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Consumer Responses to Multiple and Superfluous Labels in the Case of Eggs

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Abstract

Food labels convey various information about credence attributes. An increasing number of labels and the existence of superfluous labels lead to questions on how consumers value different number of co-presented labels. Average respondents to our national survey about eggs were willing to pay a premium for all considered attribute labels, but their valuations depended on how many other labels were presented simultaneously. For example, certified organic label lost value as it was presented with more labels. On average, respondents also valued labels that conveyed no additional information, even after being presented with their superfluity.

Keywords: choice experiment, credence attributes, eggs, labeling, number of labels, superfluous label

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Introduction

Food markets have become increasingly differentiated because of consumers' concerns about health consciousness, food safety, animal welfare, and environmental issues. Consequently, various labels have been developed to inform consumers, particularly about credence attributes. The egg market is a good example of this general trend. Organic egg sales have grown rapidly in recent years (Anderson 2009; Oberholtzer et al. 2006). Labels such as "Vegetarian-fed" and "Omega-3" appear on egg cartons, and there are an increasing number of labels regarding the treatment of laying hens, such as "certified humane" and "cage-free".

An inundation of labels in the marketplace, however, casts doubt on their effectiveness, which is disconcerting to producers and others along the supply chain who bear the cost of labeling. Studies have found that consumers spend a limited amount of time on labels and do not pay the same attention to all the information presented (Caswell and Padberg 1992; Verbeke and Ward 2006), leading to a query about how consumers use the information presented in multiple labels in their purchases. Previous studies of product attributes provide some insights. Some findings suggest that the value associated with more than one attribute is smaller than the sum of values of each label in isolation (e.g., Nilsson et al. 2006). Gao and Schroeder (2009) found that consumers' willingness to pay (WTP) decreased when the number of attributes increased from three to four, then increased when the number increased from four to five, but the ranking of attributes' relative importance did not change. In contrast, Hensher (2006) found that the weighted average WTP was not significantly influenced by the number of attributes if all other study design dimensions were considered. Thus, how consumers value a labeled attribute when it is presented with different numbers of labels and whether all labels are subject to the same effect remain uncertain.

In some instances, labels do not provide additional information about the product because another label already implies the presence of a given attribute; for example, hormones are not administered to pigs and egg-laying hens in the United States, which means that all eggs and pork products in the market are naturally hormone-free. Yet some pork and egg products are labeled as hormone-free, but others are not. Similarly, certified organic products are required to be hormone-free and antibiotics-free, which are indicated on some food products in addition to the organic certification, but not on others. In the case of eggs, besides the aforementioned case of the hormone-free label, a cage-free label appearing with an organic label is another example of redundancy. According to the Organic Production and Handling Standards (USDA 2012a), certified organic eggs are produced by hens living in a cage-free environment, which indicates that organic eggs are cage-free by definition. Yet, some suppliers affix both labels on the cartons, whereas others may only label it as organic. The use of redundant labeling seems only sensible if consumers place value on these superfluous labels.

This study uses a survey on US consumers' preferences towards various labels of eggs to examine the effects of the co-presence of multiple labels, including superfluous labels. The goal of this study is threefold: (1) to assess how consumers' valuation of selected attributes varies when other labels are co-presented, (2) to compute the WTP of selected attributes and attribute combinations, and (3) to determine how consumers value labels that do not provide new pieces of information about product attributes. A survey with a choice experiment was developed for the study and administered online to randomly selected individuals nationwide. The responses are analyzed using a random parameter logit model accounting for the heterogeneity in consumers' preferences. The conclusion discusses how our findings can be used to inform egg producers regarding effective labeling strategies.

Literature Review

Several studies that investigated consumer preferences on egg attributes found that many consumers are willing to pay a premium for most labeled credence attributes, including certified organic eggs (Anderson 2009), omega-3 eggs (Asselin 2005), and eggs produced using methods believed to enhance animal welfare (Heng et al. 2013). The majority of respondents in a Spanish study preferred local products and were willing to pay a higher premium for the combination of organic and local claims than each claim singly (Gracia et al. 2014).

Questions remain regarding consumer preferences for attributes in the context of multiple labels. Consumers increasingly desire transparency and more information about how their food is produced, and the development of information tracking and delivery technology helps provide that information (Tonsor and Wolf 2011). Yet, consumers can spend only a limited amount of time using available information to make purchase decisions, and sometimes they may choose not to be "fully" informed to avoid information overload (Caswell and Padberg 1992; Berning et al. 2008). This dilemma makes it more practical to evaluate consumer preferences on groups of labels that are presented jointly and how preferences on each label associated with particular information vary in conjunction with the others. Gao and Schroeder (2009) revealed that US beef consumer WTP decreased then increased as additional attribute information was provided. In estimating consumer WTP for travel time savings, Hensher (2006) varied the number of attributes evaluated by subjects by aggregating groups of attributes into subcategories. He concluded that no significant differences occurred in WTP when subjects were presented with a different number of attributes if the other dimensions of the experimental design were fixed, including number of choice sets, number of alternatives, number of levels of each attribute, and the range of levels. Given the contradictory findings in the literature, our study will investigate how consumers value attribute labels in the presence of other labels by allowing the utility associated with each attribute to vary by the number of labels presented in each alternative.

