Using Consumer Insights to Determine Whether Plant-based Beverages Should Be Allowed to Use the Term "Milk"

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Abstract:

An ongoing debate is whether plant-based beverages should be allowed to use the term "milk" on their packaging. The primary reasons advocates object to the use of "milk" for plant-based beverages is that such use of the term "milk" would confuse the public into thinking that (1) plant-based beverages contain animal lactation and/or (2) plant-based beverages are as healthy as cows' milk. This study used a best-worst scale experiment to reveal consumers' beliefs about the healthiness of associated cows' milk and plant-based milk products based on their nutrition panels, and on purchase intent based on nutrition panels. We find there is heterogeneity in health perceptions, consistent with the scientific literature. These results question to what degree healthiness can be used to compare animal-based and plant-based milk products to inform labeling conventions.

Key Words: Milk, Plant-based Milk (PBM), health perceptions, nutrition panels, best-worst scale analysis, alternative protein, beverages

1. Introduction

US dairy manufacturers garnished sales of over $130 billion in 2021, of which approximately $41 billion was generated from fluid milk alone (US Census Bureau, n. d.). About $2.9 billion of sales were generated by plant-based milk alternatives in 2024 (The Good Food Institute, 2024) and approximately 29% of consumers purchased plant-based milk (PBM) (Adams, et al., 2023). From 2001 to 2021, sales of fluid milk in the United States dropped 19%.[1] Meanwhile, new plant-based milk (PBM) beverages continue to be created with the product market now containing milk from almonds, coconuts, hemp, oats, peas, quinoa, rice, and soy (Cross, 2022).

Amidst the changing milk market, whether plant-based beverages should be permitted to use the term "milk" on packaging is contentious. As early as 1997, companies filed petitions asking the Federal Drug Administration (FDA) to clarify its policy regarding the use of the term "soymilk" (Harris, 2018). It was not until February 2023 that the FDA issued draft guidance and to the authors' knowledge no final guidelines have been published after the comment period was reopened (Center for Food Safety and Applied Nutrition, 2023). The draft guidance permits PBM products to use the term milk provided some strongly suggested nutritional labeling requirements are met. Prior to the press release two primary reasons why advocates argued plant-based milk should not be allowed to use the term were that such use of the term "milk" would confuse the public into thinking that (1) plant-based beverages contain animal lactation and/or (2) plant-based beverages are as healthy as cows' milk (Leone, 2019; D'Esopo, 2018; Harris, 2018). The nutrition requirement of the draft guidance addresses this second concern. This article aims to contribute to the ongoing knowledge about consumer health perceptions for different milk products.

[1] Authors' calculation from Economic Research Service (2024)

Existing research on consumer perceptions of the healthiness of milk products falls into one of two categories: consumer perceptions or health comparisons between milk products. Current consumer perception research either focuses exclusively on environmental sustainability or general views which may or may not include health. Nutritional comparison between PBM and cows' milk is of primary concern for (1) labeling in the US as well as (2) federal policy related to dietary guidelines and school lunch program beverage provision (Center for Food Safety and Applied Nutrition, 2023). Health comparisons of milk products are limited to nutritional science or might include doctor but not general consumer perceptions. Labeling can help dispel misinformation as well as be a source of differentiation for marketers. Thus, this study fills a notable gap in the literature that is relevant to both policymakers and producers by concentrating on consumer perceptions of healthiness between plant-based milk products and cows' milk.

To accomplish this objective, a survey was administered to nearly 1,600 respondents in 2021 (prior to the FDA's initial guidance). Respondents completed a best-worst scaling experiment wherein they selected the healthiest and unhealthiest nutrition panel among a selection of current milk products.

2. Methods

2.1. Experimental Design

A survey was administered in March 2021 to adult primary grocery shoppers in the US who purchased animal-based milk, plant-based milk, or both animal-based and plant-based milk in the last three months. It was administered online via Dynata using the online survey platform Qualtrics. The survey contained word association questions, a best-worst scale experiment, prior

knowledge questions, and demographic questions. The results of the BWS experiment and demographic questions will be reported in this paper.

For the BWS experiment, respondents chose between four types of cows' milk based on fat content (skim milk, 1% milk, 2% milk, and whole milk) and three types of plant-based milk (almond milk, coconut milk, and soy milk) with nutrition panels. Each nutrition panel was based off existing nutrition panels for the respective products in the market. For cows' milk, we focused on conventional products, not organic, grass-fed, non-lactose, etc. For plant-based products we concentrated on original flavors of the "original PBM" (soy), most common (almond) and growing (coconut) types of plant-based milk sold (Watson, 2024).

<<<Insert Figure 1 Here>>>

The BWS experiment had a 2x3 design resulting in six treatment groups, which are reported in Table 1. The sample was split in half between those who saw the nutrition labels labeled with the product name (referred to as labeled throughout the paper; treatments 2, 4, and 6) and those who did not (referred to as unlabeled in Table 1; treatments 1, 3, and 5) to see if knowing the product made a difference in respondent choices. Figure 1 presents the unlabeled and labeled nutrition labels. Respondents saw either health-framed questions (treatments 1 and 2), purchase-framed questions (treatments 3 and 4), or both health and purchase-framed questions (treatments 5 and 6). The health-framed questions were worded "Which of the following nutritional panels represents the healthiest product and which represents the unhealthiest product?". The purchase-framed questions were worded "Which of the following nutritional panels represents the products that you are most likely and least likely to purchase?". Questions were framed in these two ways to explore the degree to which purchase intent is related to health perceptions of products. The presence of treatments 5 and 6, where respondents

saw both health-framed and purchase-framed questions, was particularly included for this comparison purpose.

