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Exploring preferences beyond the (cereal) box: ready-to-eat breakfast cereal buying behaviors

RESEARCH ARTICLE

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Abstract

Ready-to-eat breakfast cereals vary widely in terms of nutrition and price. The diversity in cereal offerings makes it ideal for the study of preferences for individual nutrients and the potential impact that providing nutritional information may have on consumer purchasing behavior. Using a survey of 1,265 Midwestern residents, a random parameters logit model was employed to estimate the willingness to pay for nutritional elements of ready-to-eat breakfast cereal. Household demographic data, including household food security status, were collected. Agricultural and food businesses may seek to provide product information, including nutritional information, to their customers. In addition, national and local policies may seek to empower consumers' decision making through education. Nutritional information may not have the intended impact of influencing healthier choices. Responses from those shown educational material on nutrition were tested and found not different from respondents not shown the information.

Keywords: consumer willingness to pay, ready-to-eat breakfast cereal, nutrition information

JEL code: C9, C5, D1

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1. Introduction

The world's journey to address food and health needs continues to beget valuable research questions. The U.S. is not free from the economic and social impacts of food insecurity and malnutrition, even though they are a part of a group of "food-abundant industrialized countries" (Snider, 2014). In 2014, 14% of the U.S. population was estimated to be food insecure (Coleman-Jensen *et al.*, 2015). While part of the U.S. population struggles with food insecurity, others face challenges of being overweight or obese. Despite the recent focus on the negative impacts of food, or lack thereof, on health, many organizations champion the use of food and a healthy diet to impart positive change to influence nutrition and health outcomes. Another option to convey change and influence nutrition/health outcomes is nutrition education, including recommendations about intake, and nutrition information (Lang and Heasman, 2004). Presently the U.S. faces a number of economic burdens related to food, nutrition, access, and health.

In 1990, the Nutrition Labeling and Education Act (NLEA) required that certain nutrition label information appear on food products, often using the Nutrition Facts Panel (NFP) in an attempt to improve consumers health through information (Balasubramanian and Cole, 2002). The label provides information on serving size and serving count per container, calories, saturated fat, cholesterol, sodium, total carbohydrates, sugars, dietary fiber, and total protein (Burton *et al.*, 1999). However, the effectiveness of nutrition labeling is up for debate. In a study conducted by Blitstein and Evans (2006), 53% of their nationally representative sample used the NFP when shopping for food. Interestingly, "the belief that obesity is caused by a lack of knowledge required to maintain a healthy weight was associated with the consistent use of NFP information" (Blitstein and Evans, 2006). In an early study, Burton *et al.* (1999) found that survey respondents could accurately assess the nutritional information on the label and could evaluate "good" nutrition products positively over "bad" ones, but this did not necessarily influence purchasing intentions. Balasubramanian and Cole (2002) studied in-store consumer behavior and concluded that the NLEA nutritional facts panel can increase information recall for negative nutritional elements (i.e. fats) more so than for positive (i.e. vitamins), and can result in reduced consumption of products with negative nutritional attributes but not necessarily an increase for products with positive nutritional attributes. Nelson *et al.* (2014) used eye-tracking software to assess the amount of consideration participants gave to the nutritional label on 64 food products and concluded that the time spent viewing the label was not related to the nutrient density score of the food selected. They found a relationship between nutrient density score and age, with older participants selecting foods with higher scores (Nelson *et al.*, 2014). Some of the mentioned limits of the reviewed studies were demographic (race, region, wealth, culture) and economic (price) considerations (Balasubramanian and Cole, 2002; Nelson *et al.*, 2014). Understanding these influences may help generate a more complete understanding of nutrition and malnutrition amongst different populations.

Ready-to-eat breakfast cereal (RTEBC) is used in this study for the impact of nutrition information on consumers' food preferences for several reasons. The nutritional composition of cereal varies by brand and type, and a price change for cereal might affect some of the nutrient categories purchased (i.e. sugar, which varies widely) but not others (i.e. saturated fat of which cereal has very little) (Lin *et al.*, 2017). RTEBC is a nutritionally diverse product and is widely accessible across varying price points and through assistance programs. RTEBC is eligible for purchase using Supplemental Nutrition Access Program (SNAP), Women, infant, children (WIC) resources (USDA, 2017a,b), and is often available at food banks and pantries.

The diversity in nutrition, price, and consumption make RTEBC an interesting and appropriate food item for further study. This study aims to estimate respondents' willingness to pay (WTP), using a discrete choice experiment, for selected nutritional elements (nutrient content per serving) of RTEBC using a sample of Midwestern U.S. residents. In addition to estimating WTP for various attributes, this analysis seeks to discover whether educational information about nutrition provided before the choice experiment impacted consumers choices (and how). Specifically, it was hypothesized that respondents who were shown an educational nutrition information shock would have lower WTP for less healthy attributes (sugar and fat) and a higher WTP for healthy attributes (protein and fiber) compared to those who did not see the information.

2. Materials and methods

The Midwestern U.S. presents an interesting regional subject area when it comes to the elements of food security, health, and nutrition. According to a 2014 report by United States Department of Agriculture Economics Research Service Household Food Security in the United States, 13.8% of Midwesterners were food insecure (Coleman-Jensen *et al.*, 2015). A study focusing on the Midwest region, across which there are wide ranges of insecurity, can be helpful in providing insight and understanding regarding nutrition and food security questions. While averaging 3rd highest of the four U.S. regions in terms of state food insecurity, states in the Midwest range from as low as 8.4% in North Dakota (significantly lower than U.S. average) to as high as 16.9% in Ohio (significantly higher than U.S. average) (Coleman-Jensen *et al.*, 2015). Close Midwestern neighbors Kentucky and Tennessee had 17.5% and 16.3% of households experience food insecurity, respectively (Coleman-Jensen *et al.*, 2015). The Midwest region of the U.S. was found to have diverse food consumption and nutrition education patterns. By focusing on this region, food and health research questions can be refined.

