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14. Preferences for Food Labels: A Discrete Choice Approach

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Preferences for Food Labels: A Discrete Choice Approach

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Food labeling policy is a topic of growing interest and public debate—a debate largely about information and the processing and use of that information by consumers. The debate centers on questions such as how much information will facilitate effective consumer choice and what form that information should take. Economic research on the value of information characterizes information as reducing uncertainty, but applying this paradigm directly to nutrition labeling ignores the process of information extraction. Simply increasing the amount of information content on a nutrition label may actually raise the level of an individual's uncertainty by making any given amount of information harder to extract (Chaffee and McLeod 1973). Increasing the information content of a label may cause those individuals without the time or ability to process information to ignore it (Heimback 1982, Achterberg 1990, Jacoby et al. 1977, French and Barksdale 1974), leading to less optimal purchasing decisions (Magat et al. 1988). Thus, prescriptions such as "more information is always better" may not characterize an optimal policy solution for nutrition labeling.

An objective of the Nutrition Labeling and Education Act of 1990 is to enable the public to make more informed food choices by providing as complete information as possible while presenting the information in an easily processed form (Levy et al. 1996). This suggests an implicit trade-off between the cost of information acquisition and information accuracy. After a point, simplified information that is easier to process can be obtained only at the cost of less precision. Unfortunately the optimum level of simplicity and detail is likely to be different for different individuals. Survey results suggest that some consumers prefer simplified presentation of health information messages (FMI 1989, Shepherd 1990, Hanson et al. 1985, Geiger et al. 1990, Russo et al. 1986) while others prefer more detailed information content (Levy et al. 1991, 1992).

This dispersion of preferences makes sense for a number of reasons. The value of label information in providing more accurate assessments of the nutritional value of a food product will vary across individuals with different awareness of the importance of nutrition and with different nutritional needs. In addition, some individuals may prefer more detailed information because they find it relatively easy to convert chemical/physical attributes into a healthiness rating. Conversely, individuals with a lower ability to process information may prefer labels that are easier to process or provide "pre-processed" health-related information. Individuals with less supplementary information may prefer labels that provide additional information such as linking attributes to health-related conditions.

The type and volume of information presented on a food label, as well as the format of the food label, will affect the amount of time and effort an individual needs to supply in order to assess the nutritional value of a food product (Levy et al. 1992). Labels that require an individual to spend more time in processing a given set of information will have a higher "cost" than easily processed labels. Unlike a product's price, the time "cost" of information can vary across individuals because of differences in cognitive abilities and time constraints. Individuals with a greater ability to process information would be expected to process a given set of label information more quickly. However, these same individuals may have a higher opportunity cost of time.

While labeling has been the focus of major policy initiatives in the last few years, little empirical economic research has been conducted on the optimal form of labeling. The question is an important one because, given the unequal distribution over the population of cognitive abilities, nutritional needs, and values of time, labeling regulations will have equity and distributional implications. To understand these implications, policy makers need to know the characteristics of labels preferred by different sectors of the consumer population.

Typically, consumers choose quantities of food products, not the amount or type of information presented on a food nutrition label. Consequently, it is difficult to reveal consumer preferences from observable market behavior. However, an experiment conducted by the U.S. Food and Drug Administration (FDA) provides some useful data to help us investigate this question. This paper analyzes the stated preferences reported in that experiment.

A Brief Review of Previous Research

There is little empirical economics literature dealing with the optimal form of health-related information provision. This is probably due, in part, to the difficulty in measuring both the value of information and the cost of information processing. Previous research has focused primarily on analyzing behavioral response to changes in food safety information. Most of these are market studies that examine the relationship between market behavior and information. Examples include studies of behavioral responses to information about prevalent foodborne risks (Capps and Schmitz 1991, Spreen and Gao 1993, Putler and Frazao 1991, Brown and Schrader 1990, Putler 1987, Chang and Kinnucan 1991) and behavioral responses to health scares (Swartz and Strand 1981, Johnson 1988, van Ravenswaay and Hoehn 1991, Smith et al. 1988, Foster and Just 1989). This empirical literature is valuable in that it validates significant behavior changes in the face of new health information for at least some products and suggests that individuals do value health-related information. These studies focus on information provided by the media or government agencies, however, rather than food labels.

Few studies have specifically addressed information provided through grocery shopping. Levy et al. (1985) and Levy and Stokes (1987) attempted to determine the effect of shelf labels on consumer behavior. Their results indicate that simplified information messages provided at the point-of-purchase can affect market behavior, i.e., changes in market behavior are not solely driven by information provided by the media or other non-point-of-purchase sources.

Ippolito and Mathios (1990, 1994, 1995) studied changes in producer and consumer behavior due to changes in food labeling policy. Their results indicate that allowing producers to place health-related information on product labels did affect market behavior; consumers made better (healthier) food choices and producers increased their production of healthier foods. However, significant public education initiatives were occurring during the time frames studied, and much of the health-claim related activity appeared *after* the period covered in these studies (Teisl et al. 1996). In addition, Americans generally use the news media to obtain their health and nutrition information (Lichter and Amundson 1996), and attitude surveys indicate consumers place a low level of trust in industry supplied information (Byrne et al. 1991). Thus, it is unclear whether changes in consumer behavior were primarily due to private or public provision of health-related information. Research exploring the factors that influence individuals' preferences for labeling format and content are not easy to find, however. Additionally, the possible differential effects of labeling policy across individual groups has not been studied.

Theoretical Framework

Providing a modeling framework for a choice among label formats is not straightforward. One needs to consider how nutrition information enters an individual's utility function and how label format is related to nutrition information extracted. It seems reasonable to assume that consumers use nutrition labels to gain information about nutrition content because they cannot independently assess the chemical constituents of food products nor easily verify the presence or absence of a food attribute. While they may possess prior knowledge of nutrition-related health effects, they rely on the food label to develop an estimate of a food's contribution to good health.