<<<Insert Table 1 Here>>>

Each experiment contained seven questions. Therefore, participants in treatments 1-4 saw seven choice set questions while treatments 5 and 6 saw fourteen. The order of the healthiness experiment and purchase intention experiment was randomly varied for individuals in treatments 5 and 6; however, each experiment was conducted separately. The order of the seven choice questions in each experiment was varied as were the order of the nutrition labels in each question. Each question contained four nutrition labels. The BWS experimental design was generated in SAS using a balanced incomplete block design (BIBD) optimized on D-efficiency.

2.2. Sample

Our sample consisted of 1598 consumers, of which 1074 completed all BWS experiment and demographic questions reported here. Table 2 provides summary statistics of respondent demographics by treatment.

<<<Insert Table 2 Here>>>

Respondents were 52% female, with 48% not identifying as female (either “male”, “other”, or “prefer not to answer”). Our labeled treatments were slightly more female leaning than the unlabeled treatments. The average age of respondents was 53 years, with half of respondents aged fifty-seven or older. Our labeled treatment groups were slightly older than the unlabeled treatment groups. For price sensitivity, respondents were asked three five-level Likert scale questions on the importance of price, nutrition, and taste on beverage purchase behavior. Respondents who strictly ranked price as more important than both nutrition and taste were the

price-sensitive group, while everyone else was non-price sensitive. This meant that some respondents could have marked price as "extremely important" in purchase decisions but be in the non-price sensitive group if they also ranked either nutrition and/or taste as "extremely important." We considered our group price-sensitive because of the three characteristics of price, nutrition, and taste, the respondents placed strictly more importance on price. 38% of the purchase study participants were price-sensitive. For the health treatment it ranged from 34-36%. Finally, screening questions required that participants indicated purchasing either cows' and/or plant-based milk in the last three months. From prior purchase behavior questions, we generated three subgroups of purchasers of only cows' milk, purchasers of only PBM, or purchasers of both cows' and PBM. Approximately 41% of our sample only purchased animal-based milk in the last three months. About 6% of the sample only bought plant-based milk. In the health study there were twice as many people who only bought plant based milk in the labeled group than unlabeled group. Between 48-53% of the samples had bought both animal-based and plant-based milk in the last three months.

2.3. Data Analysis

Best-worst scaling is a commonly used tool in consumer behavior and preference studies of "milk" (Bir, et al. 2019). It is an attractive methodology because it requires participants to make trade-offs between provided attributes resulting in a relative ranking of attributes along a sought dimension. The nutritional argument against "milk" on plant-based beverage packaging implies a nutritional ranking of milk products with (all?) cows' milk more nutritious than plant-based alternatives. BWS is a useful tool here because it results in consumers' ranking of nutritional labels based on healthiest/unhealthiest and most/least likely to purchase.

BWS is an extension of Random Utility Theory to decisions with more than two objects. The utility respondent *n* gains from choosing alternative *j* in choice set *t* is $U_{njt} = V_{njt} + \varepsilon_{njt}$ where V_{njt} is observable and ε_{njt} is an independent, unobserved error term. When presented with a choice between alternatives *j* and *k*, the respondent will choose the alternative that provides the greatest utility. That is, $U_{njt} > U_{nkt}$ for all *j≠k.* In best-worst scale experiments in which respondents choose the extremes of alternatives presented, for example healthiest/unhealthiest, best/worst, the respondent will maximize the difference in utility, choosing alternative *j* as best and *k* as worst when $U_{njt} - U_{nkt} > U_{nlt} - U_{nmt}$ for all *j≠l* and *k≠m.*

Values for utility can be difficult to interpret; thus, in best worst scale experiments relative rankings, or preference shares, are often preferred. If we assume heterogeneity in preferences across respondents, then the unobserved rank of alternative *j* for respondent *n,* I_{nj}*,* is given by $I_{nj} = \lambda_j + \varepsilon_{nj}$ where λ_j is the observed, reported ranking of the alternative and ε_{nj} is the random error component. In our study the alternatives are the seven nutrition panels which are presented to respondents in each choice set of the BWS experiment in groups of *J=4*. Thus, respondents choose among *J(J-1) =12* possible pairs in each question the pairing that provides the greatest difference between I_{nj} and I_{nk}. This leaves *J(J-1)-1* pairs, or differences across other nutrition panels, not selected. Using a multinomial logit model (MNL), the probability of respondent *n* choosing alternatives *j* and *k* as the best (healthiest or most likely to purchase) and worst (unhealthiest or least likely to purchase) respectively among the twelve pairs of alternatives is $P_{njk} = \frac{e^{\lambda_j - \lambda_k}}{\sum_{l=1}^{J}\sum_{m=1}^{J} e^{\lambda_l - \lambda_m}}$. This equation takes the value of 1 for the chosen pair and 0 for all other, unselected pairs. λ_j represents the relative importance of one of the nutrition

panels over another panel that has been normalized to 0. We then used effects coding, -1, 0, and 1 for the alternative chosen as worst, an alternative not selected, and the alternative chosen as best, respectively.