The data for this analysis were collected using a survey constructed in Qualtrics hosted at Purdue University. The survey was launched on February 12, 2016 and concluded on February 26, 2016. Lightspeed GMI manages an opt-in panel of respondents from which the respondents were drawn. Using rates from the U.S. Census Bureau (USCB) 2014 American Community Survey 1-Year Estimates (USCB, 2014), quotas were established for the demographics of gender, age, annual pretax household income, and state of residence. The quotas were targeted to be representative of the population of the Midwest¹ with the inclusion of Kentucky and Tennessee. In addition to these demographics, respondents were asked to provide information about their household composition, food shopping behaviors, and food security status. Respondents were also asked if they or anyone in their household faced any food or dietary restrictions and were able to select: gluten-free diet, soy allergy, nut allergy of any kind, lactose intolerance, seafood or shellfish allergy of any kind, vegetarian diet, and vegan diet. This analysis focuses on RTEBC as a food product of interest.

A number of organizations and agencies provide food access assistance, so respondents were asked “In the past year have you or your household received help from one or more of the following? Select all that apply” and were provided a list of six options. The options included were, “SNAP/food stamps, WIC, church/charitable organizations, food bank/pantry, mission/soup kitchen, none and/or other”. Two follow up questions were asked of respondents who indicated having received assistance from food banks/pantries. They were asked if they were satisfied with the food options provided and if they knew how to prepare all of the food items provided. Respondents who indicated having children were asked if they or anyone in their household ate subsidized school lunches.

The United States Department of Agriculture (USDA) measures food security using a ten to eighteen question survey. Respondents in this study were all asked the ten household focused questions and those who indicated having children were asked the remaining eight questions focused on children. The responses to the questions were scored and a value of food security was calculated. Following the procedure outlined in “U.S. household food security survey module: three-stage design, with screeners” (USDA, 2012), responses of “yes, often, sometimes, almost every month, and some months but not every month”, were summed and each respondent was assigned a score from 0 to 10 (0 to 18 if children related questions were asked). Scores of 0 were rated as high food security, 1 or 2 as marginal food security, 3 to 5 low food security (3 to 7 with children related questions), and 6 to 10 as very low food security (8 to 18 with children related questions). The USDA questions used in this analysis are included in Supplementary Methods S1.

There were two nutrition specific questions asked of respondents. In order to survey attention to nutrition labels, respondents were asked to select the option that best describes personal use of food nutrition labels

¹ Midwest is defined using the USCB census regions and includes: North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Indiana, Michigan, and Ohio (USCB 2015).

and were provided four statements: “I use them to make purchasing decisions, I read them for all foods, I read them for select foods”, and “I look for what is affordable before I look at nutrition”. Respondents were also asked to evaluate the importance of seven nutritional categories, three of which were directly used in the choice experiment. Specifically, respondents were asked to rank calories, carbohydrates, fats, sugars, vitamins, proteins, and sodium as “very important, somewhat important, rarely important, not important, or don’t care/don’t know”.

With the use of RTEBC as a foundation of the choice experiment, it was important to understand respondents’ relationship with RTEBC. Respondents were asked if anyone in their household consumed RTEBC amongst the adults and children. If respondents indicated they purchased RTEBC, they were asked how often RTEBC was consumed and when: “less than 3 meals/week, greater than 3 meals/week, or never, for breakfast, lunch, dinner, and snacks.” Additionally, respondents were asked to select one of the following answers: “I buy a variety of brands/types, I buy a select few varieties and types, and I buy only one type”. Respondents were also asked to select the reasons for purchasing cereal and were allowed to select any number of options from: “it is easy to prepare, it is tasty, it is traditional, it is nutritious, it is inexpensive, and other”.

Respondents were asked to select the brands² they purchased from a list including “Kellogg, Quaker, Post, General Mills, Malt-O-Meal, Kashi, store brands, none of the above, and other”. Finally, respondents were asked to select the types of packaging they choose when purchasing RTEBC: standard sized box (12oz.), family or large sized box (17-21 oz.), bagged cereal (12-21 oz.), or none of the above.

2.1 Choice experiment for cereal attributes

Choice experiments can be employed in order to collect data about consumers’ choices amongst products with varying attributes. A hypothetical discrete choice experiment was designed for the nutritional elements of RTEBC. Respondents were asked to select one of two 12 oz. boxes of ready-to-eat breakfast cereal they would purchase based on the attributes shown, or to elect not to purchase either box. An example choice scenario, as presented to respondents, is shown in Figure 1. The experiment was divided into four blocks of eight questions with varying attribute levels, designed using the SAS OPTEX procedure (SAS Institute, Cary, NC, USA) (SAS, 2012). The design with the highest D-efficiency was chosen. The choice experiment was designed to resemble the NLEA nutrition facts label found on the side of RTEBC boxes. Respondents

² For each brand a list of known variety names was included. The full list: Kellogg (Corn Flakes, Pops, Mini-Wheats, Raisin Bran, Special K, Rice Krispies, Frosted Flakes, etc.), Quaker (Captain Crunch, Life, Honey Graham O’s, etc.), Post (Honey Bunches of Oats, Grape-Nuts, Honeycomb, Great Grains, etc.), General Mills (Chex, Cheerios, Cocoa Puffs, FiberOne, Kix, Lucky Charms, Wheaties, etc.), Malt-O-Meal (Crispy Rice, Frosted Flakes, Honey Buzzers, Frosted Mini Spooners, Marshmallow Mateys, etc.), Kashi (Whole Grain Flakes, Organic, Golden Crisp, etc.)

Please select the option of ready-to-eat breakfast cereal that you would purchase, or the no purchase option

Price \$ 3.60 Nutrition Facts Serving Size 1 cup Servings per 12 OZ Box About 11 Amount Per Serving Fats Saturated Fat 0 g Carbohydrates Sugar 29 g Fiber 14 g Proteins 8.5 g	Price \$ 5.70 Nutrition Facts Serving Size 1 cup Servings per 12 OZ Box About 11 Amount Per Serving Fats Saturated Fat 0 g Carbohydrates Sugar 14 g Fiber 6.5 g Proteins 8.5 g	I Choose not to purchase either product

Figure 1. Example choice experiment choice scenario as presented to respondents.

were asked to make one selection per question over the course of eight choice questions. No information was given about the physical composition or taste spectrum of the hypothetical RTEBC.