To our knowledge, only one study about eggs (Heng 2015) explored the issues with labels that do not provide unique pieces of information. The claim "no hormones added" cannot be used on the labels of poultry products unless it is accompanied by a statement that says "Federal regulations prohibit the use of hormones" (USDA 2013), but the hormone-free label can be affixed on egg products without the statement and may mislead consumers that other eggs have added hormones. Also, because organic and cage-free claims are not certified by the same organization, the combined usage of the organic and cage-free claims is unregulated, as are labels providing superfluous information such as "antibiotic-free" or "natural." In investigating consumer responses to redundant labeling, we hypothesized that respondents would not value such labels or would value them less after being informed of their superfluity.

Survey and Methods

Survey Instrument

The survey consisted of screening questions, general questions, demographic questions, and a choice experiment. The screening questions narrowed the respondents to individuals with recent experience in purchasing eggs. The general questions collected information on shopping behavior and attitudes toward and perceptions of food product labeling, and the demographic questions collected information such as gender, age, education, household annual income, and geographic areas of residence.

Choice experiments have been widely applied to investigate consumer preferences and estimate marginal values of attributes (Louviere and Hensher 1983; Loureiro and Umberger 2005; Hu et al. 2004). Our choice experiment was designed to estimate how consumers choose products with various credence attribute labels using eggs. Besides the credence attribute labels, egg products varied in price, color of egg shell, and packaging, to make the choice scenarios comparable to those in the marketplace. Each egg product consisting of a dozen eggs was pictured in color to visually provide information on shell color (white or brown) and package materials (paper, plastic, or Styrofoam) with a verbal description of these attributes accompanying the image (e.g., “White, Paper”).

The labels on the product indicating price and credence attributes were listed underneath the product image. Three price levels ($2.09, $2.49, and $2.89) were specified, with the mid-level of price referencing the national average retail price of white omega-3 enhanced eggs reported by the USDA during the week of June 1, 2012, when the survey was developed (USDA 2012b). The lower and higher levels of price were set at 40-cent intervals from the mid-price level. Four types of credence attribute labels representing the most prevalent attributes in the egg market (Anderson 2009; Heng et al. 2013; Gracia et al. 2014; Heng and Peterson 2014) were included for respondent consideration: production process (certified organic, omega-3, no label), animal welfare (cage-free, no label), additives (hormone-free, no label), and origin (from your state, from outside your state).

The levels of attributes are summarized in Table 1. With all possible levels for the entire set of attributes, a full factorial design included 432 (=3×2×3×2×2×2×3) product profiles, and a macro in SAS 9.2 suggested 72 profiles for a fractional factorial design, which yielded a D-efficiency score over 99%. The profiles were grouped into 24 choice scenarios with three products each, which were blocked into three sets of eight choice scenarios to minimize response fatigue. For each scenario, respondents were asked to choose from three products with different attributes and a “Not buy any of the three” option.

Concise and relevant information regarding each attribute were provided prior to the choice scenarios, and the full statement can be found in the Appendix. To examine their informed reactions to the cases of labeling redundancy, we presented to the respondents in a statement that all egg laying hens in the United States are not given hormones, and certified organic eggs are produced by hens living in a cage-free environment.

Table 1. Attributes of the choice experiment[a]

Attributes	Levels
Price	$2.09, $2.49, $2.89
Color of shell	Brown (*Brown*), White
Packaging materials	Paper (*Paper*), Styrofoam (*Styro*), Plastic
Process labeling	Organic (*Organic*), Omega-3 (*Omega*), Not labeled
Animal welfare labeling	Cage-free (*Cagefree*), Not labeled
Additive labeling	Hormone-free (*NoHorm*), Not labeled
Origin labeling	From your state (*Ownstate*), From outside your state

Note. [a]The italicized terms are names of variables specified in the random parameter logit model.

