Type of milk typically consumed, and stated preference, but not health consciousness affect revealed preferences for fat in milk

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Abstract

Fat is an important source of both pleasure and calories in the diet. Dairy products are a major source of fat in the diet, and understanding preferences for fat in fluid milk can potentially inform efforts to change fat consumption patterns or optimize consumer products. Here, patterns of preference for fat in milk were determined in the laboratory among 100 free living adults using rejection thresholds. Participants also answered questions relating to their health concerns, the type of fluid milk typically consumed, and their declared preference for type of milk (in terms of fat level). When revealed preferences in blind tasting were stratified by these measures, we observed striking differences in the preferred level of fat in milk. These data indicate a non-trivial number of consumers who prefer low-fat milk to full fat milk, a pattern that would have been overshadowed by the use of a group mean. While it is widely assumed and claimed that increasing fat content in fluid milk universally increases palatability, present data demonstrate this is not true for a segment of the population. These results underscore the need to go look beyond group means to understand individual differences in food preference.

1. Introduction

Fat is responsible for many sensory attributes in foods, affecting appearance, texture, flavor, and palatability (Mela, 1990; Richardson-Harman et al., 2000). Previously, many researchers have examined the sensory properties of milk with varying fat content, and it is clear that milk fat plays a role in appearance and texture attributes in fluid milk (Pangborn & Dunkley, 1964; Drewnowski & Greenwood, 1983; Pangborn & Giovanni, 1984; Mela, 1988; Pangborn, Bos, & Stern, 1985). Beyond appearance and texture, dairy fats are somewhat unique in that they also make a direct contribution to sensory aroma and flavor perception (Kinsella, Patton, & Dimick, 1967; Badings & Neeter, 1980; Tamsma, Kurtz, Bright, & Pallansch, 1969). A half century ago, Pangborn and Dunkley showed that panelists could detect less than 0.5% milk fat added to skim milk. As visual differences were masked in their study, one can presume that flavor, aromatic, and textural cues were primarily used to discern these differences (Pangborn & Dunkley, 1964; Drewnowski & Greenwood, 1983; Pangborn & Giovanni, 1984; Pangborn et al., 1985; Mela, 1988). Using descriptive analysis with 15 trained panelists, Tuorila investigated sensory differences between 0%, 1.9%, and 3.9% fat milk in Finland; the panelists identified significant differences in blue color, transparency, visual thickness, and greasy mouthfeel. Conversely, the panel did not note any significant differences in taste, flavor, or aroma attributes (Tuorila, 1987). More recently, trained panelists performing descriptive analysis were able to discern flavor differences, with increasing fat content significantly increasing creamy flavor and sweet taste and significantly decreasing boiled milk flavor (Frøst, Dijksterhuis, & Martens, 2001). Other research suggest naïve consumers are also able to accurately judge fat content differences in fluid dairy products (Mela, 1988). This discrimination is far from

perfect, however. Chapman and Lawless estimated only 30% discriminators among the subjects completing a triangle test comparing skim and 2% fat milk (Chapman & Lawless, 2005). Even in a dual standards test, where subjects were presented with references for both skim milk and 2% milk and asked to match samples to those reference samples, discrimination was estimated at 76% (chance corrected) (Chapman & Lawless, 2005).

A handful of studies have investigated the effects of milk fat content on product liking and consumption. Tuorila measured milk liking of 236 subjects who regularly used nonfat (0.5% fat), low-fat (1.9% fat), or regular fat milk (3.9%) and found that subjects generally best liked the type of milk that they regularly consumed (Tuorila, 1987). In contrast, Chapman and Lawless examined preferences between 2% milk and non-fat milk among both non-fat and 2% fat milk consumers and found a preference for 2% milk in both groups (Chapman & Lawless, 2005). In a female Korean population, participants also showed generally higher liking for higher fat milks (4.0% fat) compared to lower fat milks (1.0% fat) (Chung, 2009). In another Korean study relating descriptive sensory attributes to consumer overall liking ratings, Lee and colleagues found cooked, creamy, and sweet attributes associated with increased ratings of overall liking (Lee, Lee, & Shin, 2003). Richardson-Harman and colleagues examined consumer creaminess perception, consumer overall liking, and trained panel descriptive profiles in New Zealand, using thickened and unthickened fresh and reconstituted fluid dairy beverages ranging from 0.1% fat to 40% fat. They found that consumers generally defined creaminess in a similar manner. Consumer ratings of creaminess were correlated with trained panel ratings of cream aroma and flavor, butter aroma and flavor, vanilla flavor, and oily/greasy, mouthcoating, slippery, and viscous textures.