Homogeneity in preferences need not be assumed. In fact it would seem reasonable that people would rank the healthiness of milk products differently based on the respondent's health (example lactose intolerance), for example. The random parameters logit (RPL) model allows for random preference variation (Train, 2003). In contrast to the MNL model, in the RPL model each respondent, *n,* is assumed to have their own ranking parameter of nutrition panel, *j,* specified as $\widetilde{\lambda_{nj}} = \overline{\lambda_j} + \sigma_j \mu_{nj}$ where $\overline{\lambda_j}$ and σ_j are the respective mean and standard deviation of λ_j and μ_{nj} is a random error term that is normally distributed with mean zero and unit standard deviation. This last equation can be substituted into the probability equation in the above paragraph to estimate the RPL model by maximizing a simulated loglikelihood function for μ_{nj} (Train, 2003). This error term can generate a difference in scale across respondents that makes interpretation difficult. Thus, we calculated the share of preference, $S_j = \frac{e^{\widehat{\lambda_j}}}{\sum_{k=1}^{J} e^{\widehat{\lambda_k}}}$, for each nutrition panel. The preference share can be interpreted as the anticipated probability that the nutrition panel is chosen as the healthiest or most likely to purchase. Therefore, the sum of the preference shares for all seven nutrition panels must be one.

3. Results

3.1 Relative Rank of Nutrition Labels

The frequencies with which each panel was chosen as the healthiest/unhealthiest or most/least likely to purchase are reported in table A1 in the Appendix. In addition the BWS score, the difference between the best and worst on each dimension is reported. By finding the minimum of each BWS score row, the least appealing nutrition panel can be identified. Coconut "milk" was

chosen as unhealthiest and least likely to be purchased in each experiment by all treatment groups except treatment 5 that disliked almond milk more. However, coconut milk came in second-last place for this treatment group. It is helpful to identify the least appealing panel because one panel must be dropped as the comparison panel for the BWS analysis. By choosing the worst panel every time then reported probabilities should all be positive, representing the increased likelihood that that nutrition panel was picked over the least appealing panel. Thus, for consistency in all analysis (even for treatment 5) we use coconut "milk" as the baseline panel.

3.2 Model Estimates

Estimates from the RPL models are reported in Table 3[2]. The significance of many of the standard deviation estimates indicates that the RPL model is preferrable to the MNL model as our assumption of heterogeneity in preferences for the seven nutrition panels cannot be rejected. While the model estimates reveal the relative ranking of nutrition panels, the estimates are difficult to interpret. Thus we calculate the share of preferences from these estimates, which are reported in Table 4.

Table 4 shows that while preference shares are statistically significantly different based on when respondents do or do not know the product associated with the nutrition label, relative rankings are similar across treatment groups when evaluating healthiness. Most notably, the four cows' milk products are always preferred above the three plant-based milk products. Among cows' milk products skim milk is always ranked as the healthiest by a substantial margin, nearly being chosen all of the time. One percent milk is deemed healthier than two percent milk. Whether one and two percent milk are deemed healthier than whole milk depends on whether respondents know the products they are evaluating. When they do, respondents rank whole milk

[2] Estimates from the MNL models are reported in Tables A1 through A6 in the Appendix.

the lowest of the cows' milk products; when they don't, respondents rank whole milk directly after skim milk. This may indicate that when products are unknown, some people view low-fat as healthier while others think that whole animal fats are healthier. Among the PBM products soy milk is always ranked the healthiest.

There is more variation in relative ranking between unlabeled and labeled in purchase decisions. When products are unlabeled, respondents indicate that they would be more likely to buy the four animal based milks than the three PBMs. Skim is the heavily preferred choice among cows' milk and soy milk is the preferred PBM. When respondents know the product they would be purchasing which is most similar to real-world shopping experiences relative rankings change. In this case, there is not a clear preference for cows' milk over plant-based milk. While one percent milk is the most likely to purchase product, whole milk is the least likely to purchase product. Soy milk goes from the fifth most likely to purchase product to the third most likely to purchase product. To put this in perspective, soy milk goes from being on the bottom half of rankings to the top half of rankings.

Product rankings within the labeled groups change between the health and purchase treatments. Skim milk is healthiest product but the fourth likely to purchase product. Whole milk is the fourth healthiest product and the least likely to purchase product. This purchase result is surprising as in 2023 the actual cows' milk product bought most often was whole milk followed by 2%, 1%, and then skim milk (Agricultural Marketing Service & USDA Foreign Agricultural Service, 2024). Even among prior milk BWS experiments, 2% milk has typically been identified as most likely to purchase with skim milk either the third or last cows' milk product respondents intend to purchase (Bir et al., 2019; Harwood and Drake, 2018). Soy milk is the fifth healthiest product and the third most likely to purchase product. These changes suggest that consumers do

not only make purchase decisions based on healthiness. This is consistent with prior literature which indicates that price, taste, ethical information, and more, are also important purchase considerations for consumers (Estell, et al., 2021; Harwood and Drake, 2018).