Information extraction could be viewed as a "household production" process by which individuals combine their time, prior knowledge, and cognitive abilities with the potential information available from the label. Each presentation format represents a different technological process for conveying and extracting data. Thus we could model the information extraction process as:

$$I_{ij} = F_j(D_j, C_i, T_{ij}) \tag{1}$$

where I_{ij} is the nutrient information extracted by individual i from label j, D_j is the maximum amount of information potential of label j, C_i reflects individual i's cognitive ability, and T_{ij} is the time individual i chooses to devote to the information extraction process for label format j. $F_j(\,)$ denotes the technology associated with the presentation format of label j. Note that T_{ij} is a decision variable. Allocation of more time to information processing implicitly means less time for other things. Thus time has a cost that likely varies over individuals.

Given a choice among a discrete set of labels, an individual will not necessarily choose the label format that embodies the maximum amount of information, because information extraction comes at a cost—the time involved in information processing. Two individuals facing the same choice set may be observed to prefer different labels because they have different cognitive abilities and/or different values of time. We go one step further by recognizing that even if two individuals have the same cognitive abilities and value of time, they may still choose to produce different levels of I, and therefore prefer different labels, if their value of nutrition information is different. We assume here that all individuals value nutrition information, but may do so to a greater or lesser degree depending on such things as health status and awareness of the connections between nutrition and health.

The individual's utility from choosing the j^{th} label is given by:

$$U_{ij} = U(I_{ij}, H_i, A_i, g(T^* - T_{ij})) \quad \text{where } I_{ij} = F_j(D_j, C_i, T_{ij}). \tag{2}$$

In the above expression H_i reflects health status, A_i reflects prior knowledge of nutrition-health relationships, T^* is the total time endowment, and $g(\,)$ denotes other utility producing activities that can be generated by available time.

The actual information extracted, I_{ij}, is impossible to observe as is $g(\,)$ and T^*, suggesting a restatement of the individual's utility from the j^{th} label as:

$$V_{ij} = V(F_j(D_j, C_i, T_{ij}), H_i, A_i, n_i) \tag{3}$$

where V is an indirect utility function, n_i is the i^{th} individual's value of time, and I_{ij} is replaced by its arguments.

The 1991 FDA Survey

Ideally we would like to learn something about the household production technology (equation 1) as well as the preference structure (equation 2) implicit in the above decision problem, but no data exist to allow us to estimate the structure of the entire problem. However, existing FDA data provide proxies for many of the factors included in the indirect utility function (equation 3) as well as observations on individuals' choices among label formats.

With the intention of evaluating the usefulness of labels, FDA conducted a series of experiments in 1991 in which respondents, facing different nutrition labels, were asked to perform a series of timed tasks, followed by a question eliciting their preferences regarding the different nutrition labels. Respondents were recruited from shopping malls located in eight cities in the U.S. (Jackson, Mississippi; Eureka, California; Buena Park, California; Council Bluffs, Iowa; Rochester, New York; Pine Bluffs, Arkansas; Fow Valley, Illinois, and Atlanta, Georgia), resulting in a sample consisting of 1,216 food shoppers over 16 years old who stated that they did at least half of the household's food shopping.[2]

Seven nutrition labels were tested in the study (see Appendix 14.A for sample labels). In each case the label reported serving size and servings per container; percent of Daily Recommended Value figures for vitamin A, vitamin C, calcium, and iron; and total calories and total calories from fat. The labels differed in the way in which they reported the amount of seven macro-nutrient substances considered to have significant health effects: fat, saturated fat, cholesterol, sodium, carbohydrates, fiber, and protein. The *Control* format reported the macro-nutrient contents in absolute levels, measured in metric units, without any other information processing aids. The *Control/DRV* format added a column of Daily (Recommended) Value figures for each of the seven macro-nutrients to provide a basis of comparison with the actual levels present in the food. These DRV reference levels are reported as *xxx units or less* for the first 4 items, *325 g or more* for carbohydrates, and (exactly) *25 g* for fiber; no DRV is supplied for protein. The *Percent* format combined the information in the two columns of the Control/DRV format by reporting the amount of each of the seven macro-nutrients found in the food as a percent of its Daily Value. This format also included the absolute levels of the macro-nutrients, as well. The *Percent/DRV* label combined the Percent format with a column of Daily Values as a reference list. Otherwise identical with the Control/DRV format, the *Adjective* format added a third column of descriptors denoting whether levels of the seven macro-nutrients in the food were considered to be low, medium, or high. This format also added these descriptors to the vitamin and mineral list. The *Highlighting* format was identical to the Control/DRV format except that one or two asterisks were added denoting those macro-nutrients that were "low or reduced in amount per serving" or "high in amount per serving," respectively. Additionally, those nutrients that met the DRV conditions were highlighted. Finally, the *Grouping* format was identical to the Control/DRV format except that the first four macro-nutrients were grouped under the heading "CHOOSE A DIET LOW IN:", carbohydrates and fiber were grouped under the heading "CHOOSE A DIET HIGH IN:", and protein was moved to the list of vitamins and minerals, where percent of Daily Value was reported.

To illustrate more effectively the difference in these labels, we define six format characteristics and indicate which labels embodied which characteristics (Table 14.1).

Metric Units—absolute levels of seven macro-nutrients in metric units;

Daily Reference Values—recommended daily consumption levels for the seven macro-nutrients;

Percentages—nutrient levels as percentages of daily reference values;

Adjective—descriptive adjectives indicating low, medium, or high levels of nutrients present in food;

Grouping—a grouping of nutrients according to dietary recommendations;

Highlighting—highlighting of those nutrients for which the product meets daily reference recommendations, including asterisks indicating high and low levels present in the food.