Consumer segments for overall liking were found with one segment preferring full fat beverages and another preferring low fat beverages (Richardson-Harman et al., 2000). Individual differences in liking of dairy products varying by fat content have been seen to vary due to PROP phenotype (Hayes & Duffy, 2008; Keller, Steinmann, Nurse, & Tepper, 2002), weight status (Pangborn et al., 1985), health status (Rapp et al., 2009), and level of fat consumption (Pangborn & Giovanni, 1984; Mattes, 1993), but the levels of fat investigated vary considerably between studies, often including levels of fat that would not typically found in beverages . Other research has shown that health attitudes can influence consumers' perception and acceptance of milks of varying fat content (Shepherd, Sparks, Bellier, & Raats, 1991; Roininen, Lähteenmäki, & Tuorila, 1999).

The food environment and attitudes toward food and nutrition have both changed considerably since much of the research in this area was conducted. Over the past 25 years, milk consumption has decreased, and many more consumers have shifted from consuming whole milk to reduced-fat and skim milks (Briefel & Johnson, 2004). This is in part due to changes in dietary recommendations beginning in the 1980s, which were based on research linking fat consumption to cardiovascular disease and obesity. Adoption of a low-fat diet "became an overarching ideology, promoted by physicians, the federal government, the food industry, and the popular health media" (La Berge, 2008). More recent investigations into the role of dairy fat into the development of cardiovascular disease and obesity have called into question this association (German et al., 2009; Kratz, Baars, & Guyenet, 2013). Health concerns and consciousness (founded or not) can influence food choices (Hearty, McCarthy, Kearney, & Gibney, 2007; Sun, 2008), leading consumers to sometimes choose foods on the basis of health or weight consciousness rather than taste preferences per se (Visschers &

123 Siegris, 2010). Given that food choices are influenced by such non-hedonic factors,
124 grouping people based on their typical habits in addition to hedonics may give
125 additional insights into the food choices and preferences for these individuals.
126 In 2005, Prescott and colleagues (Prescott, Norris, Kunst, & Kim, 2005)
127 introduced the concept of a rejection threshold, which is defined as the concentration at
128 which a substance becomes objectionable, rather than the concentration at which it is
129 perceived (the detection threshold). Several other authors have used the method to
130 study rejection of objectionable compounds in foods (Nikolantonaki & Darriet, 2011;
131 Saliba, Bullock, & Hardie, 2009; Weekes, Walsh, Ferguson, & Ross, 2010; Yoo, Saliba,
132 Prenzler, & Ryan, 2012). Harwood and colleagues showed the method could be extended
133 by segmenting consumers by self-reported *a priori* preferences, demonstrating that
134 compared to solid milk chocolate consumers, solid dark chocolate consumers tolerated a
135 higher level of a bitterant in fluid chocolate milk (Harwood, Ziegler, & Hayes, 2012).
136 However, use of this method is not limited to off flavors and taints. Blackman and
137 coworkers examined sweetness tolerance in wine and found evidence for segmentation
138 among novice wine consumers, experienced wine consumers, and wine experts. They
139 also found that added sweetness was preferred at lower levels and became less tolerated
140 at higher levels, applying this method to a situation where the added ingredient was not
141 strictly objectionable (Blackman, Saliba, & Schmidtke, 2010).
142 Here, we use the rejection threshold method to further understand individual
143 differences in preferences for fat in fluid milk within a convenience sample of adults in
144 North American. We stratified our participants in terms of 1) self reported type of milk
145 typically consumed, 2) stated preference for type of milk based on its taste, and 3) health
146 consciousness. *A priori*, we hypothesized that patterns of milk preference determined

in a blind taste test (i.e., revealed preferences) will better align with stated (declared) preferences than with the type of milk typically consumed. That is, those who report a preference for skim milk would prefer lower fat levels than whole or 2% milk preferers, but those who report drinking skim milk would not necessarily prefer lower fat levels. We also expected that health consciousness scores would be related to type of milk typically consumed milk type and not necessarily related to stated milk preference.

2. Methods

2.1 Ethics Statement

Testing was performed in a single session in the Sensory Evaluation Center in the Department of Food Science at The Pennsylvania State University. Procedures were exempted from Institutional Review Board review by The Pennsylvania State University Office of Research Protections under the wholesome foods/approved food additives exemption in 45 CFR 46.101(b)(6). Participants provided informed, implied consent and were paid for their time.