3.3 Socio-demographic information and shares of preferences for the 7 nutrition panels

While skim milk is overwhelmingly chosen as having the healthiest nutrition panel, the significance of the standard deviation estimates in Table 4 indicate that there is heterogeneity in beliefs. According to prior literature differences in attitudes may be due to these four characteristics: gender, age, price sensitivity, and prior purchase experience. We divided the unlabeled and labeled health and purchase treatments into different subgroups based on those four characteristics. The gender subgroups were not female (answered either "male", "other", or "prefer not to answer") and female. The age subgroups were mirrored from Bazzani et al (2018) such that there were two groups, young and old, based on the sample median age. For our sample this mean that young were respondents whose age was less than 57 years, and old were respondents who were 57 years of age or older. For price sensitivity, respondents were asked three five-level Likert scale questions on the importance of price, nutrition, and taste on beverage purchase behavior. Respondents who strictly ranked price as more important than both nutrition and taste were the price-sensitive group, while everyone else was non-price sensitive. This meant that some respondents could have marked price as "extremely important" in purchase decisions but be in the non-price sensitive group if they also ranked either nutrition and/or taste as "extremely important." We considered our group price-sensitive because of the three characteristics of price, nutrition, and taste, the respondents placed strictly more importance on price. Finally, screening questions required that participants indicated purchasing either cows' and/or plant-based milk in the last three months. From prior purchase behavior questions, we

generated three subgroups of purchasers of only cows' milk, purchasers of only PBM, or purchasers of both cows' and PBM. We estimated the RPL model for each subgroup and calculated the respondents' share of preferences for the subgroups. We report these preference shares, as well as results from *t*-tests to test whether preferences were statistically significantly different among subgroups, in tables 5-10.

From Table 5 we observe that there were many differences in share preferences between females and non-females. For the unlabeled healthiness study females and non-females had statistically significant different preference shares for all seven nutrition panels. That said, relative rankings were similar. Skim and whole milk were with one or two, one percent, two percent, and soy milk were the middle three-five ranked, and almond and coconut were ranked sixth and seventh. When nutrition panels were labeled, there were differences in preference share between females and non-females for the four cows' milk products and almond's milk. Again, relative rankings were similar thou with all four cows milk products being indicated as healthiness followed by the soy, almond, and coconut milk nutrition panels. All preference shares were statistically different among women depending on whether they saw unlabeled or labeled nutrition panels. Among unlabeled panels females were less consistent in their healthiness choice as indicated by the first rank panel having a smaller percentage than in the nineties. Non-females' preference shares only statistically differed among four product panels: skim milk, one percent milk, two percent milk, and almond milk.

There was more consistency across respondents both by gender and whether they saw unlabeled or labeled panels for the likelihood to purchase decision. The four cows' milk products, always ranked within the top five, were statistically different between females and non-females. Interestingly, while the preference shares were not statistically different females

indicated soy milk was the product they were second most likely to purchase while non-females ranked soy fifth among unlabeled respondents. When respondents knew which product every label went with, females and non-females ranked all products the same except for coconut and whole milks changing places in the last two spots. Yet, there was statistical difference in preference shares between one percent, two percent, and skim milk. All of the products, except almond, were statistically different among non-females depending on whether nutrition panels were unlabeled or labeled. When panels were unlabeled whole milk was revealed as the second most likely to be purchased. When the whole milk nutrition panel was identified, non-females ranked it as their least likely to be purchased. There was movement in rankings among females who saw unlabeled or labeled nutrition panels but the movement in ranks were smaller than the whole milk movement for non-females.

From table 6 we observe many statistical differences between age groups and (un)labeled treatments. Here I will highlight a few of those differences that also translate into rankings differences. Whole milk was ranked second healthiest among both age groups who saw unlabeled nutrition panels. Once older individuals could identify the panels whole milk dropped to the bottom half of healthiest products. On the other hand, younger individuals actually ranked whole milk as healthier when they could identify it. Despite a high healthiness score among young individuals, this did not translate to a high likelihood of purchase. Rather whole milk was ranked the second least likely to be purchased product among young respondents who saw labeled nutrition panels. Among older respondents whole milk went from third most likely to purchase for unlabeled to least likely to purchase among labeled. It was uncommon for a PBM product to rank in the top half of chosen products whether for healthiness or purchase intention.

Among unlabeled treatments, younger individuals ranked soy as the third most likely to purchase while older individuals still ranked it in the bottom half.

From table 7 we can see that there were few statistically significant differences between price-sensitive and non-price-sensitive respondents in either the health or purchase groups. The differences that did exist were with cows' milk products in the purchase study. What was unexpected is that whole milk went from second or third most likely to be purchased among respondents who did not see labeled nutrition panels to second to last or last most likely to purchase. It was particularly surprising that whole milk should drop below soy and almond milk for price sensitive labeled respondents as PBMs tend to be more expensive than cows' milk (Food Institute, 2024). There were many more statistical differences between unlabeled and labeled groups across price sensitivity. There are only three times where skim milk is in the bottom half of rankings. These are all among likelihood to purchase and are labeled non-price-sensitive, labeled purchased plant-based milk only, and labeled purchased both animal and plant based milk (Table 8). In all three cases when nutrition panels were unlabeled, skim milk was revealed as most likely to purchase. The non-price sensitive respondents in the labeled purchase questions were also a bit unique in that almond milk was most frequently ranked last or second to last but received its highest ranking of 4 here (and with old unlabeled healthiness (Table 6)). In Table 8 we compare rankings across respondents' prior milk purchase behavior. Individuals who only bought PBM in the last three months were the most consistent across the unlabeled and labeled treatments and those who only purchased cows' milk were least consistent.