TABLE 14.1 Characteristics of Formats

Format	DRV List	Declaration	Adjective	Grouping	Highlighting
Module 2					
Control/DRV	Yes	Metric	No	No	No
Adjective	Yes	Metric	Yes	No	No
Percent	No	Percent and Metric	No	No	No
Grouping	Yes	Metric	No	Yes	No
Module 3					
Control	No	Metric	No	No	No
Highlighting	Yes	Metric	No	No	Yes
Percent/DRV	Yes	Percent and Metric	No	No	No
Grouping	Yes	Metric	No	Yes	No

To reduce the level of respondent burden the number of labels presented to any respondent was limited. Subjects were randomly assigned to one of three modules. In this analysis we are concerned only with Modules 2 and 3 in which each individual was asked to respond to four of the different labels in a sequence defined by a row of a 4 X 4 Greco-Latin square. All seven formats were tested over Modules 2 and 3, with four formats appearing in each module. The Control/DRV, Adjective, Percent, and Grouping formats were included in Module 2 and the Control, Highlighting, Percent/DRV, and Grouping formats in Module 3.

We posed a series of tasks that attempted to measure the respondent's ability to use the labels[3] in (1) judging the overall healthfulness of the product, (2) verifying the truthfulness of health claims made elsewhere on the product label by using information presented on the nutrition label, (3) using the Daily Value information to compute the number of servings required to meet the daily requirement for carbohydrates, and (4) using the nutrition label to judge which nutrients to consume or avoid after consuming several servings of the product in a day. The time it took individuals to perform the task 2 (verifying the truthfulness of health claims) was monitored and recorded for each label/product combination. Responses to these tasks have been analyzed in Levy et al. (1996).

After completing the performance tasks, subjects were shown a poster with the four formats displayed on cans of baked beans and were asked, "Which label would be most helpful to you for selecting nutritious foods and planning meals?" The responses to this latter question are the focus of analysis in this paper.

Although the two modules will be analyzed separately, information on the similarities and differences between respondents in the modules will aid in interpreting the results. Both socioeconomic characteristics (age, education, household income, gender, and race) and health-related characteristics (diet behavior and family health history) are compared across groups (Table 14.2). We found no significant differences in either the mean education ($t = 1.276$, $p = 0.202$) or mean income ($t = -1.643$, $p = 0.101$), or any significant differences in the distributions of gender ($\chi^2_{(1)} = 0.052$, $p = 0.820$), race ($\chi^2_{(1)} = 0.128$, $p = 0.720$), or participation in special diets ($\chi^2_{(1)} = 1.870$, $p = 0.171$). Additionally, no significant difference was found in the distributions of individuals who reported that they generally read food labels ($\chi^2_{(3)} = 2.444$, $p = 0.486$). However, we did find a significant difference in the mean age between Modules 2 and 3 ($t = -1.864$, $p = 0.063$) and a significant difference in percent of households

TABLE 14.2 Characteristics of Samples

	Module 2	Module 3
Age	39	42
Years of Education	13.8	13.6
Income	\$32,400	\$35,300
Gender (percent female)	62	63
Race (percent white)	83	82
Percent stating they read labels:		
Always	37	40
Sometimes	43	42
Rarely	13	13
Never	7	5
Percent having a household member:		
On a special diet	46	51
With cardio-vascular disease	36	43

having a member with cardio-vascular disease ($\chi^2_{(1)}$ = 3.778, p = 0.052). Module 3 exhibited the higher values in both cases.

The Empirical Model

Our task is to use the results of the experiment to determine the factors that affect preferences for different label formats over the population. We are especially interested in exploring whether different individual characteristics tend to produce different preference ratings. Any label possesses a given amount of potential information that could be extracted from it. In the absence of any additional source of dietary facts, the seven labels have implicit in them different amounts of information. The *Control* format provides the least amount of information, providing simply the absolute levels of macro-nutrients. The *Percent*, *Percent/DRV*, and *Control/DRV* formats all provide enough information so that the respondent could determine absolute levels of macro-nutrients, Daily Recommended Values, and percent of DRV's present in the food. However, different formats make the latter two more or less difficult to determine. The remaining three formats would all allow the determination of the above three measures. However the *Highlighting* and *Adjective* formats additionally provide information as to whether the levels of the macro-nutrients in the food are considered low, medium, or high; and the *Grouping* format provides information about the desirability of consuming high or low levels of different nutrients. Where the same information is possible to be extracted, different labels may require different amounts of time and cognitive ability to obtain that same information.

A priori, preference orderings for formats are not predictable. Nonetheless, were all individuals identical, we would expect a consistent ordering of labels across individuals. However, following the arguments made earlier, individuals' preferences over labels will likely vary depending on the value the individual places on detailed nutrient information, the individual's ability to extract a given amount of information in any given amount of time, and the value of the individual's time.

Given the data available, we consider first that variation in label preferences over individuals may be affected by the differing value that information on macro-nutrients would have to different individuals. This may be proxied by the categorical variables: whether the family includes an individual with a cardio-vascular problem (HEART), whether the family includes an individual on a special diet (DIET), and whether the individual stated they always/often use nutrition labels (READLBLS). The available proxies for the value of time are the individual's age (AGE) and level of education (EDUCATION).

The amount of information that could be extracted from a label is a function of the individual's cognitive abilities, the amount of information on the label, and the amount of time allocated to information processing. We do not have direct measures on all of these factors. However, we do have information regarding the amount of time individuals took to perform task 2 (verifying the truthfulness of health claims), and we have an accuracy score associated with this task. Presumably this accuracy score is related to all three factors. We constructed a variable (TIME/ACCSCORE) that normalizes the time individuals spent on task 2 by the accuracy score for this task. We hypothesize the sign on this variable to be negative because individuals should prefer labels that require less time to process a given set of information.

