Cereal Fiber	0.085	0.111	0.226	0.065
	(0.43)	(0.324)	(0.278)	(0.243)
Cereal Sugar	-0.675	-0.022	-0.018	-0.281
	(0.678)	(0.535)	(0.462)	(0.401)
Snack Pct	-0.006*	-0.004	-0.003	-0.001
	(0.004)	(0.003)	(0.003)	(0.002)
Vegetable Pct	0.003	0.001	0.002	0.002
	(0.008)	(0.007)	(0.006)	(0.005)
Wheat Bread Pct	0.023	0.018	0.009	0.003
	(0.022)	(0.017)	(0.015)	(0.013)

Notes: Table reports the regression coefficient on an indicator for whether an observation occurred after the May 8, 1994 enforcement of the NLEA. Regressions control for demographic characteristics and allow for a linear yearly time trend in addition to month fixed effects. Robust standard errors, reported in parentheses, are clustered at the household level. * ($p \leq 0.1$), ** ($p \leq 0.05$), *** ($p \leq 0.01$)

Table 4. *The Impact of the NLEA on Attitudes*

	Post coefficients for windows surrounding the NLEA (OLS)			
	+/- 2 years 1992 - 1996 (1)	+/-3 years 1991 - 1997 (2)	+/-4 years 1990 - 1998 (3)	Full Dataset 1989 - 2000 (4)
Caution (March)	0.045	0.03	0.051	0.049*
	(0.044)	(0.035)	(0.031)	(0.027)
Caution (September)	-0.042	-0.072*	-0.051	-0.035
	(0.05)	(0.039)	(0.034)	(0.03)
Unhealthy (March)	-0.029	-0.056*	-0.071***	-0.066***
	(0.037)	(0.03)	(0.027)	(0.024)
Unhealthy (September)	-0.016	-0.03	-0.055*	-0.057**
	(0.048)	(0.037)	(0.033)	(0.029)
Healthy (March)	-0.003	0.004	0.003	-0.004
	(0.032)	(0.026)	(0.023)	(0.021)
Healthy (September)	0.044	0.025	0.001	0.006
	(0.044)	(0.034)	(0.03)	(0.026)
Dieting (March)	-0.054	-0.021	0.011	0.016
	(0.04)	(0.033)	(0.029)	(0.026)
Substitutes (March)	-0.030	-0.043	-0.028	-0.015
	(0.022)	(0.031)	(0.027)	(0.024)
Planning (September)	0.146***	0.094***	0.069**	0.015
	(0.043)	(0.033)	(0.029)	(0.026)
Taste (September)	-0.016	-0.012	-0.005	0.018
	(0.036)	(0.029)	(0.025)	(0.022)

Notes: Table reports the regression coefficient on an indicator for whether an observation occurred after the May 8, 1994 enforcement of the NLEA. Regressions control for demographic characteristics and allow for a linear yearly time trend. Robust standard errors, reported in parentheses, are clustered at the household level. * ($p \leq 0.1$), ** ($p \leq 0.05$), *** ($p \leq 0.01$)

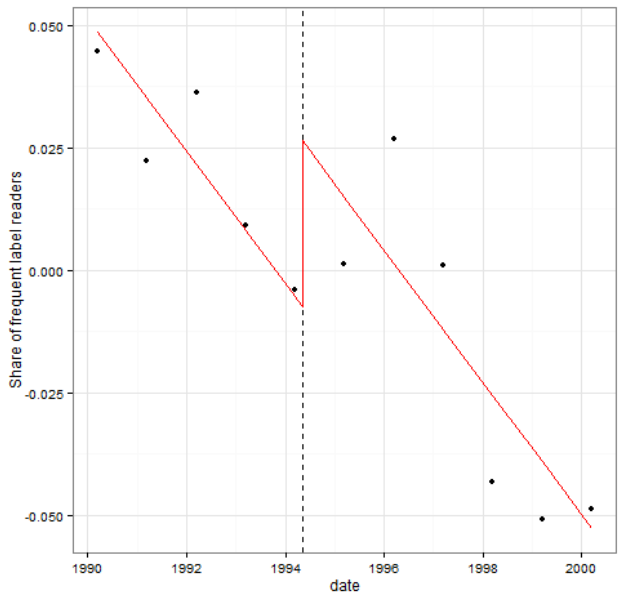

Figure 2. Label Reading

Notes: Figure presents residuals (averaged at the level of a survey period) from a regression of label reading on a set of demographic controls. The red line presents the ftted values when these residuals are regressed on a temporal variable and an indicator for whether an observation occurrs after the enforcement of the NLEA. The size of the discontinuity reflects the size of the coeffcient on the POST indicator in table 3 in the 'Full Dataset' column.

peaked in 1995 (63.5%), steadily declined until 2002 (50.7%) and has been largely stable since[11].