Conclusion

In this study we were looking at how respondents ranked the healthiness of milk products. In particular, we were interested in whether cows' milk was consistently ranked healthier than three

types of plant based milk, soy, almond, and coconut, and if nutrition panels being labeled made a difference in health perceptions. Throughout Tables 5-8 there were many statistically different preferences across unlabeled and labeled groups. However, we must keep in perspective that often times the cows' milk product that was ranked healthiest was identified as such 90-100% of the time more often than the lowest ranked nutrition panel, which was typically coconut. Thus, from a practical policy perspective, there is general consensus that cows' milk products are healthier than PBMs. There is not a lot of shifting in rankings between plant based and animal based milk so the assertion that consumers think of PBM as healthy as cows' milk seems largely refuted.

We were also interested in whether health perceptions translated into likelihood to purchase. Surprisingly, whole milk went from being in the top three healthiest to the bottom three likely to purchase, as whole and two percent milk are the most frequently purchased in stores (Agricultural Marketing Service & USDA Foreign Agricultural Service, 2024). Thus, it does not appear that healthiness is the only or the primary concern consumers have when shopping for milk products.

Since this study was conducted prior to the USDA's guidance on PBM labeling, there is opportunity to explore if and how health perceptions may have changed based on these new labeling suggestions. Any future work should attempt to address the following limitation to this study: we do not know why respondents judged a particular panel as healthier than another. It would be interesting to use a case three BWS approach to vary nutrient levels within nutrition panels, however, the reason we did not pursue this is that then some alternatives are not available in the market.

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Figure 1: Best-Worst Scaling Experiments Nutrition Panels

Almond Milk

Nutrition Facts	
Amount per serving	
Calories	**60**
	% Daily Value *
Total Fat 2.5g	**3%**
Saturated Fat 0g	**0%**
Cholesterol 0mg	**0%**
Sodium 150mg	**7%**
Total Carbohydrate 8g	**3%**
Total Sugars 7g	
Includes 7g Added Sugars	**13%**
Protein 1g	**2%**
Vitamin D 2.5mcg	15%
Calcium 450mg	35%
Iron 0.7mg	4%
Potassium 170mg	4%
Vitamin A 150mcg	15%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutritional advice.

Coconut Milk

Nutrition Facts	
Amount per serving	
Calories	**70**
	% Daily Value *
Total Fat 4.5g	**6%**
Saturated Fat 4g	**20%**
Cholesterol 0mg	**0%**
Sodium 65mg	**3%**
Total Carbohydrate 6g	**2%**
Total Sugars 5g	
Includes 5g Added Sugars	**10%**
Protein 0g	**0%**
Vitamin D 2mcg	10%
Calcium 460mg	35%
Iron 0.5mg	2%
Potassium 170mg	2%
Vitamin A 180mcg	20%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutritional advice.

Cow Skim Milk

Nutrition Facts	
Amount per serving	
Calories	**80**
	% Daily Value *
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Cholesterol 5mg	**2%**
Sodium 105mg	**5%**
Total Carbohydrate 11g	**4%**
Total Sugars 11g	
Includes 0g Added Sugars	**0%**
Protein 8g	**16%**
Vitamin D 2mcg	10%
Calcium 300mg	25%
Iron 0mg	0%
Potassium 390mg	8%
Vitamin A 142mcg	15%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutritional advice.

Cow 1% Milk

Nutrition Facts	
Amount per serving	
Calories	**100**
	% Daily Value *
Total Fat 2.5g	**3%**
Saturated Fat 1.5g	**8%**
Cholesterol 10mg	**3%**
Sodium 105mg	**5%**
Total Carbohydrate 11g	**4%**
Total Sugars 11g	
Includes 0g Added Sugars	**0%**
Protein 8g	**16%**
Vitamin D 2mcg	10%
Calcium 300mg	25%
Iron 0mg	0%
Potassium 380mg	8%
Vitamin A 143mcg	15%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutritional advice.

Cow 2% Milk

Nutrition Facts	
Amount per serving	
Calories	**120**
	% Daily Value *
Total Fat 5g	**6%**
Saturated Fat 3.5g	**18%**
Cholesterol 25mg	**8%**
Sodium 120mg	**5%**
Total Carbohydrate 11g	**4%**
Total Sugars 11g	
Includes 0g Added Sugars	**0%**
Protein 8g	**16%**
Vitamin D 2.5mcg	10%
Calcium 290mg	25%
Iron 0mg	0%
Potassium 370mg	8%
Vitamin A 150mcg	15%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutritional advice.

Cow Whole Milk

Nutrition Facts	
Amount per serving	
Calories	**150**
	% Daily Value
Total Fat 8g	**10%**
Saturated Fat 5g	**25%**
Cholesterol 35mg	**12%**
Sodium 110mg	**5%**
Total Carbohydrate 11g	**4%**
Total Sugars 11g	
Includes 0g Added Sugars	**0%**
Protein 8g	**16%**
Vitamin D 2.5mcg	10%
Calcium 300mg	25%
Iron 0mg	0%
Potassium 400mg	8%
Vitamin A 90mcg	10%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutritional advice.