Finally, we would expect that individual preferences for label formats may also be related to the individual's cognitive abilities; individuals with greater cognitive abilities may prefer labels with more complete information. Again, we do not have a direct measure of an individual's cognitive abilities. We use as a proxy the accuracy score (COGSCORE) for task 3 (using the Daily Value information to compute the number of servings required to meet the daily requirement for carbohydrates). The ability to calculate mathematically, required in task 3, is assumed to be a reasonable indicator of the individual's cognitive abilities for these types of tasks.

To operationalize the theoretical model we assume:

$$V_{ij} = \alpha(TIME/ACCSCORE)_{ij} + \beta_j(COGSCORE_i) + \varphi_j HEART_i + \epsilon_j DIET_i$$
$$+ \phi_j READLBLS_i + \rho_j EDUCATION_i + \eta_j AGE_i + e_{ij}$$

where $(\text{TIME/ACCSCORE})_{ij}$ reflects the amount of time, in seconds, that it takes the i^{th} individual using the j^{th} label to complete task 2, normalized on the accuracy score for the task. COGSCORE_i is the individual's average accuracy score for task 3 and is meant to proxy for the individual's cognitive abilities. HEART_i, DIET_i, and READLBLS_i are indicator variables used to denote the value of the label in providing relevant information. HEART_i equals 1 if the respondent stated they, or a member of their household, ever had a cardiovascular disease (specifically heart disease, high blood pressure, or stroke), 0 otherwise. DIET_i is equal to 1 if the respondent stated they, or a member of their household, were on a weight control program or followed a low-calorie, low-fat, or low-cholesterol diet, 0 otherwise. READLBLS_i equals 1 if the respondent stated they always/often used nutrition labels, 0 if they stated they sometimes/never used labels. EDUCATION_i denotes the education level of the i^{th} individual, measured in years. AGE_i equals 1 if the respondent was greater than 35 and less than 65 years old , 0 otherwise.

There are several aspects of the experimental design that need to be corrected before implementing the empirical estimation. The first problem is that each individual performed the evaluation tasks for the four different labels in succession. As a respondent gained experience and became familiar with the task requirements, the time to complete a task is likely to have decreased, producing a learning effect, irrespective of the order of the formats. In addition, the time needed to complete task 2, and the accuracy score for tasks 2 and 3, may be dependent upon the version of the survey administered to the respondent, and of the products used to display the label. We need to control for potential differences in time and accuracy scores due to learning effects or differences in the experimental design.

Another problem arises because the time and accuracy data used to calculate the first explanatory variable above reflects a process that is, at least in part, endogenous. Although the design of the experiment made the actual label evaluation tasks exogenously determined, respondents were allowed to determine their own time in performing them, and we need to correct for this endogeneity.

To remove the endogeneity of $\text{TIME/ACCSCORE}_{ij}$ and COGSCORE_i, we followed a procedure outlined by Heckman (1979). The endogenous variable is regressed on a set of exogenous regressors, and the parameter vector from the auxiliary regression is used to provide predicted values of the dependent (endogenous) variable. The predicted values are then used in place of the actual values in the main regression. In addition to following this procedure, we adjusted the predicted values to correct for learning and experimental design effects.

For the auxiliary regressions, the following equations were estimated:

$$
\begin{aligned}
TIME/ACCSCORE_{ij} = {} & \sum_{j=1}^{7} \gamma_{1,j} LABEL_{ij} + \gamma_2 AGE_i + \gamma_3 GENDER_i + \gamma_4 RACE_i \\
& + \gamma_5 EDUCATION_i + \gamma_6 READLBLS_i + \sum_{k=1}^{7} \gamma_{7,k} CITY_{ik} + \gamma_8 TASK_{ij} \\
& + \gamma_9 TASK_{ij}^2 + \sum_{m=1}^{3} \gamma_{10,m} PRODUCT_{im} + \gamma_{1j} VERSION_i + \omega_{ij} .
\end{aligned}
$$

and

$$
\begin{aligned}
COGSCORE_{ij} = {} & \sum_{j=1}^{7} \delta_{1,j} LABEL_{ij} + \delta_2 AGE_i + \delta_3 GENDER_i + \delta_4 RACE_i \\
& + \delta_5 EDUCATION_i + \delta_6 READLBLS_i + \sum_{k=1}^{7} \delta_{7,k} CITY_{ik} + \delta_8 TASK_{ij} \\
& + \delta_9 TASK_{ij}^2 + \sum_{m=1}^{3} \delta_{10,m} PRODUCT_{im} + \delta_{1j} VERSION_i + \mu_{ij}
\end{aligned}
$$

where $\text{TIME/ACCSCORE}_{ij}$ and COGSCORE_{ij} are defined as previously for the i^{th} individual's trial using the j^{th} label. The seven variables LABEL_{ij} are dummy variables which take the value of 1 if the trial uses the j^{th} label and zero otherwise. The coefficients on these dummy variables serve as intercepts that shift with different labels. AGE_i is a dummy variable equal to 1 for "middle-age" and 0 otherwise; GENDER_i equals 1 if the respondent was female, 0 if male; RACE_i equals 1 if the respondent was white, 0 otherwise; EDUCATION_i is the number of years of education, and READLBLS_i equals 1 if the individual always/often reads labels, 0 otherwise. $\text{CITY}_{i,k}$ is a dummy variable equal to 1 if the i^{th} respondent was interviewed in the k^{th} city. TASK_{ij} is a categorical variable (1,2,3,4) that denotes the order of the label presentation to the i^{th} respondent; for example, $\text{TASK}_{ij} = 2$ if the i^{th} respondent was presented the j^{th} label in the second task. TASK_{ij}^2 is equal to (TASK_{ij} * TASK_{ij}). Thus, we allow for the effect of learning (by repeating the task on different labels) to be non-linear. PRODUCT_{im} is a vector of dummy variables denoting the product on which the label information was represented; VERSION_i is a dummy variable equaling 0 or 1 depending on the version of the survey introduction used; ω_{ij} and μ_{ij} are errors assumed independently and identically distributed with zero mean.