The prices for the experiment were obtained by observing retail prices of two major Midwestern supermarkets during December 2015. The price options for a 12oz. box of cereal were \$1.45, \$3.60, and \$5.70. The USDA Food Composition Database lists nutritional information for a number of RTEBC³. Figure 2 charts four nutritional elements: sugar, fiber, protein, and saturated fat. There were 238 RTEBC analyzed: 59 belonged to the General Mills brand, 28 to the Post brand, 68 to the Kellogg brand, 25 to the Kashi brand, 21 to the Malt-o-Meal brand, and 37 to the Quaker brand. Mean sugar content, measured in grams per serving, of 238 different RTEBC was 9.45 g per NLEA serving (g/serving) with a maximum of 22.02 g. The protein, sugar, fiber, and saturated fats were calculated using the USDA National Nutrient Database for Standard Reference (FCD, 2015). The NLEA serving size for the majority of the RTEBC in the USDA National Nutrient Database was listed as one cup (FCD, 2015), so respondents were informed that the nutrients were in terms of grams per one cup serving.

Each nutrient, except for saturated fat, had three levels presented in the choice experiment. The attribute saturated fat had two levels presented in the choice experiment, 0 and 5 g per serving. All respondents saw instructions before the choice experiment that explained the questioning process and provided definitions for each of the nutrients. Following Lusk (2003), the “cheap-talk” method was adopted to inform respondents to answer the questions as in the real purchasing situation in order to reduce WTP overestimation bias caused by hypothetical purchasing situations before they participate in the tasks. The full text is included in Supplementary Methods S1.

The influence of nutritional education was a focus of this study; thus, half of the survey respondents were randomly selected to see the nutritional information displayed in Supplementary Methods S2, which was obtained from the U.S. Food and Drug Administration (FDA, 2015).

³ The database list more RTEBC than analyzed here. The RTEBC included here are ones for which the data was complete and the brand was known. This data was downloaded in October 2015.

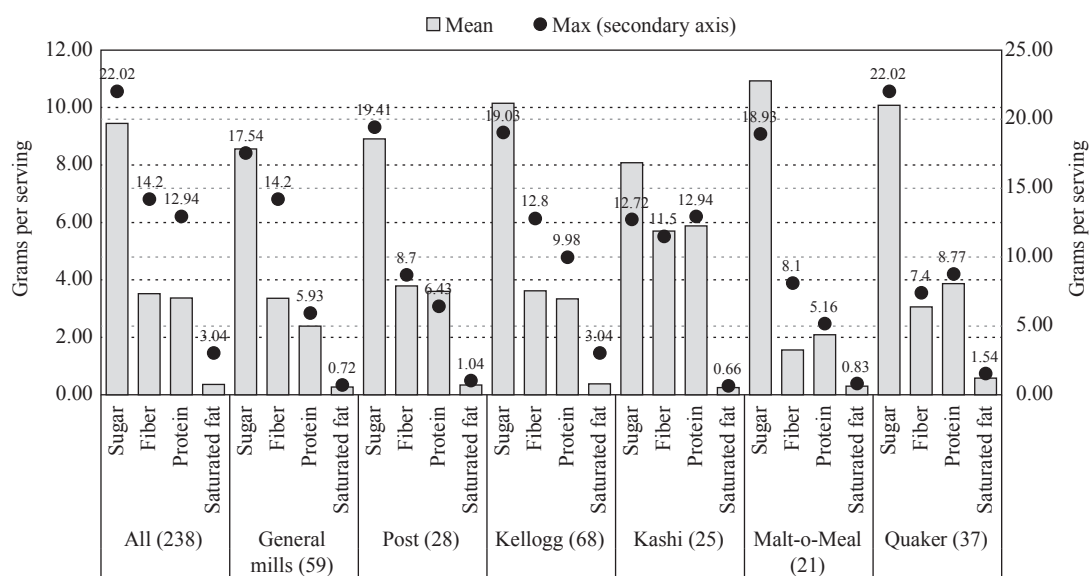


Figure 2. Nutritional data for ready-to-eat breakfast cereal, mean and max grams per serving (adapted from FCD, 2015). Sugar and protein are measured as total grams per one Nutrition Labeling and Education Act (NLEA) serving. Fiber is measured as total dietary grams per one NLEA. Saturated fat is measured as total grams of saturated fatty acids per 1 NLEA serving.

2.2 Estimating consumer willingness to pay

Willingness to pay calculations, estimated from choice experiment data, rely on the properties of random utility theory, in which a decision maker, faced with a set of choices, selects an alternative that reveals something about their underlying preferences (Greene, 2012). The choice of product with various attributes, based on underlying preferences, are made by decision makers to maximize their utility (Train, 2002). The attributes selected by the individual n for the alternative j is designated a vector x_{nj} (Greene, 2012; Train, 2002). Individual n 's utility function from consuming the product of alternative j can be represented as V_{nj} , where V_{nj} is a function of the attributes of the alternative selected by the decision maker and some characteristics of the decision-maker themselves, s_n , or $V_{nj} = V(x_{nj}, s_n)$ (Train, 2002). The total utility can then be represented by the relative utility estimated by the researcher and some unobserved random elements, $U_{nj} = V_{nj} + E_{nj}$ (Train, 2002).

Following Train (2002), the individual n selects an alternative, or choice, from a set of J alternatives with each alternative contributing (positively or negatively) to the individual's utility. The decision-makers selection of alternative j from J alternatives reveals that j provides a greater utility compared to the remaining alternatives (Greene, 2012; Train, 2002). In a discrete expression, a decision-maker picks alternative i if $U_{ni} > U_{nj}$ for all $j \neq i$ (Train, 2002).