Table 3 and Figure 3 capture the effect of the NLEA on consumer behavior. With the exception of a marginally significant reduction in snacking, we observe no effects of the NLEA on any of the assessed behaviors. While the estimates vary in their precision, there is no systematic directional pattern in the results consistent with healthier eating after the policy enactment.

To further explore the policy's effect, we examine changes in the consumption of cereal, a product for which we can clearly identify healthy and unhealthy exemplars. While the main regressions suggest no changes in the mean consumption of calories, fiber or sugar from cereals, our case study permits us to detect any change in purchases of specific cereals. As one particular strong test of the effect of labels, we compare the consumption of the five healthiest and five unhealthiest cereals, as measured by sugar content, among the thirty cereals that are most commonly consumed. The results, summarized in Figure 5, indicate no systematic change in consumption of healthy relative to unhealthy cereals associated with the policy implementation.

Table 5 summarizes the analysis of the NLEA on health attitudes. We observe no impact of the NLEA on the generic encouragement of healthy foods, active dieting, encouragement of substitutes, or the belief that healthy foods do not taste good. Of the ten attitudinal measures, over the +/- 4 year window, we observe a significant change only in the encouragement of unhealthy foods and in intent to plan meals. Yet, when interpreted in the context of Figure 3, which displays the average of the residual measures each year conditioned on respondent demographics, our regression estimates are likely the product of our simplifying assumption of a linear-trend and an estimation window that fails to capture strong broader trends. Indeed, over lengthier windows, if anything, we observe strong long-run shifts in encouragement that strongly favor unhealthy eating.

While the aggregate analysis of behaviors fails to reveal a clear impact of the NLEA on either, it is possible that the policy may have impacted certain sub-populations of consumers characterized by income, education and race. This analysis, summarized in Table 3, suggests a uniform rise in label- reading across groups, and also provides suggestive evidence that, over shorter windows, consumers in low, as compared to high, income households may have shifted away from unhealthier foods as evidence by consumption of cereal calories (Low-Income: β = -1.3, ns; High-Income: β = +2.0, ns) and fibers (Low- Income: β = +0.4, ns; High-Income: β = -0.3, ns). We find some similar patterns with respect to attitudes towards healthy (e.g., oatmeal and skim milk) and unhealthy foods (e.g., French fries, butter, and bacon). However, due to small samples, the analysis of heterogeneity is fairly imprecise.

iii. Correlation between attitudes and behavior

Finally, to assess the extent to which attitudinal variables predict the behavioral measures, we examine bivariate correlations in the pooled data, as summarized in Table 6. Here, we partition both attitudes and behaviors into "healthy" and "unhealthy" subsets. We observe a negative association between healthy attitudes and unhealthy consumption and a positively association between such attitudes and healthy consumption (Panel A) and the converse set of relationships between unhealthy attitudes and consumption (Panel B). While this evidence is not causal, it is consistent with the presumed causal relationship between consumer attitudes and their behavior.

Conclusion

In this paper, we leverage a novel dataset featuring both behavioral and attitudinal measures to help understand the widely documented failure of the NLEA to significantly change consumer behavior. To make sense of the data in a way that can inform policy discussions, we introduced a simple framework to organize explanations for consumer response to information disclosures. Overall, our analyses confirm past findings of the limited effect of the NLEA on consumer diet.

The framework helps to rule out consumer inattention to labels as an explanation for the limited success of the labels. The majority of consumers profess to read labels regularly, and if anything, the revised NLEA labels appeared to prompt even more label-reading, at least in the brief period following

[11] Press release describing results on NPD website: https://www.npd.com/wps/portal/npd/us/news/press-releases/u-s-consumers-interest-in-reading-nutrition-facts-labels-wanes-as-time-goes-on-reports-npd/, retrieved December 2016.