TABLE 14.3 Results of Least Squares Regressions

Independent Variables	Dependent Variable	
	TIME/ACCSCORE	COGSCORE
LABEL:		
GROUP	156.103***	54.899***
HIGHLIGHT	165.458***	52.874***
PERCENT/DRV	133.904**	50.969***
CONTROL	141.683**	38.639***
PERCENT	101.483	52.844***
ADJECTIVE	121.541**	56.440***
CONTROL/DRV	155.541***	56.086***
AGE	1.199***	-0.236***
GENDER	28.379***	5.428***
RACE	-10.600**	-4.719**
EDUCATION	-0.447***	0.988***
READLBLS	-32.741	3.711**
$CITY_A$	-29.972***	12.558***
$CITY_B$	17.700	6.998***
$CITY_C$	25.606***	14.823***
$CITY_D$	-39.494	-7.985***
$CITY_E$	13.824***	15.630***
$CITY_F$	-6.820**	13.021***
$CITY_G$	40.896***	7.349***
TASK	-90.270***	2.852
$TASK^2$	15.441***	-0.201
$PRODUCT_1$	253.168	2.932
$PRODUCT_2$	13.349	-4.242**
$PRODUCT_3$	39.679	0.423
VERSION	42.954***	-2.495*
Adjusted R^2	0.23	0.77

Note: A * denotes significance at the 10 percent level, ** denotes significance at the 5 percent level, and *** denotes significance at the 1 percent level.

The results of the auxiliary regressions are reported in Table 14.3 and are interesting in their own right.[4] The coefficients on many of the explanatory variables are significantly different from zero. By combining the results from the two regressions we can say what type of people, conditional on achieving the same scores on a task, took the longest time to achieve these scores; and which type of people in general achieved the highest scores, irrespective of time spent. In general younger people, males, whites, and the more highly educated took less time to achieve a given level or accuracy on the tasks, while younger people, women, blacks, and the more highly educated achieved the higher scores, irrespective of time spent. The presence of city dummies affects these results since the age, race, and education distribution of the population will vary over cities. However, we include these location dummy variables to correct for other socio-demographic factors like general income levels, quality of education, etc.

The inclusion of TASK and $TASK^2$ has the desired effect. We find that with learning (that is, with experience performing the same task on different labels), TIME/ACCSCORE falls but at a decreasing rate. However, the task order has no significant effect on the accuracy scores themselves. The coefficients on the label dummy variables in each equation represent the normalized average base response times for each label and the average accuracy scores for each label, holding other factors constant. It appears that the PERCENT label produces the lowest time costs to achieve a given level of accuracy, but the ADJECTIVE and CONTROL/DRV formats produce the highest accuracy scores. Conversely, the HIGHLIGHT label requires the most time for a given accuracy score and the CONTROL format yields the lowest average accuracy scores.

Given the presence of a learning effect and of significant design effects (denoted by the significance of the TASK, $TASK^2$, PRODUCT, and VERSION coefficients), we corrected the predicted values for TIME/ACCSCORE and COGSCORE by subtracting these influences. In addition to correcting for task order and design effects, we average the differential effects of the label intercepts on the predicted value of COGSCORE so that it varies across individuals and not across formats. Finally, we replace the TIME/ACCSCORE and COGSCORE variables used in the conditional logit regressions with TIME/ACCSCORE* and COGSCORE* so that the systematic portion of the discrete choice model to be estimated is:

$$V_{ij} = \alpha TIME/ACCSCORE_{ij}^{*} + \beta_j COGSCORE_i^{*} + \varphi_j HEART_i + \epsilon_j DIET_i$$
$$+ \phi_j READLBLS_i + \rho_j EDUCATION_i + \eta_j AGE_i + e_{ij}$$

where α and the vectors, β, φ, ϵ, ϕ, ρ, and η are parameters to be estimated. Note that only one α is estimated since TIME/ACCSCORE varies over individuals and alternatives. Since the remaining variables vary only over individuals, their coefficients vary over alternatives. In this case (called the multinomial logit model, see Maddala 1983), the coefficients must be normalized on one alternative.

It is difficult to form expectations on the signs and sizes of these coefficients. We might expect that people will value higher values of the label attribute captured by our TIME/ACCSCORE variable. That is, if they recognize this feature of a label, they might tend to rank more highly those labels that require less time to produce a given level of accuracy. In this case we would expect α to be significant and have a negative sign.

The remaining coefficients are especially difficult to anticipate. They will express the preferences for a given label, relative to the normalized label, by individuals with certain characteristics. As an example, we might expect that individuals with household members having heart disease or on special diets may prefer more specific nutrition information about fat, sodium, and cholesterol. If so, these individuals might tend to prefer the Grouping (Modules 2 and 3) or Highlighting (Module 3) labels relative to others because these labels emphasize the fat and cholesterol content of the food products. As a result the parameters for φ and ϵ that correspond to these labels would be expected to be significantly different from zero and positive when any of the other labels was serving as numeraire.