Table 1. Demographics

	Health			Purchase		
	Unlabeled	Labeled	Full Sample	Unlabeled	Labeled	Full Sample
Female %	50	54	52	50	53	52
Age (years)	52	53	53	51	54	53
p-num1 %	36	34	35	38	38	38
pf_amo %	43	41	42	41	41	41
pf_pmo %	5	10	7	6	6	6
pf_b %	52	48	50	53	52	53
N	326	377	703	338	382	720

Table 2. Best-Worst Scaling Treatment Groups

	Healthiness Only	Purchase Only	Healthiness & Purchase
Unlabeled Nutrition Panels	Treatment 1	Treatment 3	Treatment 5
Labeled Nutrition Panels	Treatment 2	Treatment 4	Treatment 6

	Health			Purchase		
	Unlabeled	Labeled	Full Sample	Unlabeled	Labeled	Full Sample
almond	-8.069(3.074)***	6.139(2.761)**	3.158(1.868)*	3.476(2.925)	28.091(3.577)***	1.132(0.433)***
skim	47.567(3.758)***	50.981(3.746)***	43.769(4.332)***	32.217(3.252)***	36.225(3.618)***	2.895(0.97)***
onep	16.481(3.071)***	40.929(3.448)***	27.111(3.053)***	19.913(3.021)***	77.986(4.221)***	3.678(1.222)***
twop	13.912(3.383)***	37.334(3.425)***	25.13(3.018)***	12.668(3.146)***	65.825(4.129)***	3.002(1.006)***
whole	29.275(3.338)***	32.357(3.288)***	24.306(2.925)***	13.832(3.326)***	-7.45(3.747)**	1.14(0.472)**
soy	9.625(3.511)***	22.065(3.029)***	18.324(2.66)***	13.334(3.032)***	35.688(3.382)***	1.644(0.576)***
Standard deviations of the random parameters						
almond	113.556(5.363)***	102.035(5.574)***	91.066(8.403)***	99.594(6.771)***	134.516(5.939)***	8.854(3.034)***
skim	115.866(5.678)***	122.389(6.442)***	108.342(9.827)***	94.201(6.255)***	156.631(6.151)***	9.944(3.356)***
onep	97.274(5.17)***	107.918(5.922)***	95.027(8.727)***	96.375(6.511)***	144.473(5.743)***	9.084(3.095)***
twop	143.288(6.519)***	135.11(6.967)***	122.581(11.031)***	135.542(8.541)***	152.447(5.924)***	11.592(3.868)***
whole	158.404(7.034)***	151.524(7.528)***	134.925(12.149)***	153.13(9.172)***	171.923(5.938)***	12.839(4.258)***
soy	123.838(6.024)***	89.749(5.143)***	92.465(8.497)***	90.356(6.41)***	97.658(4.613)***	7.742(2.668)***
Model Fit Criteria						
OBS	2282	2639	4921	2366	2674	5040
LL	-5136.046	-6021.099	-11201.825	-5410.122	-6242.819	-11865.3
AIC	10326.092	12096.198	22457.649	10874.244	12539.638	23784.53
BIC	10480.877	12254.908	22633.184	11030.006	12698.704	23960.71

Table 4. Preference shares and rankings of healthiness and purchase intent of milk products' nutrition panels

Healthiness

	Unlabeled			Labeled			Full Sample	
Rank	Product	Share		Product	Share		Product	Share
1	skim_h	1.00E+00	*‡	skim_h	9.99E-01	*‡	skim_h	0.99999993
2	whole_h	2.70E-06	*	onep_h	1.27E-03	*‡	onep_h	5.82804E-08
3	onep_h	6.51E-12	*‡	twop_h	4.69E-05	*‡	twop_h	8.04E-09
4	twop_h	7.76E-13	*‡	whole_h	8.10E-07	*‡	whole_h	3.52636E-09
5	soy_h	3.25E-14	‡	soy_h	4.15E-11	‡	soy_h	8.89973E-12
6	coco_h	1.91E-18	*	almond_h	6.40E-18	*‡	almond_h	2.30604E-18
7	almond_h	4.44E-22	*‡	coco_h	4.73E-20	*‡	coco_h	9.80E-20

Likelihood to purchase

	Unlabeled			Labeled			Full Sample	
	Product	Share		Product	Share		Product	Share
1	skim_p	1.00E+00	*‡	onep_p	9.99E-01	*‡	onep_p	0.438753522
2	onep_p	1.20E-04	*‡	twop_p	1.44E-03	*‡	twop_p	0.223170891
3	whole_p	2.13E-06	*	soy_p	4.01E-16	*‡	skim_p	0.200524775
4	soy_p	4.14E-07	*‡	skim_p	1.56E-16	*‡	soy_p	0.057393887
5	twop_p	2.23E-07	*‡	almond_p	2.75E-19	*‡	whole_p	0.034672186
6	almond_p	4.91E-11	*‡	coco_p	4.73E-31	‡	almond_p	0.034395915
7	coco_p	2.74E-12		whole_p	1.04E-34	*‡	coco_p	0.011088825

* indicates that the hypothesis that the mean of the corresponding values are the same across the unlabeled and labeled groups is rejected at the 0.001 level of significance according to a two-tailed unpaired *t*-test. ‡ indicates that the hypothesis that the mean of the corresponding values are the same across the healthiness and likelihood to purchase groups is rejected at the 0.001 level of significance according to a two-tailed unpaired t-test.