Model Specification

A random parameters logit (RPL) model was used to analyze the choice responses to circumvent the independence of irrelevant alternatives assumption of the standard multinomial logit model and accommodate the heterogeneity of preferences within the population (Hensher and Greene 2001; McFadden and Train 2000). When presented with different alternatives associated with different combination of attributes in choice experiments, individuals are assumed to choose the alternative providing the highest level of utility. The utility of an individual *i* derived from choosing alternative *j* can be written as:

$$(1)\quad U_{ij} = \beta_i X_{ij} + \varepsilon_{ij}$$

where X_{ij} represents observed attributes of the alternative *j* and characteristics of the individual *i*, β_i is a vector consist of variable coefficients representing individual's taste, and ε_{ij} is an independent and identically distributed extreme value error term. The researchers can specify the probability density of the coefficient vector $f(\beta|\theta)$, where θ is the parameter vector that describes this distribution of β across individuals. Following Hensher and Greene (2001), the probability of individual *i* choosing alternative *j* is an integral of standard logit probabilities over the parameter densities:

$$(2)\quad P_{ij}(\theta) = \int \left(\frac{e^{X_{ij}\beta_i}}{\sum_{k=0}^{J} e^{X_{ik}\beta_i}}\right) f(\beta_i|\theta)\, d\beta_i.$$

To capture the effects of other labels presented jointly, the utility function was specified with interaction terms between the labeled credence attribute and the number of co-presented labels, in addition to prices, product labels, and visible attributes of egg products. To examine the redundant case of cage-free and organic joint labels, another interaction term between the two labels was included. Thus, the individual's utility for choosing one of three egg products or "none of these three" option associated with price, attributes, and labels can be written as:

$$(3)\quad U_{ij} = \beta_{0j} + \beta_1 Price_j + \beta_{2i} Organic_j + \beta_3 N_j \times Organic_j + \beta_{4i} Cagefree_j + \beta_5 N_j \times Cagefree_j + \beta_6 Organic_j \times Cagefree_j + \beta_{7i} NoHorm_j + \beta_8 N_j \times NoHorm_j + \beta_{9i} Omega_j + \beta_{10} N_j \times Omega_j + \beta_{11i} Ownstate_j + \beta_{12} N_j \times Ownstate_j + \beta_{13} Brown_j + \beta_{14} Paper_j + \beta_{15} Styro_j + \varepsilon_{ij}$$

where *Organic*, *Cagefree*, *NoHorm*, *Omega*, and *Ownstate* are dummy variables representing egg attribute labels, with the value of 1 indicating their presence, and N_j represents the number of credence attribute labels affixed on the alternative *j* (N_j = 1, …,4). *Brown*, *Paper*, and *Styro* are dummy variables representing visible attributes of shell color and package materials. Because this was not a branded design, a single intercept was specified for all egg products. The utility function was normalized by setting the value for the opt-out option to zero.

The statistical significance of the coefficients on the interaction terms involving N_j imply that consumers indeed adjust their valuation of labels by how many other labels are presented along with the label. Many possible functional relationships besides linear can be expected between the number of labels and labeled attributes, and several non-linear specifications were explored. But these specifications were costly in terms of degrees of freedom, and most of them failed to reach convergence in estimation. The linear specification, despite its limitation, would illustrate how generally preferences change in response to the number of labels rather than the precise patterns of the changes. The coefficients on *NoHorm* and the interaction term *Organic* × *Cagefree* indicate how consumers value labels with superfluous information.

Because identification of parameters can be difficult and may cause failure of reaching convergence in a reasonable number of iterations in the random parameter logit models (Train and Weeks 2005), the intercept, price, packing material, and all interaction term coefficients were specified as fixed across individuals to simplify the computation. The fixed price allows a straightforward interpretation of the attribute WTPs, which would be distributed in the same way as the coefficients. All other parameters were specified as random with normal distribution, and individual-specific label coefficients (*Organic*, *Cagefree*, *NoHorm*, *Omega*, *and Ownstate*) were described as functions of individual characteristics, which can be written as:

$$(4)\quad \beta_{ki} = \beta_k + \delta_k' z_i + \sigma_k v_i,$$

where β_k is the population mean for the *k*th attribute label coefficient, δ and σ are parameters, z_i is a vector of observed individual characteristics and attitudes towards labeling, and v_i is an iid error term.

Definitions and descriptive statistics of the variables of individual characteristics and attitudes in our analysis are reported in Table 2. Our selected respondent characteristics included gender (a binary variable *Female* equaling one for female), age (*Age* in years), educational attainment (a binary variable *BPlus* equaling one for holding a bachelor's degree or higher), household income (*Income* in 10,000 US dollars), and respondents' attitudes toward labeling. In addition, respondents' attitudes and perceptions can also be used to explain heterogeneous preferences. Two variables regarding respondents' attitudes towards labeling were generated from three items using 5-point Likert scales. An index variable (*CONF*) equals the average of individual responses to two similar questions (items a and b in Table 3), measuring respondents' confidence on labeling information. A Cronbach's α test was conducted, and a score of 0.86 indicates the internal consistency (Cortina 1993). A variable (*MORE*) using responses to an individual item (item c in Table 3), measures respondents' favorable perception of numerous labels. A higher value of *CONF* indicates greater attention given to the labeled content, and a higher value of *MORE* represents appreciation for many labels.