Results

The results of the estimated discrete choice models for Modules 2 and 3 are reported in Tables 14.4 and 14.5, respectively. Each module represents a choice set of four possible label alternatives. To aid in the interpretation of the effects of individual characteristics on label preferences, we estimate the

TABLE 14.4 Results of Conditional Logit Regressions for Module 2

TIME/ACCSCORE*	0.0973*	0.0973*	0.0973*	0.0973*
$COGSCORE^*_2$	0.0084	0.0176	-0.0176	-0.0027
$COGSCORE^*_3$	0.0111	0.0203	0.0027	-0.0203
$COGSCORE^*_4$	-0.0091	0.0091	-0.0084	-0.0111
$HEART_2$	0.0840	-0.3919	0.3919	0.3692
$HEART_3$	-0.2852	-0.7610**	-0.3692	0.7610**
$HEART_4$	0.4758	-0.4758	-0.0840	0.2852
$DIET_2$	0.6869*	0.2505	-0.2505	0.2577
$DIET_3$	0.4292	-0.0073	-0.2577	-0.0073
$DIET_4$	0.4365	-0.4365	-0.6869*	-0.4292
$READLBLS_2$	1.1444***	0.5494**	-0.5494**	0.0586
$READLBLS_3$	1.0858**	0.4908	-0.0586	-0.4908
$READLBLS_4$	0.5950*	-0.5950*	-1.1444***	-1.0858**
$EDUCATION_2$	-0.0158	-0.0540	0.0540	0.0911
$EDUCATION_3$	-0.1069	-0.1451	-0.0911	0.1451
$EDUCATION_4$	0.0382	-0.0382	-0.0158	0.1069
AGE_2	-0.5732	0.2675	-0.2675	-0.3704
AGE_3	-0.2028	0.6379*	0.3704	-0.6379*
AGE_4	-0.8407**	0.8407**	0.5732	0.2028
Numeraire	Control/DRV	Grouping	Adjective	Percent
Subscript 2	Adjective	Adjective	Grouping	Adjective
Subscript 3	Percent	Percent	Percent	Grouping
Subscript 4	Grouping	Control/DRV	Control/DRV	Control/DRV
χ^2	162.60***	162.60***	162.60***	162.60***

Note: A * denotes significance at the 10 percent level, ** denotes significance at the 5 percent level, and *** denotes significance at the 1 percent level.

model for each module four times, normalizing on a different label each time. The numeraire and the index to the label ordering is given at the bottom of Tables 14.4 and 14.5. The results are, of course, substantively the same over these different normalizations, but different normalizations make easier the interpretation of rankings of labels by individual characteristics. Because the information is difficult to process even in this form, a summary of the results is presented in Table 14.6.

In both modules the parameter estimates for the TIME/ACCSCORE variable are positive but not significant at the 5 percent level. They are only marginally significant at the 10 percent. We would have expected a negative parameter here if individuals are cognizant of the "efficiency" of the labels at producing accurate assessments with least cost times. The low significance level could result from an inability on the part of respondents to form an accurate assessment of the "efficiency" of the labels or

TABLE 14.5 Results of Conditional Logit Regressions for Module 3

TIME/ACCSCORE*	0.0920*	0.0920*	0.0920*	0.0920*
$COGSCORE^*_2$	0.0046	0.0118	-0.0118	-0.0463**
$COGSCORE^*_3$	0.0509*	0.0582***	0.0463**	-0.0582***
$COGSCORE^*_4$	-0.0072	0.0072	-0.0046	-0.0509*
$HEART_2$	-0.3266	-0.2084	0.2084	0.0369
$HEART_3$	-0.3635	-0.2453	-0.0369	0.2453
$HEART_4$	-0.1182	0.1182	0.3266	0.3635
$DIET_2$	1.1963***	0.0994	-0.0994	0.5802
$DIET_3$	0.6161	-0.4808	-0.5802	0.4808
$DIET_4$	1.0968**	-1.0968**	-1.1963***	-0.6161
$READLBLS_2$	0.6743	-0.0478	0.0478	0.7036**
$READLBLS_3$	-0.0292	-0.7514**	-0.7036*	0.7514*
$READLBLS_4$	0.7222*	-0.7222*	-0.6743	0.0292
$EDUCATION_2$	0.6999*	0.2011	-0.2011	0.4009
$EDUCATION_3$	0.2990	-0.1998	-0.4009	0.1998
$EDUCATION_4$	0.4988	-0.4988	-0.6999*	-0.2990
AGE_2	-0.7772*	0.0984	-0.0984	-1.1780***
AGE_3	0.4008	1.2765***	1.1780***	-1.2765***
AGE_4	-0.8757**	0.8757**	0.7772*	-0.4008
Numeraire	Control	Grouping	Highlighting	Percent/DRV
Subscript 2	Highlighting	Highlighting	Grouping	Highlighting
Subscript 3	Percent/DRV	Percent/DRV	Percent/DRV	Grouping
Subscript 4	Grouping	Control	Control	Control
χ^2	235.26***	235.26***	235.26***	235.26***

Note: A * denotes significance at the 10 percent level, ** denotes significance at the 5 percent level, and *** denotes significance at the 1 percent level.

from the artificial nature of the particular task in the survey, which required individuals to verify the truthfulness of front panel health claims by using the nutrition panel information.

The COGSCORE variables are not significant in any of the four equations in Module 2, indicating that cognitive abilities do not seem to affect preferences for these four label formats. However, in Module 3, where different combinations of label formats were compared, there were some interesting results. People with higher accuracy scores (higher values for COGSCORE*) preferred the Percent/ DRV format to the Highlighting, Grouping, and Control formats, which may suggest that people with higher cognitive abilities find the concept of percentages easier to deal with.