The selection of an alternative from set (s) of alternatives can be thought of as an event, and maximum likelihood models, like logit models, predict the probability that the selection event occurs (Greene, 2012). If the unobserved terms, E_{nj} , are independent and identically distributed, following Greene (2012) and Train (2002), the estimated random utility equation takes on a multinomial logit (MNL) form:

$$V_{nj} = \beta x_{nj} \quad (1)$$

The closed form of the logit probability, given the underlying distribution of the error term, can be expressed as:

$$Prob(Y_i = j) = \frac{\exp(V_{nj})}{\sum_{j=1}^J \exp(V_{nj})} \quad (2)$$

Consumer preferences have been shown to be heterogeneous in numerous studies dedicated to measuring WTP (Alfnes, 2004; Hu *et al.*, 2005; Janssen and Ham, 2012; Olynk and Ortega, 2013; Ubilava *et al.*, 2010; Zheng *et al.*, 2016), in which case simple MNL estimation is insufficient for computing the coefficients. A more appropriate model is the random parameters logit (RPL) which allows for the utility associated with an attribute to be random (Greene, 2012). The RPL considers the variation and standard deviations across individuals as well as the mean estimations when estimating the β s (Greene, 2012). With $f(\beta)$ representing the distribution of the random parameter, the probability then becomes:

$$Prob(Y_i = j) = \int \frac{\exp(V_{nj})}{\sum_{j=1}^J \exp(V_{nj})} f(\beta) d\beta \quad (3)$$

Heterogeneity in consumer preferences can also be observed by analyzing the Cholesky matrix. For this estimation, β can be thought of as a $k \times 1$ vector of attribute coefficients and η is a vector of random attribute coefficients, $(k-2) \times 1$, within β (Revelt and Train, 1998; Train, 2002). When η is specified $\eta = N(b, \Omega)$, the vector can be expressed as $\eta = b + LM$, for which L is a lower triangular Cholesky factor of Ω and $LL' = \Omega$ and M is a vector of independent standard normal deviates (Revelt and Train, 1998). Heterogeneity is expressed by the estimated random parameters having statistically significant diagonal elements in the Cholesky matrix (Olynk and Ortega, 2012).

The final model for the RPL was estimated using Nlogit 5 (Econometric Software Inc., Plainview, NY, USA) and is represented by:

$$V_n = \beta_1 Optout_n + \beta_2 Price_n + \beta_3 Protein_n + \beta_4 Sugar_n + \beta_5 Fiber_n + \beta_6 Saturated_n + \beta_7 Optout18_n + \beta_8 Optout25_n + \beta_9 Optout45_n \quad (4)$$

All variables except for PRICE were set to be normally distributed. $Optout_n$ represents the respondent's election to purchase neither of the products shown during the choice experiment. This can also represent the disutility a consumer experiences from not having the product in their choice set (Olynk and Ortega, 2013). Three of four age dummy variables were used in order to understand the impact of opting out amongst age groups. Although interactions between other demographics were considered, the final model included only interactions between the demographic age and the opt-out dummy variable. $Optout18_n$ is the interaction variable between the age group of 18 to 24 year olds and opting out. The interaction between 25 to 44 or 45 to 64 year olds and opting out is represented by the variable $Optout25_n$ and $Optout45_n$, respectively. The variable $Price_n$ represents the price attribute of the selected product. $Protein_n$ represents protein content per serving in grams, while $Sugar_n$, $Fiber_n$ and $Saturated_n$ all similarly represent sugar, protein, and saturated fat, respectively.

Using statistically significant coefficients from the RPL estimation, WTP can be calculated by dividing the marginal utility of an attribute by the marginal utility of an income or cost attribute (Hensher *et al.*, 2005). For this study, WTP can be interpreted as the amount of money respondents were willing to give up in order to have the selected amount of nutrient per serving as an attribute of their selected box of RTEBC. Using the equation above, the WTP for sugar, for example, can be calculated as,

$$WTP = -\frac{\beta_4}{\beta_2} \quad (5)$$

The WTP for opting out takes on a different form because of the nature of the interaction terms included in the RPL model. The disutility experienced by respondents for not having RTEBC in their choice set, captured by the opt out variable, can be calculated in the following way, using the age proportions to weight the variables

$$WTP = -1 \times \frac{\beta_1 + \beta_7 \times \%AGE18 + \beta_8 \times \%Age25 + \beta_9 \times \%Age45}{\beta_2} \quad (6)$$

This equation can be reduced for respondents of specific ages.

Mean WTP cannot be representative of the entire sample if preference heterogeneity exists, as shown by statistically significant standard deviations (Olynk and Ortega, 2013; Ubilava *et al.*, 2010; Zheng *et al.*, 2016). Using parametric bootstrapping, 95% confidence intervals were calculated, to enable the evaluation of variability in the estimations (Krinsky and Robb, 1986; Olynk and Ortega, 2013). WTP estimate observations were simulated by drawing observations for each variable from a normal distribution 1000 times using the variance-covariance matrix and means estimated from the RPL (Krinsky and Robb, 1986; Olynk and Ortega, 2013). It was also important to consider the impact of opting out on each of the ages included as interaction terms. In order to determine if the impact of opt out was different for one age compared to another, a complete combinatorial method was used (Poe *et al.*, 2005). WTP calculations and the complete combinatorial test were performed in Matlab (MathWorks, Novi, MI, USA).

3. Results and discussion

The survey concluded with a sample of 1,265 Midwestern respondents completing the choice experiment. Demographics of the whole sample and the two sub-samples are summarized in Table 1. The sub-samples were characterized by having seen (n=632) or not having seen (n=633) the nutrition information before completing the choice experiment. A comparison to the demographics provided by the USCB population estimates for the specified study area is also provided. For the total sample, all targeted demographic categories are within five percentage points of the U.S. census. Male respondents made up 48% of the total sample. The largest age group was for those 45 to 64 years old, making up around 38% of the sample. Ages 25 to 44

Table 1. Sample summary statistics (percent of respondents, n=1,265).^{1,2}

		Yes Information N=632	No Information N=633	Total N=1,265	USCB 2014 ACS Estimates
Male		49	47	48	49
Age	18-24	09	07	08	13
	25-44	31	34	33	31
	45-64	38	39	38	36
	65 and older	22	20	21	20
Income	Less than \$25,000	21	21	21	24
	\$25,000 to \$34,999	11	11	11	11
	\$35,000 to \$49,999	13	14	14	14
	\$50,000 to \$74,999	21	19	20	19
	\$75,000 to \$99,999	12	13	13	12
	\$100,000 to \$149,999	13	13	13	12
	\$150,000 or more	8	9	9	8
Household composition	No children	58	60	59	
	Children in household	29	28	28	
	Unstated or ambiguous	13	12	12	
Importance of nutrition for select nutrient categories³		Very important	Somewhat important	Rarely important	Not important
	Calories	31	43	12	8
	Carbohydrates	36	39	18	11
	Fats	33	40	15	7
	Sugars	39	35	13	8
	Vitamins	32	38	17	8
	Protein	36	37	15	7
	Sodium	33	38	16	7

¹ The percent for female can be obtained by subtracting the percent for male from 100. The age categories and income categories sum to 100. Subtracting the percent of respondents with at least one child from 100 is the proportion of respondents who do not have children at home and the proportion who did not report or gave ambiguous responses for household composition. Source: U.S. Census Bureau; American Community Survey, 2014 American Community Survey 1-Year Estimates, Table S1901; generated by S. R. Dominick; using American FactFinder; <http://factfinder2.census.gov> (21 September 2015).