Table 2. Descriptive statistics of the heterogeneity-in-means variables

Variable	Definition	Mean	St. dev.	Min	Max
Age	Midpoint of age ranges 18-24, 25-34, 35-44, 45-54, 55-64, 65-84	51.14	16.83	21.00	74.50
Bplus	1 if bachelor's degree or higher; 0 otherwise	0.43	0.49	0.00	1.00
CONF	Level of confidence on labeled information on a 5-point scale (see Table 3)	3.78	0.98	1.00	5.00
Fem	1 if female; 0 otherwise	0.58	0.49	0.00	1.00
Income	Midpoint of annual household income ranges in \$10,000: 0.5-1, 1-2.4999, 2.5-4.9999, 5-7.4999, 7.5-9.9999, 10-19.9999, 20-50	9.24	8.43	0.75	35.00
MORE	Perception on number of labels on a 5-point scale (see Table 3)	2.66	1.10	1.00	5.00

Table 3. Variables and items associated with attitudes on labeling

Variable / Questions	Average Score	Agree or Strongly Agree
Please indicate the levels at which you agree or disagree with the following statements.		
(1=strongly disagree…5=strongly agree)		
Confidence on information conveyed by labels *(CONF)* (*α*= 0.86)		
a. Labels help me identify valuable attributes.	3.86	72.70
b. Labels provide reliable information about products.	3.69	64.80
Preferences toward a greater number of labels *(MORE)*		
c. The product with more labels is more valuable.	2.66	21.22

Generally, WTP for the kth attribute by individual i (WTP_{ki}) can be estimated as a negative ratio between the attribute and price parameters, where the attribute parameter is individual-specific (β_{ki}) whereas the price parameter (β_1) is fixed across individuals. To consider the impact of consumer reactions in the presence of multiple labels, the calculation of WTP was adjusted as:

$$(5)\ WTP^*_{ki} = -\frac{\beta_{ki} + \beta_{k+1}}{\beta_1}, \qquad k = 2,4,7,9,11$$

where β_{k+1} represents the interaction term coefficient of *k*th attribute and number of total presented labels *N*, according to equation (3), or the marginal value of specific attribute when one additional label is presented alongside.

In addition, consumer *i*'s WTP for different label combinations WTP_i^c can be calculated similarly and represented by:

$$(6)\ WTP_i^c = -\sum_k \left(\frac{\beta_{ki} + N \times \beta_{k+1}}{\beta_1}\right).$$

For example, consumer's preference on the combination of certified organic label (*k* = 2) and locally produced label (*k* = 11) can be calculated as $-\left(\frac{\beta_{2i}+2\times\beta_3}{\beta_1} + \frac{\beta_{11,i}+2\times\beta_{12}}{\beta_1}\right)$. For label combinations including a certified organic label in conjunction with a cage-free label, the coefficient of interaction term was included for WTP calculation; that is, individual *i*'s WTP on the egg product with two labels that certified organic and cage-free was calculated as

$$-\left(\frac{\beta_{2i} + 2 \times \beta_3}{\beta_1} + \frac{\beta_{4i} + 2 \times \beta_5}{\beta_1} + \frac{\beta_6}{\beta_1}\right).$$

Results and Discussion

The survey was administered online by Research Now to a random, nationwide sample that was stratified by gender, age, region, and household income. After a pre-test, the survey was launched in June 2012 and returned 608 completed responses. The average completion time was about 19 minutes; the responses completed less than five minutes were discarded to prevent responses from individuals that skimmed over questions, leaving us with a total of 589 responses.

Our sample consisted of high proportions of female and highly educated respondents. These sample characteristics are not unlike other survey work on food purchases, because the female is the food buyer in majority of households, and people with higher educational attainment may be more likely to express their viewpoints. According to Table 2, the mean age (51.1 years) of our respondents (above 18 years old) as well as the mean household income level ($92,400) were higher than the national levels, where the mean age of population above 18 years old was 46.7 years and median household income was $50,502 in 2010 (U.S. Census Bureau 2011; 2012). These sample characteristics should be noted in interpretations of estimated results. Regarding the attitude variables, the means of *CONF* and *MORE* were 3.78 and 2.66, respectively, indicating that average consumers were confident in labeled information and not in favor of more labels.