For individuals with household members having heart disease, there were no significant preferences among label alternatives in Module 3, but in Module 2 the Grouping format was preferred by these

TABLE 14.6 Summary Rankings of Label Formats

Module 2	
Individuals:	
With higher cognitive skills:	No difference in preferences
With heart disease:	Grouping > Percent
On special diets:	Adjective > Control/DRV
Who read labels:	All other formats > Control/DRV Adjective > Grouping > Control/DRV
With more education:	No difference in preferences
Who are "middle-age":	Control/DRV, Percent > Grouping
Module 3	
Individuals:	
With higher cognitive skills:	Percent/DRV > All other formats
With heart disease:	No difference in preferences
On special diets:	Highlighting, Grouping > Control
Who read labels:	Grouping > Control, Percent/DRV Highlighting > Percent/DRV
With more education:	Highlighting > Control
Who are "middle-age":	Control, Percent/DRV > Grouping, Highlighting

individuals to the Percent format. For individuals with household members on special diets, the Adjective format was marginally preferred to the Control/DRV format in Module 2, and in Module 3 both the Highlighting and the Grouping formats were preferred to the Control. These results are not surprising, since the Highlighting, Grouping, and Adjective formats focus their presentation on particular high fat or high cholesterol nutrients.

For the most part differences in education, *ceteris paribus*, did not affect preferences significantly. However, differences in age had a significant effect on label preferences. In Module 2 middle-aged individuals, *ceteris paribus*, tended to prefer the Control/DRV and the Percent formats to the Grouping format; and in Module 3 they preferred the Control and the Percent/DRV to the Grouping format and the Percent/DRV to the Highlighting format.

Finally, those individuals in Module 2 who reported to read labels "always or often," tended to prefer the Percent, Adjective, and Grouping formats to the Control/DRV format and to prefer the Adjective format to the Grouping format. In Module 3, the Grouping and Highlighting formats were preferred to the Percent/DRV format.

Discussion and Conclusions

While still difficult to interpret, the results suggest a few interesting patterns that could be followed up in subsequent research. First, individuals, on average, did not seem to prefer labels that reduce the time cost of information processing. However, this counterintuitive result may be an artifact of the experimental design, or of the particular task we used to measure this effect. The experiment was designed specifically to measure individual performance on several cognitive tasks. As a result, individuals may not have been able to determine the time cost of the different formats and may have relied on other signals to rank the label formats (e.g., the perceived amount of information associated with the different formats).

The remainder of the results can be summarized in a few general patterns. The Grouping, Highlighting, and Adjective formats tended to be preferred by individuals with household members having heart disease or on special diets and by those who regularly read labels. Interestingly, these formats tend to include the greatest amount of nutritional information. Individuals with greater nutritional needs may be willing to accept the burden of processing more informational content on a label because this additional information has value to them. Conversely, the middle-aged and individuals with higher cognitive skills tended to dislike these types of labels. These individuals may have higher time valuations or more prior information and may be willing to accept less information either because it takes more time to process or because they do not need it.

These two groups are reversed in their preferences for formats that include Percent and DRV figures. The middle-aged and those with higher cognitive abilities tend to prefer these type labels and those with special dietary needs or health problems and those who regularly read labels rank these labels relatively low. Perhaps the middle-aged and those with higher cognitive abilities find the Percent and DRV type formats the most expeditious means of conveying the nutrition information because these individuals are used to dealing with concepts like percents on a daily basis, while others tend to find these more difficult concepts to process.

The types of results that can be found in analyses such as this one have potential implications for policy. The individuals who are most likely to use labels seem to dislike the format versions (Control and Control/DRV) closest to the "old" nutrition label. This suggests that FDA's revision away from this format may have been favored by many individuals. However, the label formats (Percent and Percent/DRV) closest to the "new" nutrition facts panel were also rejected by many of the respondents in this experiment. In fact, respondents with particular nutritional information needs seemed to prefer the more detailed label formats (Adjective, Grouping, or Highlighting), which were also endorsed by many consumer groups interested in food label reform (Levy et al. 1996).

This begs the question as to why FDA chose the Percent format for the new nutrition label. The answer is that respondent preferences were only one input into the policy-making process. An important factor used by FDA in choosing the Percent format for the new nutrition label is that this format was the best overall format in terms of performance accuracy on all the tasks set forth in these surveys; it was either the top-scoring format or equivalent to the top-scoring format on each of the tasks (Levy et al. 1996). The fact that respondent preferences did not predict actual performance are consistent with much of the literature on consumer preferences and the ability to use information (Geiger et al. 1990, Levy et al. 1992, Jacoby et al. 1977).

Due to lack of data, explicit welfare analysis could not be performed here. However, the results do provide some interesting insights into individual preferences for different labeling policies. Although the application here is to food labeling, the results may be relevant to other labeling policies. For example, the results regarding the differential effects of education and cognitive abilities, as well as the desire of individuals to reduce information processing costs, may carry over to policy discussions about optimal warning labels, safe handling labels, and "green" labeling.

Notes

[1]Teisl is a Ph.D. student in the Department of Agricultural and Resource Economics, University of Maryland, and Staff Fellow in the Consumer Studies Branch, U.S. Food and Drug Administration; Bockstael is a Professor in the Department of Agricultural and Resource Economics, University of Maryland; Levy is the Chief of the Consumer Studies Branch, U.S. Food and Drug Administration. The research was partially funded through U.S. Department of Agriculture Grant # 433AEM480108. The authors gratefully thank Dr. Laurian Unnevehr for her helpful comments.

[2] The experiment consisted of face-to-face interviews conducted in central interview facilities in each mall. These interviews took place in the Fall of 1991, with equal numbers of respondents obtained from each site. Although the shopping mall intercept sites were chosen to obtain a geographically and demographically diverse sample of shoppers, the resulting sample may not be representative of the U.S. food shopping population. Mall patrons may not be representative of food shoppers and interviewer bias or self-selection bias may cause a non-representative sample to be drawn. To reduce the possibility of these biases and to help ensure that individuals in the samples were distributed in approximate proportion to that of the U.S. population, the sample was quota controlled on race, age, income, and education. However, respondents were required to pass a literacy screening test before being included in the sample.

[3]The seven nutrition labels were displayed on each of four different food products (canned condensed soup, cake, frozen dessert, macaroni and cheese). Each label was of typical size and shape for that type of product, and the nutrient information for a given product was the same across all formats.