² Food secure and Food insecure does not sum to 100. The difference is for a category called Marginal Food Security. The difference in “households with children” and “households without children” can be accounted for by a group of respondents for whom specific household make up could not be determined, these are known as ambiguous households (n=156); ACS = American Community Survey.

³ not shown was the category “don’t care/don’t know” which can be obtained by subtracting the sum on the shown categories from 100%

made up 33% of the total sample. The majority of respondents reported not having children (persons under 18 years old) living in the household. 28% reported at least one child, and 12% did not report or gave an ambiguous response.

3.1 Consumers' recognition of nutrition labels and status of food insecurity

Questions were asked in order to determine the respondents' general use of nutrition labels and nutritional values and responses are summarized in Table 2. Half of the sample reported they look for what is affordable before they look at the nutrition of food purchased. The majority of respondents read nutrition labels for select foods (69%), and 38% read for all foods. 70% reported using nutrition labels to make purchasing decisions.

Table 2. Percentage of respondents who indicated food security levels.

USDA food security score	High food security	Food insecure	Low food security	Very low food security
All adults (n=1,265)	65	25	10	15
Households with children (n=360)	46	44	15	28
Households without children (n=749)	72	18	8	10
In the past year has respondent or household received help from				
SNAP/food stamps			16	
Women, infant, children services (WIC)			5	
Church/charitable organizations			6	
Food bank/pantry			8	
Mission/soup kitchen			4	
None			77	
Other			1	
Do you or does anyone in your household eat subsidized school lunches(n=360)				
Yes			36	
No			64	
Select the option that best describes your use of food nutrition labels	Yes	No		
I use them to make purchasing decisions.	70%	30%		
I read them for all foods.	38%	62%		
I read them for select foods.	69%	31%		
I look for what is affordable before I look at nutrition.	50%	50%		

Using a Likert scale ranging from “very important” (1) to “don’t care/don’t know” (5) respondents were asked to rank the nutritional importance of seven nutrient categories, three of which were used in the choice experiment (Table 1). 31% of respondents rated calories as a very important nutritional category, 26% carbohydrates, 33% fats, 39% sugars, 32% vitamins, 36% proteins, and 33% sodium. A higher proportion of respondents reported the category as somewhat important for all categories except sugars for which only 35% reported as somewhat important (compared to the 39% who rated it very important). The combined rarely important, not important, and don’t care/don’t know ranks accounted for 26% of respondents for calories, 35% for carbohydrates, 27% for fats, 26% for sugars, 30% for vitamins, 27% for proteins, and 29% for sodium.

Food security status for respondents was calculated using the survey and methodology used in the USDA ERS Current Populations Survey Food Security Supplement (USDA, 2012). Table 2 summarizes the food insecurity score of all respondents. The majority of all respondents had high food security 65% while 25% were food insecure. Of the food insecure, 10% were classified as having low food security and 15% as having very low food security. 72% of respondents who reported having no children in the household had high food security and a smaller portion of those who reported having children had high food security (46%). Households with children also had higher proportions of food insecurity severity with 15% having low food security and 28% very low food security.

Restrictions to a person’s ability to access food, often due to the cost of food, can be alleviated by a number of sources (Evans *et al.*, 2015; Hoisington *et al.*, 2002). In our survey, respondents were asked if they or someone in their household had received assistance in the last year from a list of five sources. The majority of respondents (77%) reported having received no assistance in the last year. 16% of the sample reported they or someone in their household received assistance from SNAP or food stamps. Food bank/pantry was the next largest proportion with 8%, followed by church/charitable organization with 6%, WIC with

5%, and mission/soup kitchen with 4%. 86% of the sample who had received assistance from food banks (n=107) were satisfied with the food options, the majority (62%) knew how to prepare all the food, 35% knew how to prepare some of the food, and 4% knew how to prepare few or none of the options. The sample of respondents who reported having at least one child in the home were asked if they or someone in their household ate subsidized school lunch, 36% reported in the affirmative.

3.2 Buying behaviors for ready-to-eat breakfast cereal across demographics

Demographics such as age, income, and whether or not children are present in the household were found to be drivers of cereal consumption across various studies (Binkley and Golub, 2011; Castetbon *et al.*, 2011; Holmes *et al.*, 2012). Respondents of our survey were asked a number of questions to provide a base understanding of their existing relationship with RTEBC and are summarized in Figure 3. When asked if their household consumes RTEBC, 48% of respondents selected adults only, 32% selected adults and children, and 2% selected children only. The remaining respondents (18%) said no one in the house consumes RTEBC.

The respondents who indicated their household consumed RTEBC were asked a number of follow up questions (Figure 3). Respondents were asked to select their reasons for purchasing RTEBC. The majority (83%) reported their reason was that it was easy to prepare, 70% that it was tasty, 45% that it was nutritious, 33% that it was inexpensive, and 27% that it was traditional. Four consumption time options were presented in order to gauge how often RTEBC was consumed. A majority of respondents not only ate cereal for breakfast (97%) but also ate it for breakfast three or more times a week (52%). Of those who ate it for lunch (36%) and dinner (38%), most respondents ate RTEBC for three or more meals a week. 61% consumed RTEBC for a snack and 44% for three or more meals a week. Respondents were also asked what packaging type they usually purchase when buying RTEBC. 60% selected the standard sized box (12oz.). Nearly as many respondents (59%) indicated they purchase family or large sized box (17-21oz.) and 20% indicated purchasing bagged cereal.