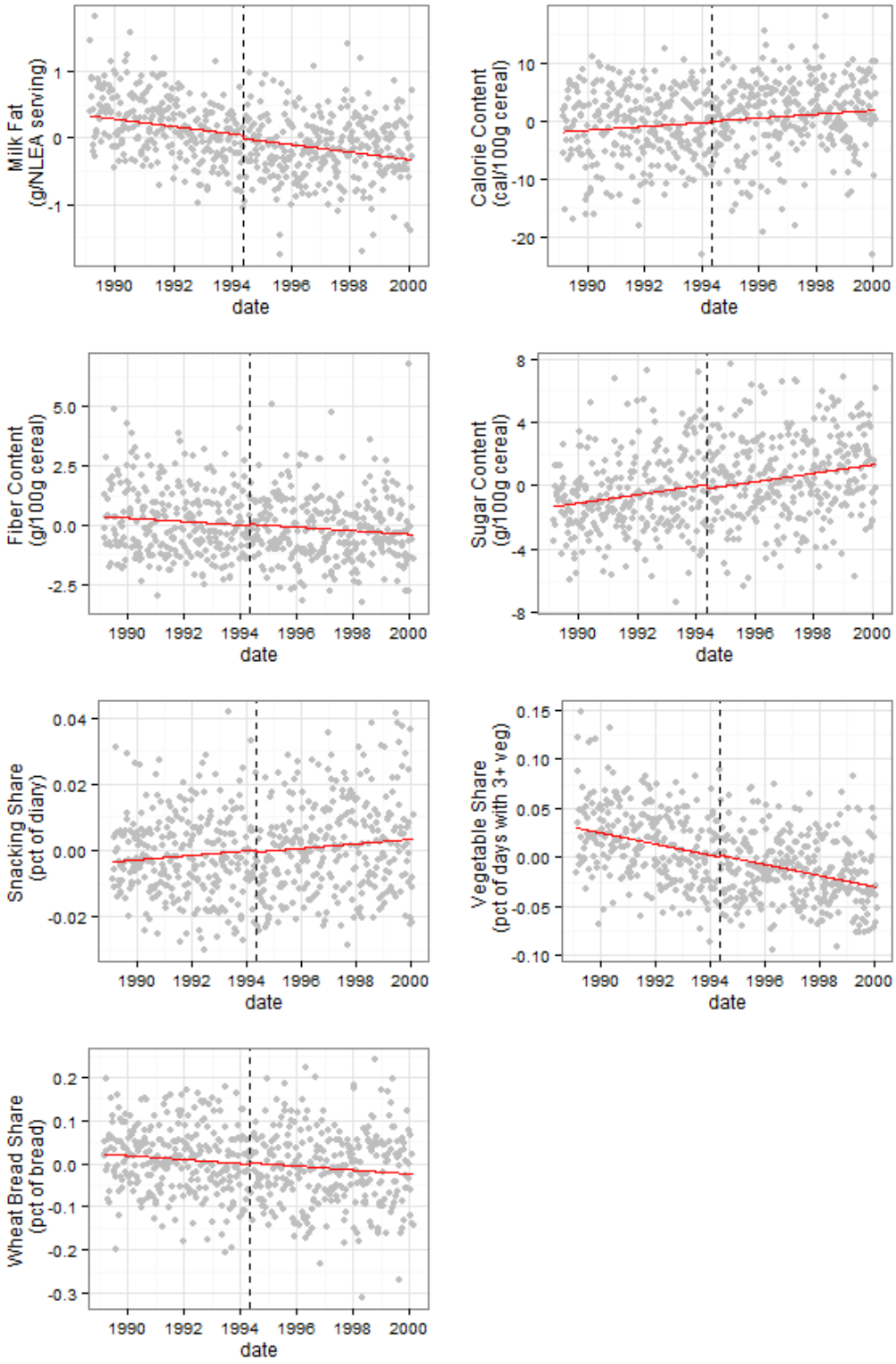

Figure 3. Behavioral Measures

Notes: Each panel plots residuals (averaged at the level of a food diary period) from regressions of behavioral measures on a set of demographic controls and an indicator for the survey month. The red line presents the fitted values when these residuals are regressed on a temporal variable and an indicator for whether an observation occurs after the enforcement of the NLEA. The size of the discontinuities reflect the size of the coefficients on the POST indicator in table 3 in the 'Full Dataset' column.