[4]The likely pattern in the error structure has not been accounted for in the econometric analysis, but forthcoming work will address this problem.

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Appendix 14.A

Nutrition Label Formats

A. Control Format

MACARONI & CHEESE

NUTRITION INFORMATION PER SERVING

Serving Size ¼ box (45g) ¾ cup prepared
Servings per Container 4

	AS PREPARED
Calories	270
Calories from fat	105
	AMOUNT
Fat	13 g
Saturated fat	5 g
Cholesterol	30 mg
Sodium	660 mg
Carbohydrates	31 g
Fiber	0 g
Protein	5 g
PERCENT OF DAILY VALUE	
Vitamin A	4
Vitamin C	‡
Calcium	12
Iron	10

† As part of a 2,350 calorie diet
‡ Contains less than 2 percent of the DV of this nutrient

INGREDIENTS:XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

B. Control/DRV Format

CAKE

NUTRITION INFORMATION PER SERVING

Serving Size 1oz slice (28g)
Servings per Box 14

Calories	70	
Calories from fat	0	
	AMOUNT	DAILY VALUE (DV) †
Fat	0 g	75 g or less
Saturated fat	0 g	25 g or less
Cholesterol	0 mg	300 mg or less
Sodium	115 mg	2,400 mg or less
Carbohydrates	16 g	325 g or more
Fiber	0 g	25 g
Protein	1 g	

PERCENT OF DAILY VALUE

Vitamin A	‡
Vitamin C	‡
Calcium	‡
Iron	‡

† As part of a 2,350 calorie diet
‡ Contains less than 2 percent of the DV of this nutrient

C. Adjectival Format

FROZEN DESSERT

INGREDIENTS:XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

NUTRITION INFORMATION PER SERVING

Serving Size: 6 fl oz (156g) ¾ cup
Servings per Container: 2½

Calories	150
Calories from fat	45

	AMOUNT	DAILY VALUE †
Fat	MEDIUM 5 g	75 g or less
Saturated fat	LOW 0 g	25 g or less
Cholesterol	LOW 0 mg	300 mg or less
Sodium	LOW 20 mg	2,400 mg or less
Carbohydrates	MEDIUM 27 g	325 g or more
Fiber	LOW 0 g	25 g
Protein	MEDIUM 2 g	

PERCENT OF DAILY VALUE

Vitamin A	LOW 2
Vitamin C	LOW 2
Calcium	HIGH 20
Iron	LOW 2

---

† As part of a 2,350 calorie diet

D. Grouping Format

CONDENSED SOUP

NUTRITION INFORMATION PER SERVING

Serving Size: 4 ounces condensed
1 cup (250g) as prepared

Servings per Container 2¾

Calories	170	
Calories from fat	30	
CHOOSE A DIET LOW IN:	AMOUNT	DAILY VALUE (DV) †
Fat	3 g	75 g or less
Saturated fat	1 g	25 g or less
Cholesterol	5 mg	300 mg or less
Sodium	1,000 mg	2,400 mg or less
CHOOSE A DIET HIGH IN:		
Carbohydrates	27 g	325 g or more
Fiber	3 g	25 g

PERCENT OF DAILY VALUE

Protein	20
Vitamin A	‡
Vitamin C	2
Calcium	4
Iron	8

† As part of a 2,350 calorie diet
‡ Contains less than 2 percent of the DV of this nutrient

INGREDIENTS: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

E. Highlighting Format

CONDENSED SOUP

NUTRITION INFORMATION PER SERVING

Serving Size: 4 ounces condensed
1 cup (244g) as prepared

Servings per Container 2¾

Calories	90	
Calories from fat	30	
	AMOUNT	DAILY VALUE (DV) †
Fat	3 g*	75 g or less
Saturated fat	0 g*	25 g or less
Cholesterol	5 mg*	300 mg or less
Sodium	910 mg	2,400 mg or less
Carbohydrates	12 g	325 g or more
Fiber	0 g	25 g
Protein	5 g	

PERCENT OF DAILY VALUE

Vitamin A	‡
Vitamin C	2
Calcium	4
Iron	8

† As part of a 2,350 calorie diet
‡ Contains less than 2 percent of the DV of this nutrient
Meets FDA definitions and is consistent with dietary recommendations as:
*Low or reduced in amount per serving

INGREDIENTS: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

F. Percent/DRV Format

MACARONI & CHEESE

NUTRITION INFORMATION PER SERVING

Serving Size ¼ box (45g) ¾ cup prepared
Servings per Container 4

Calories		270	
Calories from fat		105	
	PERCENT OF DV		DAILY VALUE (DV) †
Fat (13g)		17	75 g or less
Saturated fat (5g)		20	25 g or less
Cholesterol (30mg)		10	300 mg or less
Sodium (660mg)		28	2,400 mg or less
Carbohydrates (31g)		10	325 g or more
Fiber (0g)		0	25 g
Protein (5g)		10	
Vitamin A		4	
Vitamin C		‡	
Calcium		12	
Iron		10	

† As part of a 2,350 calorie diet
‡ Contains less than 2 percent of the DV of this nutrient

INGREDIENTS:XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

G. Percent Format

FROZEN DESSERT

INGREDIENTS:XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

NUTRITION INFORMATION PER SERVING

Serving Size: 6 fl oz (156g) ¾ cup
Servings per Container: 2½

Calories	150
Calories from fat	45

PERCENT OF DAILY VALUE (DV)

Fat (5g)	6
Saturated fat (0g)	0
Cholesterol (0mg)	0
Sodium (20mg)	‡
Carbohydrates (27g)	8
Fiber (0g)	0
Protein (2g)	4
Vitamin A	2
Vitamin C	2
Calcium	20
Iron	2

‡ Contains less than 2 percent of the DV of this nutrient