2.2 Participants

One hundred non-smoking adults (32 men) who regularly consumed dairy milk were recruited from the Pennsylvania State University campus and surrounding community (State College, PA). Forty-five participants reported typically drinking skim milk, 40 participants reported typically drinking 2% milk, and 15 participants reported typically drinking whole milk. Twenty-two participants reported preferring the taste of skim milk, 45 participants reported preferring the taste of 2% milk, and 31 participants reported preferring the taste of whole milk.

2.3 Stimuli

Samples were prepared one day prior to the experiment using freshly processed whole and skim milks from the Berkey Creamery (University Park, PA). Samples were standardized to 0.1, 0.5, 1, 2, and 3.5% milk fat using the Pearson square method (Olson, 1924). Fat content was verified with NMR analysis in a SMART Trac II system (CEM Corporation, Matthews, NC). These concentrations were selected to represent commercially available milk fat levels in the United States: 0.1% and 0.5% milk fat correspond to skim milk and 3.5% milk fat corresponds to whole milk, as legally defined by United States Food and Drug Administration (Food and Drug Administration, 1999)

2.4 Procedure

An ascending series of two-alternative forced choice (2-AFC) preference tests were administered in accordance with the American Society for Testing and Materials method E-2263 (ASTM, 2004). Five pairs of samples were presented to each participant. Each pair contained an 0.1% fat sample (very low-fat control) and a sample where the fat level was varied systematically. Pairs were presented on one tray in ascending fat levels. Within pairs, sample order was counterbalanced. Participants were instructed to taste samples in order within each pair and indicate the sample they preferred before moving onto the next pair of samples. Samples were served cold and participants were allowed to retaste. Participants were also instructed to rinse their mouths with provided water between tastings with a twenty second forced time delay between pairs. Samples were presented under normal white lighting in individual booths with computers running Compusense Five v5.2 (Guelph, ON) for data collection and instruction. After tasting all pairs of samples, participants rated their level of concern regarding food and health issues (Table 2) on 9-point scales anchored at 'I am not all concerned" on the left end,

194 "Neutral" in the middle, and "I am extremely concerned" on the right end (Päivi,
195 Tuorila, & Rita, 1996). Finally, participants indicated the type of milk they typically
196 drank and the type of milk they preferred to drink based on its taste.

197 **2.5 Data Analysis**

198 All analyses were conducted using SAS® version 9.2 (Cary, NC). A composite health
199 consciousness score was calculated by summing all items (Table 2). Participants were
200 then divided into three groups based on the summed scores: high health consciousness
201 (≥ 71), medium health consciousness (<71 and >57) and low health consciousness (≤
202 57). To test the hypothesis that milk type typically consumed, stated milk preference,
203 and health consciousness would predict preferences for fat in milk, logistic regression
204 was performed via PROC LOGISTIC statement on the following models:

205 1. Sample preferred (control or fat added) = % milk fat + milk type typically consumed + % milk fat
206 * milk type typically consumed
207 2. Sample preferred (control or fat added) = % milk fat + stated milk preference + % milk fat *stated
208 milk preference
209 3. Sample preferred (control or fat added) = % milk fat + health consciousness group + % milk fat
210 *health consciousness group.

211 When appropriate (i.e. a chance adjusted proportion of 75% or 25% was achieved),
212 rejection thresholds were calculated by using the PROC REG statement to regress the
213 proportion of participants preferring the higher fat sample to the control sample (75%)
214 or the proportion of participants preferring the control sample to the higher fat sample
215 (25%) against fat concentration. Data for the 0.1% fat milk sample compared to itself
216 was omitted from the model, as this should occur at chance. The resulting regression
217 equation from the model was used to solve for the concentration at which 75% percent
218 or 25% of the subjects preferred one sample over another (50% preference corrected for

chance) defined as the 'consumer rejection threshold' (CRT). Because in some scenarios the test samples (added fat) were actually preferred to control samples, it became necessary to differentiate between the low fat rejection threshold (added milk fat preferred to low fat control) and the high fat rejection threshold (low fat control preferred to added milk fat). For individual paired comparison tests at a given concentration, the binomial distribution was used to test for significance among a given consumer segment.

To determine the effects of gender, milk type typically consumed, and stated milk preference on health consciousness ratings, the PROC ANOVA statement with the following model was used:

Health consciousness item rating = gender + milk type typically consumed + stated milk preference

When appropriate post-hoc Tukey's analyses were performed to identify inter-group differences. Because of the limited number of subjects within the group, participants who stated a preference for a type of milk other that skim, 2%, or whole milk were excluded from this analysis.