Table 5. Effects of the NLEA by Demographic Subgroups

	Post coefficients for demographic subgroups					
	Income $<$ 35k	Income $>=$ 35k	Non-college graduate	College graduate	Black	White
	(1)	(2)	(3)	(4)	(5)	(6)
Label Reading	0.036*	0.035*	0.029*	0.049**	0.074	0.033**
	(0.019)	(0.019)	(0.016)	(0.023)	(0.045)	(0.014)
Milk Fat	0.01	-0.108	-0.023	-0.118	-0.186	-0.049
	(0.107)	(0.103)	(0.093)	(0.124)	(0.274)	(0.077)
Cereal Calories	-1.268	2.083	-0.834	1.844	-3.472	0.66
	(1.555)	(1.514)	(1.236)	(1.836)	(2.822)	(1.115)
Cereal Fiber	0.373	-0.305	0.335	-0.347	0.826	-0.053
	(0.371)	(0.35)	(0.29)	(0.426)	(0.665)	(0.261)
Cereal Sugar	-0.509	-0.134	-0.239	-0.5	2.747*	-0.398
	(0.559)	(0.59)	(0.495)	(0.685)	(1.587)	(0.417)
Snack Pct	0.000	-0.002	-0.003	0.005	0.005	-0.001
	(0.003)	(0.003)	(0.003)	(0.004)	(0.008)	(0.002)
Vegetable Pct	0.000	0.004	0.001	0.007	0.005	0.003
	(0.007)	(0.008)	(0.006)	(0.009)	(0.018)	(0.006)
Wheat Bread Pct	0.023	-0.016	0.002	0.007	-0.002	0.005
	(0.019)	(0.019)	(0.016)	(0.025)	(0.044)	(0.014)
Caution (March)	0.098**	0.008	0.052	0.05	0.177	0.046
	(0.041)	(0.037)	(0.035)	(0.044)	(0.109)	(0.028)
Caution (September)	0.004	-0.07*	-0.03	-0.036	0.147	-0.041
	(0.045)	(0.04)	(0.038)	(0.047)	(0.099)	(0.031)
Unhealthy (March)	-0.059	-0.064**	-0.067**	-0.071*	-0.037	-0.066***
	(0.038)	(0.031)	(0.032)	(0.038)	(0.094)	(0.025)
Unhealthy (September)	-0.084*	-0.044	-0.06	-0.066	0.025	-0.06**
	(0.043)	(0.038)	(0.037)	(0.046)	(0.116)	(0.03)
Healthy (March)	-0.005	-0.001	-0.009	0.01	-0.058	-0.002
	(0.031)	(0.029)	(0.026)	(0.034)	(0.081)	(0.022)
Healthy (September)	0.054	-0.033	0.001	0.027	0.042	-0.007
	(0.038)	(0.036)	(0.033)	(0.042)	(0.09)	(0.028)
Dieting (March)	0.017	0.021	0.029	-0.001	0.052	0.008
	(0.039)	(0.034)	(0.032)	(0.044)	(0.089)	(0.027)
Substitutes (March)	0.006	-0.035	0.000	-0.05	-0.126	-0.008
	(0.035)	(0.034)	(0.03)	(0.041)	(0.089)	(0.026)
Planning (September)	0.056	-0.022	0.05	-0.041	0.088	0.008
	(0.038)	(0.035)	(0.033)	(0.041)	(0.108)	(0.027)
Taste (September)	0.022	0.009	0.029	-0.025	-0.031	0.031
	(0.032)	(0.031)	(0.028)	(0.036)	(0.079)	(0.023)

Notes: Table reports the regression coefficient on an indicator for whether an observation occurred after the May 8, 1994 enforcement of the NLEA. Regressions control for demographic characteristics and allow for a linear yearly time trend. Robust standard errors, reported in parentheses, are clustered at the household level. * ($p \leq 0.1$), ** ($p \leq 0.05$), *** ($p \leq 0.01$)

the introduction of the labels. Although we did observe correlations between attitudes and behavior that are consistent with a causal impact of the former on the latter, relying on plots of residual attitudes over time, we find that the labels did not lead to a significant shift in consumer attitudes over horizons extending beyond a few years. Moreover, we found that the labels did not lead consumers to place greater importance on healthy eating and, if anything, did not deter longer-run attitudinal trends in favor of unhealthy eating.