Model Parameter Estimates

A random parameter logit model was estimated by maximum simulated likelihood using 100 Halton draws using NLOGIT 4.0 (Greene 2007). The estimates of the mean and standard deviations of the structural parameter densities are presented in Table 4. As Bonferroni correction is a common approach in multiple testing to reduce Type I error, the significance of coefficients that were determined by Bonferroni corrected p-values are also presented (Abdi 2007).[1] As expected, the intercept was positive and the coefficient for *Price* was negative and statistically significant, suggesting that egg purchases generate utility, whereas higher prices generate disutility.

Regarding credence attributes, the coefficient means were positive for *Organic* and *NoHorm* and statistically significant at the 1% level. The coefficient means were negative for *Cage-free* and positive for *Omega* and *Ownstate,* yet they were not statistically different from zero. The interaction terms with the number of credence attribute labels captured the impacts of number of co-presented attributes on consumers' valuation of egg attributes, and only those for certified organic and cage-free were statistically significant at 5% level. Yet, the estimated coefficients of credence attributes and the interaction terms did not remain significant after Bonferroni correction.

For the certified organic label, its marginal utility with each additional label presented is -0.33 and the mean of the *Organic* coefficient is 1.47, so consumers value the organic label when presented singly with the mean utility of 1.14. Therefore, although average respondents preferred eggs with a certified organic or hormone-free label, the certified organic label loses its value the most rapidly when it is presented with other labels. This could be because consumers may not clearly understand the information carried by the label, and when more specific attribute labels of interest become available, the importance of the organic label diminishes. Several studies have shown that consumers have lack understanding about the concept of organic produce. For example, Campbell et al. (2014) found 40% of respondents believed that organic produce has higher nutritional value than conventionally grown food. Onozaka et al. (2010) reported that 80% of US respondents in their sample misperceived local food as organic. Because the organic claim is usually more costly due to input costs and certification processes, organic producers should carefully evaluate decisions of affixing additional labels to avoid decreasing the label's significance.

In contrast, although average respondents valued the cage-free label the least (the mean utility of -0.21) when it presented alone, the value of the cage-free label increased as it was presented with more labels. Such findings suggest that this label alone lacks general appeal as other labels such as certified organic, but its message becomes more salient when contrasted with other labeled messages. The results allude to its effectiveness in the current marketplace where multiple labels are commonly observed. The changes in the values of the hormone-free and own-state labels from the number of co-presented labels were statistically not different from zero.

Another important aspect of the result pertained to the consumer valuation of redundant labels. The results indicated respondents value superfluous labels even after they were informed about

[1] We thank an anonymous reviewer for offering this suggestion.

the nature of such labels. The mean utility value of a singly presented, hormone-free label was 1.18, which was the highest among the five attributes. A positive and statistically significant coefficient of the interaction term *Organic×Cagefree* further proved that consumers value the joint labeling of egg products with the certified organic and cage-free labels, validating the use of the cage-free label, which is redundant in this case.

The heterogeneity-in-mean parameters capture the effects of demographics on attribute parameters. As shown in several studies (Govindasamy and Italia 1999; Krystallis and Chryssohoidis 2005; Bertheau 2013), younger respondents, on average, valued organic label more than older respondents. On the other hand, the older respondents, along with female respondents, cared more about the origin of the product and preferred eggs from within state. The result that lower-income respondents valued the cage-free label more is contrary to previous studies (e.g., Andersen 2011), which could be attributed to the relatively higher average income in the sample. The valuation of the hormone-free label were lower among older and more educated respondents, which also contradict some findings regarding hormone-free attributes in other food products (e.g., Alfnes 2004). However, because the hormone-free label is meaningless for egg products, older and more educated respondents could know or accept that fact better than their counterparts. Furthermore, respondents in favor of more labels placed a higher average value on the hormone-free label, which suggests these consumers indeed preferred more labels to less labels regardless of their informational content. In contrast, respondents who placed more confidence on labeling information tended to value the omega-3-labeled eggs more than their counterparts.

Regarding non-credence attributes, respondents did not value brown shell eggs on average, which is consistent with Heng et al. (2013) but different from some previous study results (Chang et al. 2010; Fearne and Lavelle 1996). This difference could be attributed a common association of brown shells with organic or cage-free eggs in the market (Chang et al. 2010) and whether the studies explicitly accounted for these attributes. It may also indicate wider acceptance of the fact the brown color does not mean more nutrition and difference in the shell color is solely due to the breeds. An average respondent preferred paper to plastic packaging may indicates that environmental concerns play a role in deciding what to buy. Previous studies also indicated that paper packaging is considered to be more environmental friendly and preferred by egg consumers who care about packaging materials (Satimanon and Weatherspoon 2010; Mintel Academic 2011).