Three statements were used to understand the consistency of consumer purchasing. 45% selected the statement “I buy a variety of brands/types” of RTEBC (Figure 3). For the statement “I buy a select few varieties and types”, 48% respondents who eat RTEBC agreed. Only 7% of respondents selected “I buy only one type”. While a number of brands exist for RTEBC, respondents were asked to select all the brands of RTEBC they purchase from a list of seven kinds. The brand selected most was Kellogg (72%) followed by General Mills (66%). Post and Quaker were selected by 34% and 32%, respectively, Malt-O-Meal was selected by 27%, 26% selected store brands, 13% selected Kashi, and 1% selected none of the above.

In this sample of Midwestern respondents, the proportion of respondents who are 18 to 24 and eat RTEBC for lunch three times a week were not statistically different from the proportion of 25 to 44 year olds who ate RTEBC for lunch 3 times a week (Table 3). However, both were statistically different and larger than the proportions of those 45 to 64 and those 65 and older. In a study of breakfast patterns, Siega-Riz *et al.* (2000) found that 18 to 40 year olds were more likely to skip breakfast (23%), compared to 41 to 65 year olds (12.5%). The age groups were statistically different in their consumption of different foods for breakfast, with more 41 to 65 year olds eating eggs plus other primary food groups and bread (Siega-Riz *et al.*, 2000). The two age groups were not different in their consumption of ready-to-eat cereal and other food groups not including eggs (Siega-Riz *et al.*, 2000). Siega-Riz *et al.* (2000) also found that females, those with higher incomes, and those with college degrees were more likely to follow cereal and bread patterns, while lower income followed egg patterns.

The proportion of respondents with children who purchase RTEBC because “it is easy” was statistically larger than the proportion of respondents who do not have children and purchase RTEBC for the same reason (82.5% compared to 63.2%) (Table 3). The proportion of respondents who were food secure and purchase RTEBC because it is inexpensive was larger than the proportion who were food insecure and purchased RTEBC because it is inexpensive. Further investigation with a larger sample may enable further analysis into

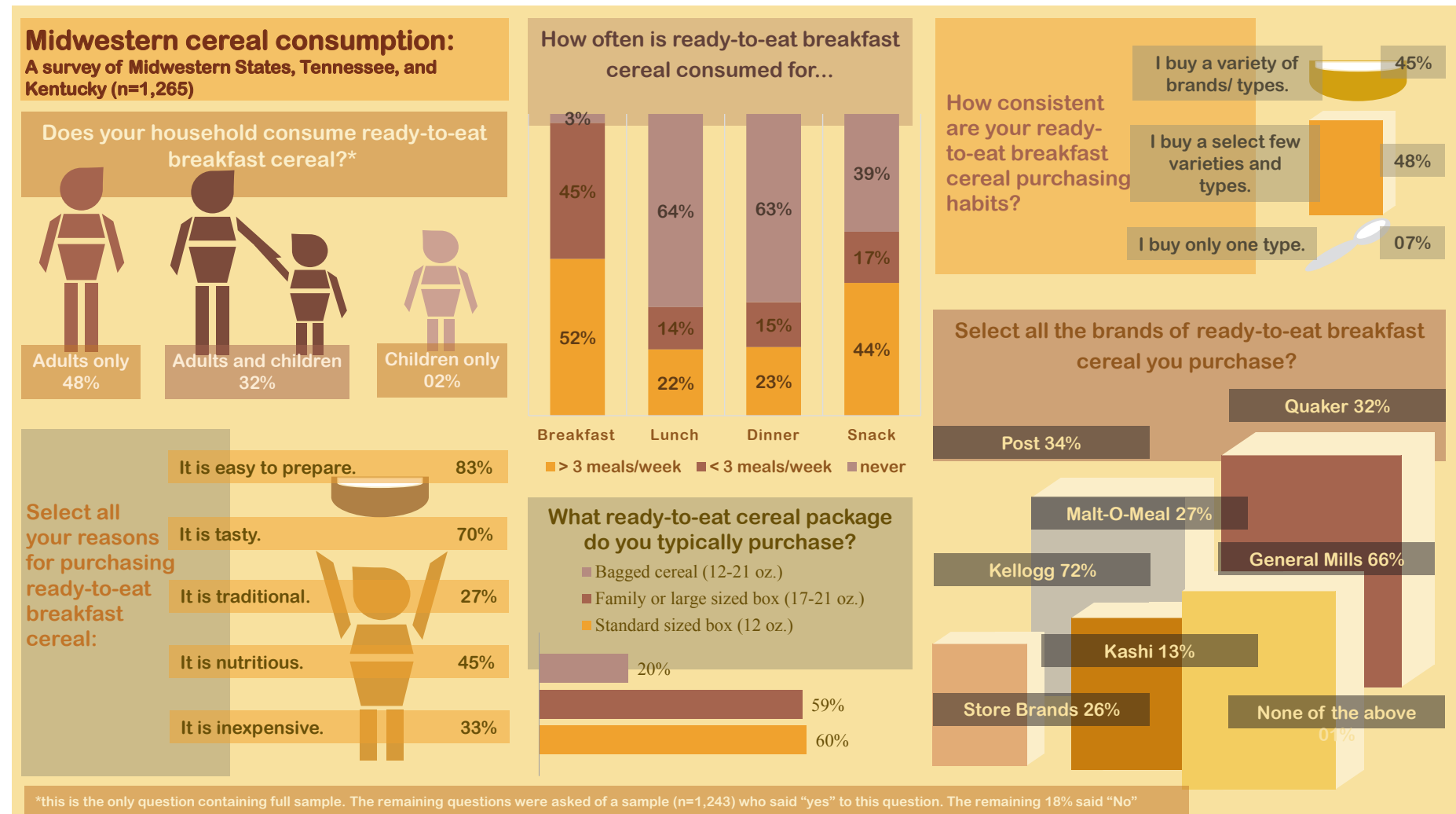


Figure 3. Midwestern cereal consumption (percent of respondents n=1,265).