These patterns, as well as the possibility that labels led to negative inferences about the taste of healthy foods, suggests that the labels failed to communicate the adverse consequences of poor eating in the long-run. In light of other research pointing towards the importance of simple nutritional disclosures, such as traffic lights, that can be easily interpreted (e.g., VanEpps et al. forthcoming), this failure could be due to overly complicated labels, or labels which fail to highlight the consequences of healthy or unhealthy eating. More generally, the large shifts in consumer attitudes towards unhealthy foods, point to the potential limits of information disclosure and hint at the promise of more aggressive policies directly engaging food cost, availability, convenience, and marketing as a means of achieving large-scale changes to consumer behavior.

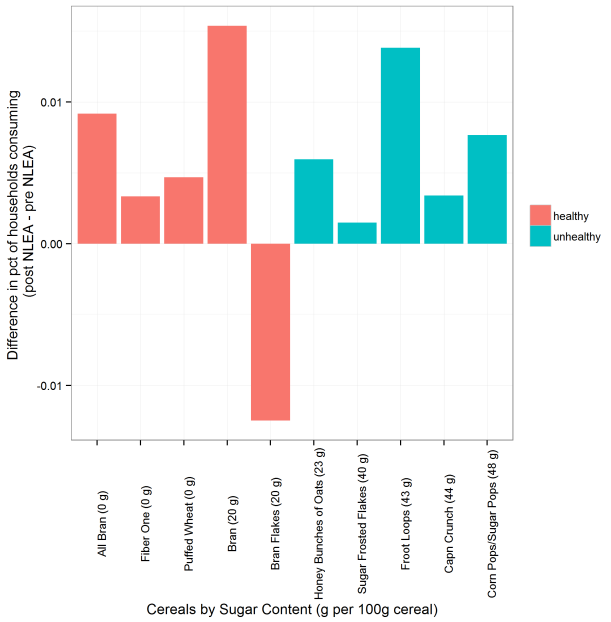

Figure 4. Changes in cereal consumption following the NLEA

Notes: Figure presents changes in the consumption of cereals before vs. after the implementation of the NLEA. The five 'healthiest' and 'least healthy' cereals among the thirty most commmonly consumed cereals are plotted. Cereals are arranged by sugar content (listed in parentheses) measured by grams per 100 grams of cereal, with healthy cereals plotted in red, and unhealthy cereals plotted in blue.