Willingness-to-Pay Estimates

Individual WTP estimates for single attribute labels were simulated according to equation (5), and the estimated results for each attribute are reported in Table 5. On average, respondents were willing to pay a $0.39 in premium for dozen eggs with the certified organic label, and 96% of respondents were willing to pay a positive premium for this label. This result is consistent with previous studies indicating organic eggs were generally perceived as healthier, whereas the magnitude of premium for organic eggs is estimated to be smaller in our study (Chang et al. 2010). Average respondents were willing to pay a $0.42 premium for own-state products, with 90% of respondents willing to pay a positive premium. Consumer preferences for local products have been supported by many previous studies (Darby et al. 2006; Bernard et al. 2011), and the literature has shown the WTP for local origin is consistently higher than for organic production methods (Gracia et al. 2014; Loureiro and Hine 2002; Hu et al. 2004). Nearly 80% of respondents were also willing to pay a positive premium for omega-3 eggs, which is consistent with the study by Asselin (2005). In contrast, less than two out of three (64%) of respondents were willing to pay a premium for eggs with a single cage-free label, with an average premium of $0.08, which is lower than previous estimates (Chang et al. 2010). Our estimated individual WTPs are comparable with those based on revealed preferences data, suggesting that hypothetical bias from the use of stated preferences data is likely small, if any. For example, Satimanon and Weatherspoon (2010) found the premium for specialty eggs ranged between $0.28 and $1.98 per dozen by US consumers, and Chang et al. (2010) found US consumers were willing to pay a premium of $1 premium a dozen of cage-free eggs and $1.5 for a dozen of organic eggs using scanner data.

Most respondents (96%) were still willing to pay a premium averaging $0.28 per dozen for eggs with a hormone-free label even after being presented that US laying hens are not allowed to be treated with or consume growth hormones. The statement offered on redundant labels evidently did not reduce consumers' evaluation of the hormone-free label, which may reflect respondents' strong demand for assurance regarding the use of additives. In our sample, over half (52%) of respondents stated that no additives is a somewhat or extremely important factor associated with eggs, compared with 23.5% for nutrient enhancement and 43% for animal welfare. It is also possible that several, perhaps many, respondents did not fully acknowledge the statement.

Respondent preferences can be further examined by their attitudes toward the content and number of labels. First, the WTP statistics were computed separately for respondents who were confident about the labeled information ($CONF > 3$) and those who were not ($CONF \leq 3$) (Table 5, middle section). The respondents describing themselves as relying on labels to identify valuable attributes on average were willing to pay a higher premium on all credence attribute labels than their counterparts, except for the hormone-free label. This suggests that people who focus on labeling information may be more knowledgeable about labeling content and discredit redundant labels more. When divided by their attitude toward the number of labels ($MORE > 3$ and their counterparts $MORE \leq 3$), respondents with a belief that a greater number of labels is better placed a higher premium on most of labels including the hormone-free label, except the *Ownstate* label (Table 5, bottom section). This could be attributed to the choice design where the origin label (from your state or from outside your state) was affixed to every alternative, so having the *Ownstate* label did not increase the number of labels presented. In sum, although average consumers would like to pay a positive premium for the hormone-free label due to general concern about additives, consumers who focus on labeling information would like to pay less than their counterparts, whereas consumers who focus on the number of labels would like to pay more than their counterparts, but they were only 20.7% of our sample.

To further study consumer valuation on the presence of multiple labels, the WTPs for different label combinations presented on egg products were calculated according to equation (6) and are presented in Table 6. Estimated results were grouped by the number of co-presented labels in descending order by average WTPs within each group. Results show that in the case of two labels, respondents value the combination of the organic and own-state labels the most on average, followed by the combination of hormone-free and own-state. As more labels were jointly presented, the valuation of products with the cage-free label increased considerably; for example, the top four valued three-label products as well as four-label products have a cage-free label, whereas the WTP for multiple-label products with other labels have no obvious pattern. Moreover, the highest WTP for each combination size increased from $0.65 for two labels to $0.96 for three labels and $1.01 for four labels, but then decreased to $0.85 for five labels, suggesting marginal values of additional labels can be negative in the presence of too many labels.

Conclusions

Product differentiation has become a common strategy for suppliers, so it is important to understand how consumers value differentiated attributes and associated labels. This study examined consumer valuation of egg attributes in cases of multiple and superfluous labels and yielded practical implications that call for detailed assessment of specific labeling strategies to ensure their effectiveness in enhancing product value. On average, respondents were willing to pay a positive premium for each credence attribute label included in this study when those labels were presented as a single label. Consumer's valuation on each label changed in different ways when respondents were presented with several labels jointly, and producers should take such information into consideration because certified claim might be costly. Moreover, superfluous labels were still valued even after respondents were informed of their redundancy. Such findings suggest that consumers could be misled by redundant labels and provide additional premium for producers, which would justify the cost of affixing such labels.