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Table 5. Preference shares and rankings by gender and (un)labeled nutrition panels

Healthiness

	Unlabeled						Labeled					
Rank	Not female			Female			Not female			Female		
1	skim_h	1.00E+00	*†	skim_h	0.3669208	*†	skim_h	9.52E-01	*†	skim_h	9.93E-01	*†
2	whole_h	3.21E-06	†	whole_h	0.2080331	*†	onep_h	4.49E-02	*†	twop_h	4.35E-03	*†
3	onep_h	1.96E-07	*†	onep_h	0.1185696	*†	twop_h	2.61E-03	*†	whole_h	1.95E-03	*†
4	soy_h	8.23E-08	†	twop_h	0.09946091	*†	whole_h	3.83E-05	†	onep_h	3.24E-04	*†
5	twop_h	1.51E-09	*†	soy_h	0.07942591	*†	soy_h	1.72E-07		soy_h	3.96E-08	*
6	almond_h	6.03E-17	*†	coco_h	0.07849454	*†	almond_h	5.27E-13	*†	almond_h	5.09E-15	*†
7	coco_h	6.23E-19	†	almond_h	0.0490951	*†	coco_h	7.33E-17		coco_h	6.64E-16	*

Likelihood to Purchase

	Unlabeled						Labeled					
Rank	Not female			Female			Not female			Female		
1	skim_p	9.89E-01	*†	skim_p	1.00E+00	*†	onep_p	9.98E-01	*†	onep_p	9.80E-01	*†
2	whole_p	6.34E-03	*†	soy_p	4.24E-05	*	twop_p	1.77E-03	*†	twop_p	1.97E-02	*†
3	onep_p	4.63E-03	*†	onep_p	2.56E-05	*†	skim_p	3.15E-16	*†	skim_p	1.83E-08	*†
4	twop_p	4.24E-04	*†	whole_p	6.02E-07	*†	soy_p	4.14E-17	*	soy_p	2.22E-10	*
5	soy_p	6.69E-08	*	twop_p	9.58E-09	*†	almond_p	3.83E-19		almond_p	1.19E-12	
6	almond_p	1.83E-11		coco_p	3.93E-10		coco_p	3.75E-30	*	whole_p	5.92E-15	*
7	coco_p	4.61E-14	*	almond_p	5.58E-12		whole_p	1.46E-35	*	coco_p	4.37E-18	

* indicates that the hypothesis that the mean of the corresponding values are the same across the unlabeled and labeled groups is rejected at the 0.001 level of significance according to a two-tailed unpaired *t*-test. † indicates that the hypothesis that the mean of the corresponding values are the same across the gender groups is rejected at the 0.001 level of significance according to a two-tailed unpaired t-test.

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Table 6. Preference shares and rankings by age and (un)labeled nutrition panels

Healthiness

	Unlabeled						Labeled					
Rank	Young			Old			Young			Old		
1	skim_h	9.94E-01	*†	skim_h	9.72E-01	*†	whole_h	9.58E-01	*†	skim_h	9.97E-01	*†
2	whole_h	4.93E-03	*†	whole_h	2.22E-02	*†	skim_h	3.21E-02	*†	onep_h	2.96E-03	*†
3	twop_h	3.28E-04	*†	onep_h	1.51E-03	*†	onep_h	5.09E-03	*†	twop_h	3.45E-04	*†
4	onep_h	1.42E-04	*†	almond_h	1.27E-03	*†	twop_h	2.80E-03	*†	soy_h	5.69E-12	*†
5	soy_h	1.14E-04	*†	twop_h	1.10E-03	*†	soy_h	1.27E-03	*†	whole_h	1.20E-13	*†
6	almond_h	2.91E-07	†	soy_h	9.80E-04	*†	coco_h	5.73E-04	*†	almond_h	2.08E-16	*†
7	coco_h	1.25E-07	*†	coco_h	6.65E-04	*†	almond_h	3.36E-04	†	coco_h	1.71E-23	*†

Likelihood to Purchase

	Unlabeled						Labeled					
Rank	Young			Old			Young			Old		
1	skim_p	9.53E-01	*†	skim_p	1.00E+00	*†	onep_p	3.16E-01	*†	onep_p	1.00E+00	*†
2	whole_p	2.20E-02	*†	onep_p	5.23E-05	*†	twop_p	2.55E-01	*†	twop_p	4.72E-05	*†
3	soy_p	1.87E-02	*†	whole_p	3.99E-05	†	skim_p	1.02E-01	*†	skim_p	6.27E-18	*†
4	onep_p	3.43E-03	*†	twop_p	3.99E-07	*†	soy_p	1.01E-01	*†	soy_p	3.03E-22	*†
5	twop_p	2.73E-03	*†	soy_p	3.93E-08	*†	almond_p	9.22E-02	*†	almond_p	4.45E-23	*†
6	almond_p	1.65E-04	*†	coco_p	6.48E-12	†	whole_p	7.28E-02	*†	coco_p	1.60E-42	†
7	coco_p	2.64E-05	*†	almond_p	3.88E-13	*†	coco_p	6.10E-02	*†	whole_p	1.39E-44	†

* indicates that the hypothesis that the mean of the corresponding values are the same across the unlabeled and labeled groups is rejected at the 0.001 level of significance according to a two-tailed unpaired *t*-test. † indicates that the hypothesis that the mean of the corresponding values are the same across the age groups is rejected at the 0.001 level of significance according to a two-tailed unpaired t-test.