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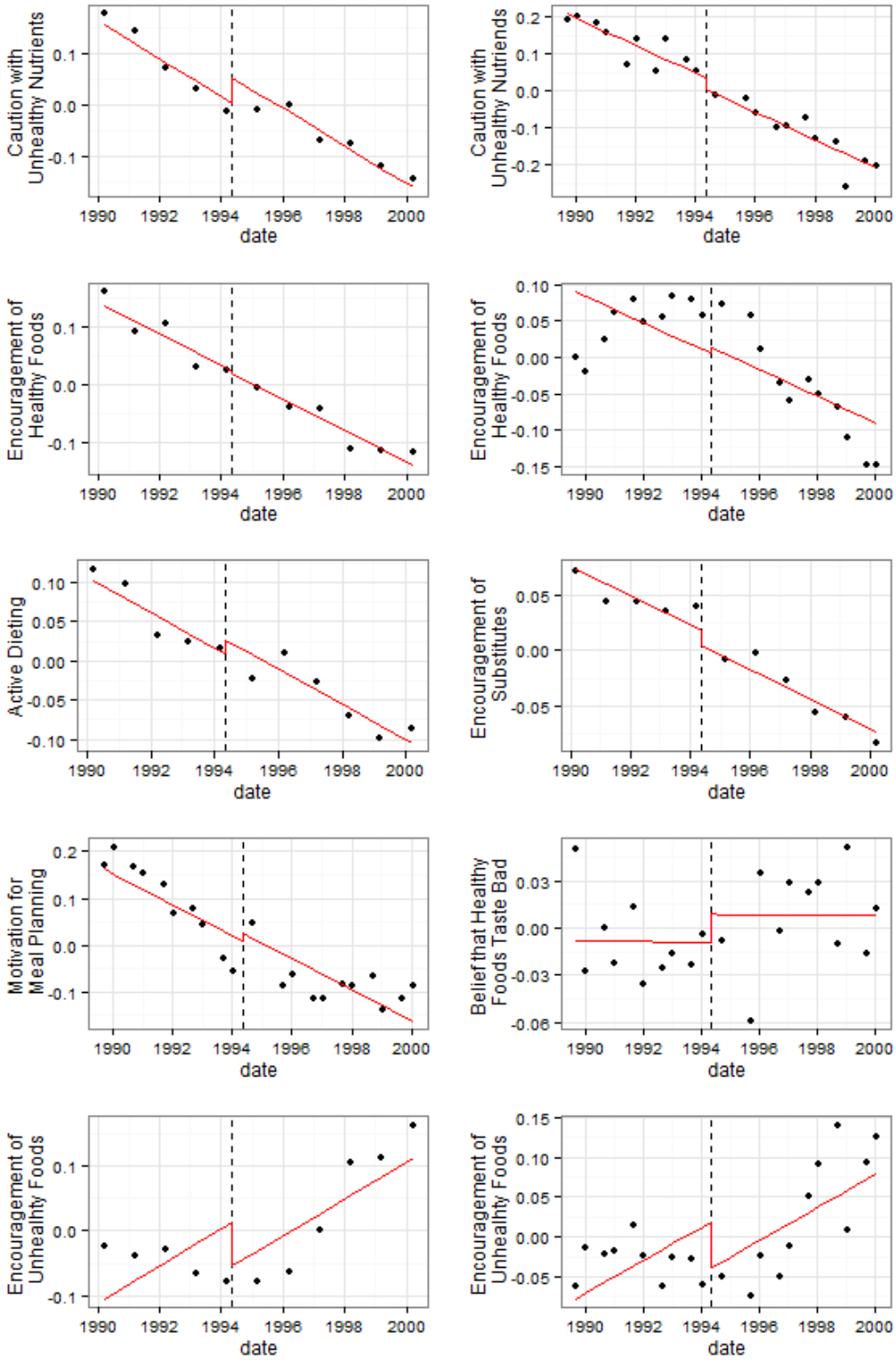

Figure 5. Attitudinal Measures

Notes: Figure presents attitudinal data over time. Data are collected in surveys in March (survey 1), and January or September (survey 2). Plotted points are average quarterly values with 95% confidence intervals for ten attitudinal measures.

Table 6. Correlations between Attitudes and Behaviors

Panel A: Healthy Attitudes

	Behavioral Measures						
	Unhealthy consumption				Healthy consumption		
	Milk Fat	Cereal Calories	Cereal Sugar	Snack Pct	Veg Pct	Bread Pct	Cereal Fiber
Caution (March)	-0.03***	-0.04***	-0.04***	-0.03***	0.04***	0.04***	0.02**
Caution (September)	-0.01	-0.04***	-0.03***	-0.04***	0.04***	0.07***	0.02*
Healthy (March)	-0.05***	-0.09***	-0.09***	-0.08***	0.2***	0.11***	0.07***
Healthy (September)	-0.4***	-0.05***	-0.03**	-0.03***	0.05***	0.1***	0.06***
Dieting (March)	-0.18***	-0.07***	-0.06***	-0.09***	0.12***	0.11***	0.06***
Substitutes (March)	-0.12***	-0.03***	-0.02**	-0.02***	-0.03***	-0.01	0.01
Planning (September)	0.02*	-0.08***	-0.08***	-0.12***	0.2***	0.07***	0.06***

Panel B: Unhealthy Attitudes

	Behavioral Measures						
	Unhealthy consumption				Healthy consumption		
	Milk Fat	Cereal Calories	Cereal Sugar	Snack Pct	Veg Pct	Bread Pct	Cereal Fiber
Unhealthy (March)	0.41***	0.09***	0.05***	-0.02**	-0.13***	-0.19***	-0.11***
Unhealthy (September)	0.34***	0.14***	0.10***	0.02**	-0.16***	-0.23***	-0.14***
Taste (September)	0.18***	0.07***	0.03**	-0.08***	-0.14***	-0.26***	-0.11***