Stated values for label combinations increased with the number of co-presented labels at a decreasing rate, peaking at four labels, then diminished dramatically. Combined, these results illustrate consumer prowess in recognizing pieces of information that are relevant to them and the limited scope of information that consumers can process. Labeling strategies should be evaluated carefully in terms of both quantity and content.

The stated preferences approach is subject to hypothetical bias, although our premium estimates were comparable to existing estimates based on revealed preference data. Future studies are encouraged to use tools such as cheap talk scripts to reduce potential bias. Also, our data did not allow us to fully capture the likely nonlinear pattern in the attribute values as the number of co-presented labels changed. Lastly, although we assume all respondents were informed with the meaning of labels through the statement before the choice experiments, future studies are encouraged to use test questions or split sample approach with different presented information to assess if they are truly aware of all the information provided.

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Appendix

Statement that Appeared Before the Choice Scenarios

In the following, you will be asked to make choices as if you would in an actual shopping situation. Suppose in a typical grocery shopping trip, you need to purchase eggs. Foods are produced in various ways, and here is some terminology used to describe ways to distinguish how eggs are produced.

Color: almost all commercial eggshells are *white* or *brown*, which depend on the breed of hens.

Packaging: some eggs are sold in *paper cartons*, some are in *plastic cartons*, and others are sold in *Styrofoam cartons.*

Additional Attributes:

Eggs are produced nationwide. Some eggs sold in the market are produced in your state, that is to say, these eggs *are from your state.* Some eggs are produced in states other than your state are *from outside your state.*

Certified organic eggs are produced by hens living in a cage-free environment and are fed organic grains without pesticides, fertilizer or animal byproducts, and this label is regulated by the U.S Department of Agriculture.

Omega-3 eggs are produced by hens that are fed a diet enhanced with omega-3 essential fatty acids, which has been showed that may help reducing the risk of heart disease by some studies.

Most eggs **without these labels** can be assumed to be produced by hens fed conventional diets which include feed ingredients, such as corn and soybean meal, fish meals and meat meals, and major minerals (e.g. Ca and P), and non-nutritive additives.

Many eggs are produced by hens that are confined in battery cages (i.e., *caged*) all the time. *Cage-free* eggs are produced by hens that are able to move freely in barns or warehouses.

Egg laying hens in the US are not given hormones. Some egg cartons say that the eggs are *hormone-free;* however, this is true for all eggs in the market.

Table 4. Estimated random parameter logit parameter distributions

Variables	Coefficient		Std. error
Intercept (fixed)	6.84	***†	0.24
Price (fixed)	-2.46	***†	0.09
Organic (random)	1.47	***	0.50
Standard deviation	0.92	***†	0.07
Heterogeneity-in-mean			
Fem	0.10		0.13
Age	-0.01	***	0.00
Bplus	-0.02		0.13
Income	0.00		0.01
CONF	0.08		0.06
MORE	-0.00		0.06
N×*Organic* (fixed)	-0.33	**	0.13
Cagefree (random)	-0.57		0.49
Standard deviation	0.86	***†	0.08
Heterogeneity-in-mean			
Fem	0.18		0.12
Age	0.00		0.00
Bplus	0.04		0.12
Income	-0.02	**	0.01
CONF	0.01		0.07
MORE	0.02		0.06
N×*Cagefree* (fixed)	0.36	***	0.13
Organic×*Cagefree* (fixed)	0.22	*	0.12
NoHorm(random)	1.29	***	0.48
Standard deviation	0.66	***†	0.09
Heterogeneity-in-mean			
Fem	0.03		0.11
Age	-0.01	***	0.00
Bplus	-0.23	**	0.11
Income	0.01		0.01
CONF	-0.07		0.06
MORE	0.09	*	0.05
N×*Hormone* (fixed)	-0.11		0.13

Table 4. *Cont.*

Variables	Coefficient		Std. Error
Omega (random)	0.24		0.57
Standard deviation	0.79	***†	0.14
Heterogeneity-in-mean			
Fem	-0.19		0.14
Age	-0.00		0.00
Bplus	0.16		0.14
Income	0.01		0.01
CONF	0.14	*	0.07
MORE	0.00		0.06
N×*Omega* (fixed)	-0.21		0.14
Ownstate(random)	0.56		0.41
Standard deviation	1.02	***†	0.08
Heterogeneity-in-mean			
Fem	0.24	*	0.13
Age	0.01	***†	0.00
Bplus	-0.19		0.13
Income	-0.01		0.01
CONF	0.05		0.07
MORE	-0.08		0.06
N×*Ownstate*(fixed)	-0.06		0.07
Brown (random)	-0.88	***†	0.10
Standard deviation	1.78	***†	0.10
Paper (fixed)	0.80	***†	0.06
Styro (fixed)	0.00		0.06
Number of observations	4,712		
Log likelihood function	-4393.39		
McFadden Pseudo R-squared	0.33		
Akaike Information Criterion	1.89		

Note. Single, double, and triple asterisks (*, **, ***) represent significance at the 10%, 5%, and 1% level using Wald tests. A dagger (†) represents significance at the 5% level after Bonferroni correction. Bonferroni corrected significance level of p-value is 0.002 at 10% and 0.001 at 5%.