Table 3. Cross tabulations of respondents cereal consumption behaviors and demographics.¹

	Sex		Age				Income			Children in household		Food secure	
	Male	Female	18 to 24	25 to 44	45 to 64	65+	Low	Mid	High	Yes	No	Yes	No
Eats 3 or more times a week													
Break	42.8	43.2	41.7 ^{ab}	48.2 ^b	42.1 ^{ab}	37.2 ^a	40.5 ^a	39.8 ^a	48.5 ^b	48.1 ^a	41.0 ^b	40.4 ^a	51.3 ^b
Lunch	18.5	18.1	26.0 ^a	25.1 ^a	16.5 ^b	8.2 ^c	19.9	16.9	18.0	27.5 ^a	14.6 ^b	15.2 ^a	28.2 ^b
Dinner	18.5	19.0	27.1 ^a	25.5 ^a	16.7 ^b	8.9 ^c	17.9	16.5	21.7	28.6 ^a	14.8 ^b	16.4 ^a	26.2 ^b
Snack	34.4	37.2	44.8 ^a	42.2 ^a	35.9 ^a	23.0 ^b	33.2	35.8	38.6	49.4 ^a	30.5 ^b	33.6 ^a	43.3 ^b
Purchases RTEBC because													
It's easy	69.2	68.2	69.8 ^a	74.7 ^a	69.7 ^a	57.2 ^b	63.1 ^a	66.1 ^a	76.4 ^b	82.5 ^a	63.2 ^b	68.8	68.5
It's tasty	55.8	59.1	58.3 ^{ab}	58.1 ^{ab}	59.8 ^b	52.4 ^a	52.6 ^a	56.5 ^a	63.3 ^b	65.0 ^a	54.5 ^b	58.8	53.4
It's traditional	23.6	20.4	13.5	23.6	21.9	22.3	19.4 ^a	19.8 ^a	26.3 ^b	30.3 ^a	18.6 ^b	3.1	18.1
It's nutritious	39.9	35.1	19.8 ^a	31.7 ^b	37.3 ^b	44.2 ^b	33.2 ^a	34.4 ^a	44.3 ^b	40.8	36.0	39.5 ^a	30.5 ^b
It's inexpensive	29.5	25.5	36.5 ^a	31.1 ^a	27.6 ^a	18.2 ^b	31.0 ^a	29.4 ^a	22.2 ^b	36.4 ^a	23.9 ^b	36.6 ^a	24.6 ^b
Other	2.3	4.1	2.1 ^{ab}	0.5 ^b	4.1 ^a	6.3 ^a	4.7	2.8	2.3	1.1 ^a	4.1 ^b	3.2	3.4
Purchases package type													
Standard box	46.8 ^a	52.4 ^b	44.8 ^{ab}	53.3 ^b	50.1 ^{ab}	45.4 ^a	46.7 ^a	46.8 ^a	55.4 ^b	56.4 ^a	47.1 ^b	51.3 ^a	44.6 ^b
Family size box	51.1	46.4	58.3 ^{ab}	56.4 ^b	47.8 ^a	34.6 ^c	39.6 ^a	51.5 ^b	54.3 ^b	67.8 ^a	41.0 ^b	46.2 ^a	56.4 ^b
Bagged	17.1	16.3	18.8	21.0	17.1	8.6	18.2	16.7	15.2	28.6 ^a	11.9 ^b	14.0 ^a	25.5 ^b
None of these	0.5	0.2	0.0	0.2	0.6	0.0	0.5	0.5	0.0	0.0	0.4	0.2	0.7
Uses of nutrition labels													
Look for affordability	49.3	51.5	57.3 ^a	54.5 ^a	50.9 ^a	40.9 ^b	61.7 ^a	51.3 ^b	39.0 ^c	57.5 ^a	47.6 ^b	43.8 ^a	71.8 ^b
Used to make decisions	64.6 ^a	74.8 ^b	70.8	70.8	69.7	68.4	62.2 ^a	68.7 ^b	78.3 ^c	76.1 ^a	67.4 ^b	70.5	69.7
Read for all foods	38.9	37.4	41.7 ^{ab}	45.5 ^b	31.5 ^a	37.2 ^a	35.9	38.6	39.7	45.8 ^a	35.0 ^b	35.9 ^a	45.3 ^b
Read for select foods	66.2 ^a	71.6 ^b	69.8 ^{ab}	69.9 ^{ab}	71.1 ^b	63.9 ^a	62.7 ^a	66.8 ^a	77.1 ^b	74.7 ^a	66.7 ^b	69.8	66.4

¹ RTEBC = ready-to-eat breakfast cereal.

this finding, perhaps RTEBC is too large of a category with diverse products included to address consumption of the product category across food security statuses. Future studies should include other categories of food items and evaluate the purchasing behavior of those items and food insecure households.

3.3 Estimated willingness to pay for cereal nutritional attributes

Table 4 displays the results from the RPL as well as calculated mean WTP values and associated confidence intervals. The samples of respondents who did and did not see the nutritional information before participating in the choice experiment were pooled after conducting a Log-Likelihood Ratio (LR) test. Following Wooldridge (2012) LR χ^2 tests were performed on the sample who saw the nutritional information and those who did not using MNL and RPL models. A *P*-value was obtained, and it was found with 95% confidence that the two samples could be pooled. Reflective of Lin *et al.* (2017), respondents who saw the nutritional information in this sample did not necessarily select healthier nutrient attributes as found by the WTP calculations from the RPL, as there were no statistical differences between the groups when WTP was compared using the complete combinatorial method (Poe *et al.*, 2005).