Table 7. Preference shares and rankings by price sensitivity and (un)labeled nutrition panels

Healthiness

	Unlabeled						Labeled					
Rank	Not price sensitive			Price sensitive			Not price sensitive			Price sensitive		
1	skim_h	1.00E+00	*†	skim_h	1.00E+00	*†	skim_h	9.93E-01	*†	skim_h	9.89E-01	*†
2	whole_h	3.63E-04	†	whole_h	1.28E-08	*†	twop_h	5.49E-03	*†	onep_h	1.11E-02	*†
3	twop_h	2.31E-05	*†	onep_h	2.90E-12	*	onep_h	1.08E-03	*†	twop_h	4.84E-06	*†
4	soy_h	2.29E-05		twop_h	1.70E-15	*†	whole_h	6.23E-05		whole_h	5.00E-09	*
5	onep_h	7.39E-06	*	soy_h	7.62E-20		soy_h	6.39E-07	†	soy_h	1.90E-10	†
6	coco_h	4.20E-08		coco_h	3.00E-27		almond_h	3.50E-12	†	almond_h	1.97E-18	†
7	almond_h	1.99E-09		almond_h	7.32E-29		coco_h	1.01E-14		coco_h	4.68E-21	

Likelihood to Purchase

	Unlabeled						Labeled					
Rank	Not price sensitive			Price sensitive			Not price sensitive			Price sensitive		
1	skim_p	9.94E-01	*	skim_p	9.94E-01	*	onep_p	9.90E-01	*†	onep_p	9.84E-01	*†
2	whole_p	5.80E-03	*†	onep_p	4.08E-03	*†	twop_p	9.87E-03	*†	twop_p	1.56E-02	*†
3	onep_p	5.73E-05	*†	whole_p	1.33E-03	*†	soy_p	8.78E-13	*	skim_p	3.60E-09	*†
4	twop_p	9.24E-06	*	soy_p	7.44E-05		almond_p	3.11E-15	*	soy_p	5.69E-13	
5	soy_p	4.07E-06	*	twop_p	1.57E-05	*	skim_p	6.38E-18	*†	almond_p	3.14E-13	
6	coco_p	3.94E-10	*	coco_p	8.32E-10		coco_p	7.70E-27	*	whole_p	1.22E-22	*
7	almond_p	7.52E-13	*	almond_p	2.63E-11		whole_p	6.26E-30	*	coco_p	7.87E-23	

* indicates that the hypothesis that the mean of the corresponding values are the same across the unlabeled and labeled groups is rejected at the 0.001 level of significance according to a two-tailed unpaired *t*-test. † indicates that the hypothesis that the mean of the corresponding values are the same across the price sensitivity groups is rejected at the 0.001 level of significance according to a two-tailed unpaired t-test.

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Table 8. Preference shares and rankings by prior purchase behavior and (un)labeled nutrition panels

Healthiness

	Unlabeled									Labeled			
Rank	Only Cows' Milk			Only PBM			Both cows' and PBM			Only Cows' Milk			Only PBM
1	skim_h	4.40E-01	*	whole_h	9.74E-01	*	skim_h	1.00E+00	*	skim_h	9.66E-01	*	whole_h
2	whole_h	2.05E-01	*	skim_h	2.04E-02	*	whole_h	5.75E-05	*	onep_h	3.34E-02	*	skim_h
3	onep_h	1.15E-01	*	onep_h	4.43E-03	*	soy_h	1.51E-07	*	twop_h	7.16E-04	*	soy_h
4	twop_h	9.92E-02	*	soy_h	1.08E-03	*	onep_h	1.54E-09	*	soy_h	1.04E-11	*	twop_h
5	soy_h	6.36E-02	*	twop_h	6.28E-05		twop_h	6.60E-10	*	whole_h	1.51E-13	*	onep_h
6	coco_h	4.25E-02	*	coco_h	1.39E-09		almond_h	4.29E-15		almond_h	4.62E-18	*	almond_h
7	almond_h	3.41E-02	*	almond_h	4.98E-11		coco_h	7.18E-16		coco_h	1.55E-24	*	coco_h

Likelihood to Purchase

	Unlabeled									Labeled			
Rank	Only Cows' Milk			Only PBM			Both cows' and PBM			Only Cows' Milk			Only PBM
1	skim_p	9.97E-01	*	skim_p	9.66E-01	*	skim_p	7.19E-01	*	onep_p	1.00E+00	*	whole_p
2	onep_p	2.07E-03	*	whole_p	2.66E-02	*	soy_p	1.64E-01	*	twop_p	9.15E-05	*	twop_p
3	twop_p	5.12E-04	*	onep_p	7.67E-03	*	whole_p	8.34E-02	*	skim_p	9.14E-22	*	soy_p
4	whole_p	2.91E-04	*	coco_p	1.04E-05		twop_p	3.19E-02	*	soy_p	5.73E-22	*	coco_p
5	soy_p	1.69E-04	*	soy_p	2.73E-07		onep_p	1.45E-03	*	almond_p	4.28E-24	*	almond_p
6	coco_p	9.56E-09		twop_p	7.48E-09	*	almond_p	2.44E-09		coco_p	4.53E-38		skim_p
7	almond_p	4.35E-09	*	almond_p	6.26E-10		coco_p	8.69E-13	*	whole_p	3.64E-42	*	onep_p

* indicates that the hypothesis that the mean of the corresponding values are the same across the unlabeled and labeled groups is rejected at the 0.001 level of signi

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