Table 5. Statistics of simulated specific WTP distributions

Labels	**Mean**	**St. Dev.**	**Max**	**Min**	**Prob (>0)**
All sample (n = 589)					
Organic	0.39	0.26	1.29	-0.29	0.96
Omega	0.15	0.18	0.84	-0.40	0.79
Cagefree	0.08	0.22	0.86	-0.93	0.64
NoHorm	0.28	0.16	0.79	-0.27	0.96
Ownstate	0.42	0.30	1.27	-0.38	0.90
Sub-samples by confidence on information conveyed by labels					
$CONF > 3$ $(n = 455)$					
Organic	0.41	0.26	1.29	-0.29	0.96
Omega	0.17	0.18	0.84	-0.40	0.83
Cagefree	0.10	0.22	0.86	-0.93	0.66
NoHorm	0.28	0.16	0.79	-0.27	0.97
Ownstate	0.44	0.31	1.27	-0.38	0.91
$CONF \leq 3(n = 134)$					
Organic	0.34	0.25	1.02	-0.23	0.94
Omega	0.07	0.17	0.61	-0.30	0.64
Cagefree	0.02	0.21	0.71	-0.53	0.57
NoHorm	0.29	0.17	0.75	-0.12	0.95
Ownstate	0.36	0.28	1.08	-0.31	0.90
Sub-samples by preferences toward a greater number of labels					
$MORE > 3$ $(n = 122)$					
Organic	0.48	0.28	1.22	-0.16	0.99
Omega	0.25	0.19	0.65	-0.35	0.96
Cagefree	0.14	0.24	0.89	-0.47	0.89
NoHorm	0.30	0.16	0.62	-0.24	0.99
Ownstate	0.38	0.30	1.17	-0.23	0.95
$MORE \leq 3(n = 467)$					
Organic	0.39	0.26	1.27	-0.29	0.99
Omega	0.14	0.19	0.95	-0.36	0.96
Cagefree	0.08	0.22	0.72	-0.93	0.90
NoHorm	0.27	0.17	0.85	-0.28	0.99
Ownstate	0.43	0.31	1.29	-0.44	0.95

Table 6. Statistics of simulated label combination WTP distributions

	Labels					Statistics ($/dozen)				
Combination	*Organic*	*Omega*	*Cagefree*	*NoHorm*	*Ownstate*	**Mean**	**StdDev**	**Max**	**Min**	**Prob>0**
Two labels	×				×	0.65	0.38	1.62	-0.58	0.97
				×	×	0.64	0.34	1.51	-0.48	0.98
			×		×	0.62	0.40	1.67	-0.86	0.94
	×		×			0.57	0.36	1.72	-0.71	0.95
	×			×		0.50	0.33	1.56	-0.68	0.95
			×	×		0.47	0.29	1.61	-0.74	0.95
		×			×	0.46	0.35	1.35	-0.67	0.90
	×	×				0.32	0.31	1.23	-0.79	0.87
		×		×		0.30	0.25	1.06	-0.56	0.90
		×	×			0.29	0.30	1.21	-0.67	0.86
Three labels	×		×		×	0.96	0.48	2.09	-0.79	0.97
			×	×	×	0.94	0.44	2.07	-0.69	0.98
	×		×	×		0.79	0.43	2.29	-0.65	0.97
		×	×		×	0.72	0.45	1.76	-0.62	0.94
	×			×	×	0.69	0.42	1.75	-0.98	0.96
	×	×	×			0.56	0.42	1.75	-0.68	0.92
		×	×	×		0.55	0.36	1.56	-0.62	0.94
		×		×	×	0.54	0.39	1.54	-0.69	0.93
	×	×			×	0.47	0.41	1.58	-0.97	0.87
	×	×		×		0.30	0.37	1.48	-0.94	0.80
Four labels	×		×	×	×	1.01	0.52	2.50	-1.03	0.96
		×	×	×	×	0.91	0.49	1.98	-0.72	0.96
	×	×	×		×	0.84	0.52	2.01	-1.01	0.94
	×	×	×	×		0.65	0.48	2.13	-1.00	0.93
	×	×		×	×	0.38	0.46	1.45	-1.46	0.80
Five labels	×	×	×	×	×	0.85	0.56	2.17	-1.40	0.93