Considering previous studies (Binkley and Golub, 2011; Castetbon *et al.*, 2011; Holmes *et al.*, 2012; Siega-Riz *et al.*, 2000) and the early findings in this study through analysis of other questions, age was of particular interest in this analysis. The willingness to opt out and its interaction with age was calculated (Table 4). The age group 25 to 44 had disutility associated with opting out of RTEBC purchases in the choice experiment. The age group 18 to 24 years of age had a mean estimated disutility associated with opting out, although the confidence interval surrounding that estimated value included zero. The distribution of willingness to not purchase (opt out) for the two younger age groups was not statistically different from each other (*P*-value 0.7817). However, they were both different from the willingness to opt out (*P*-value 0.0030 for ages 18-24 vs 45 and up and 0.000 for ages 25-44 vs 45-64) for the oldest age group included, as shown by the complete combinatorial method proposed by Poe *et al.* (2005) with 95% confidence. Interestingly, the participants in this study straddle the NLEA implementation of nutritional information in 1990 (someone born that year would be 26 years old at the time of data collection). These results may reflect in part a generational impact of nutritional understanding, among many other potential differences. Additional research could further

Table 4. Random parameters logit model estimated coefficients (n=1,265).¹

Variable	Coefficient (standard error)	Standard deviation (standard error)	Mean WTP	Confidence interval
Sugar	0.0152*** (0.0014)	0.0113*** (0.0019)	\$0.16	[\$0.13, \$0.20]
Protein	0.0073** (0.0030)	0.0467*** (0.0050)	\$0.08	[\$0.02, \$0.14]
Fiber	0.0235*** (0.0035)	0.0221*** (0.0046)	\$0.25	[\$0.17, \$0.33]
Saturated fat	0.0707*** (0.0110)	0.1774*** (0.0141)	\$0.74	[\$0.50, \$1.02]
Price	-0.0956*** (0.0088)			
Opt out age 18 to 24	-1.4288*** (0.2747)		\$-15.09	[\$-21.51, \$-9.23]
Opt out age 25 to 44	-1.7260*** (0.1860)		\$-18.25	[\$-23.38, \$-13.44]
Opt out age 45 to 64	-0.5189*** (0.1699)		\$-5.56	[\$-9.28, \$-2.01]

¹ *P*<0.10=*, *P*<0.05=** and *P*<0.01=***, WTP = willingness to pay.

contribute to these findings by designing experiments that focus more heavily on food insecure shoppers and their purchasing choices.

Table 4 reveals significant standard deviation coefficients for all nutritional attributes studied, which confirms heterogeneous preferences for nutrient content. A positive WTP was estimated for each of the RTEBC attributes investigated. Given the structure of the experiment, interpretation of WTP per gram may not be intuitive. Thus, one may wish to interpret WTP per serving of 8.5 grams of protein, for example, as \$0.68 per box, rather than as \$0.08 per gram. If marketers and cereal providers are interested in best meeting consumers' demands for product attributes, focusing on those attributes for which the highest mean marginal willingness to pay estimates were obtained would seem a reasonable criteria. However, willingness to pay for a single attribute may or may not translate into increased sales of products with those attributes, depending on a multitude of factors including other competing goods available and the other attributes present and/or desired which may be outside the scope of this analysis.

While positive WTP for protein may be unsurprising, positive WTP for sugar may be less expected, given the focus on sugar reduction in diets recently. In a study of soy based food products, Chang *et al.* (2012) investigated the effects of health claims on consumers' willingness to purchase soy products. They found health claims overall were impactful, followed by the taste, but the protein content of the product had the lowest WTP.

Chidmi and Lopez (2007) found that cereal purchased by consumers was negatively related to the amount of calories per serving, and that fiber was perceived to be healthier but sugar tastier, so preference was dependent on the ratio of one to the other. Castetbon *et al.* (2011) also found there was a trade between sugar and fiber in RTEBC in that the Nutrient Profile Index scores assigned to the studied cereals were higher (more nutritious) when there was less sugar and more fiber content. Binkley and Golub (2011) suggest consumers were willing to make a trade between health and taste. 70% of the consumers of RTEBC studied here reported buying RTEBC because it was tasty. Those in the food industry should evaluate if their product is purchased for taste or nutrition. For stakeholders who intend to change the nature of taste based consumption in favor of health (i.e. sugar added beverages) understanding the strength of the taste relationship of a product can impact the direction of advertising and policy.

Past studies have sought to investigate consumer spending on RTEBC with various nutrient profiles. Using a Nutrient Profile Index for RTEBC, Castetbon *et al.* (2011) found that buying decreased as the RTEBC nutrition increased. They also found that brand loyalty and buying frequency increased as nutrition increased (Castetbon *et al.*, 2011). In a study of cereal and nutrition, Lin *et al.* (2017) found that high nutrition cereals were more own price elastic than low nutrition cereals, meaning price changes would impact high nutrition cereals more. Berning (2014) investigated the U.S. household use of coupons on the nutritional quality of food and found that consumers used retailer and manufacturer coupons to purchase breakfast cereals with higher sodium and sugar averages (Garasky *et al.*, 2016). Additionally, RTEBC is a significant part of the products purchased with WIC stamps and many high priced RTEBC products are eligible for purchase with those stamps (Garasky *et al.*, 2016). They found that sugar increased from 25% per serving to 33% with the use of manufacturer coupons, and found that price was positively correlated with fat, fiber, and protein, for the cereals included in the study, but negatively correlated with sugar (Berning, 2014).

4. Conclusions and implications

Consumers have been found to have heterogeneous food preferences, including for the nutritional attributes of RTEBC. Generally, 50% of the sample reported looking for food that was affordable before looking at nutrition. 82% of the sample reported consuming RTEBC and 45% of those reported purchasing it because it was easy. Prioritization of affordable food is imperative for agribusiness and food companies as they seek to meet the demands and needs of their consumers. While nutrient levels and other attributes are certainly of interest to segments, and often majorities, of the marketplace, the focus on food security and affordability was

front of mind for many in the sample. Interaction terms in the RPL model suggest that younger consumers are different from older consumers in the disutility associated with not having RTEBC.

Nutritional education may not have the intended impact of enabling consumers to select healthier versions of certain products, given those who saw and did not see the nutrition information were able to be pooled in this analysis. The findings of this study present a number of considerations for both future nutrition research and for food organizations and policy makers that rely on nutrition labels as a communication tool. Future research should consider measuring choices discretely amongst age groups and should further investigate the reasons behind purchases. Users of nutrition labels should consider the relationship their consumers have with the product, for example taste and convenience, in addition to focusing on nutritional composition.

Supplementary material

Supplementary material can be found online at <https://doi.org/10.22434/IFAMR2017.0113>.

Methods S1. WTP attribute definitions.

Methods S2. Information presented to half of respondents.

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