3. Results

3.1 Milk Fat Preference

While the combined data for all participants indicate a slight increase in preference with increasing fat content, preference varied as a function of the interaction between milk fat concentration and type of milk typically consumed (Wald Chi-Square = 12.9, p = 0.0016) and the interaction between milk fat concentration and stated milk preference (Wald Chi-square = 11.0, p =0.0041). Conversely, there was no evidence that health consciousness group influenced revealed preferences in the blind taste taste (Wald Chi-

242 square < 1.1, p > 0.57). Table 3 shows the proportion of participants from each group
243 selecting the added fat sample over the low fat control (0.1% fat).

244 As shown in Figure 1, individuals who typically consume skim milk showed no
245 significant differences in liking between control and added fat milks, with a slight trend
246 toward a slight decrease in preference as fat content increased. Conversely, individuals
247 with a stated preference for the taste of skim milk showed a steep decline in preference
248 with increasing fat content (see Figure 2), with a significant preference for the 0.1% fat
249 sample over the 3.5% fat sample [16 of 22; binomial p=0.053]. Although this group did
250 not quite meet reach a chance adjusted preference of 75% (our *a priori* definition for
251 rejection threshold) in observed dagta, a high fat rejection threshold was estimated at
252 3.8% milk fat, just outside the range of samples tested.

253 As shown in Figures 1 and 2, participants who typically drink 2% milk [29 of 40]
254 and the participants with a stated preference for 2% milk [30 of 45] significantly
255 preferred 3.5% milk to 0.1% fat milk in blind testing (binomial p's of <0.0064 and
256 0.036, respectively). Somewhere surprisingly, these two groups did not significantly
257 prefer 2% milk to 0.1% milk [consumption: 25 of 40, binomial p = 0.15; stated
258 preference: 25 of 45, binomial p = 0.55]. Nonethless, both groups still showed a trend
259 toward increasing preference with increasing fat content, as can be seen in Figures 1 & 2.
260 Two percent milk drinkers had an estimated low fat rejection threshold at 3.6% milk fat,
261 just outside the range tested.

262 Participants who drank whole milk and participants who had a stated preference
263 for whole milk showed increasing preference with increasing fat content. Those who
264 typically drank whole milk significantly preferred 2% milk [12 of 15] and 3.5% milk [15
265 of 15] over 0.1% fat milk (binomial p's < 0.035, p < 0.0001). Those individuals with a

stated preference for whole milk significantly preferred 3.5% milk to 0.1% fat milk in blind testing [26 of 31; binomial $p = 0.0002$). These groups were also the only groups within our cohort that reached a chance adjusted preference of 75% in the range tested here. Low fat rejection thresholds were calculated to be 1.4% milk fat for whole milk drinkers and 2.6% milk fat for participants with a stated preference for whole milk.

As expected, a significant correlation ($rho = 0.66$, $p < 0.001$) was found between the type of milk consumers typically drank and their stated milk preference (see Table 4). As shown in Table 4, whole milk drinkers unanimously (15 of 15) reported a preference for whole milk based on taste, and the majority of two-percent drinkers reported preferring the taste of two-percent milk (29 out of 40). Conversely, fewer than half of skim milk drinkers (22 of 45) reported preferring the taste of skim milk.

3.2 Health Consciousness

Levels of concern regarding fat consumption, calorie consumption, sugar consumption, and weight gain differed significantly by type of milk typically consumed, with participants who drank skim milk being the most concerned with all measures (Table 5 and Figure 3). Levels of concern regarding sugar consumption differed significantly by stated milk preference with those with a stated preference for whole milk being less concerned with getting too much sugar than those stated a preference for skim milk (Table 5). Women had significantly higher composite health consciousness ratings and ratings for concern regarding fat consumption, calorie consumption, and weight gain (Table 5). Concerns over high salt, energy from food, food additives, coronary heart disease, cholesterol, and blood pressure were not related to gender, type of milk typically consumed or stated milk preference.

4. Discussion

In agreement with our hypothesis that stated preference would better predict revealed preferences in a blind taste test versus the type of milk typically consumed, those consumers who declared a preference for skim milk also showed a significant preference for lower fat milk compared to higher fat milk, whereas consumers who reported they typically drank skim milk showed no significant preferences between lower fat and higher fat milk samples. In contrast, those consumers who typically drink whole milk show stronger preferences for fat in milk, as compared to those who stated a preference for whole milk. This result makes sense when considering the nutritional implications of consuming whole milk. Per 8 ounce serving (237mL), whole milk provides 149 kilocalories compared to only 83 kilocalories for skim milk, so this suggests that only those consumers with a very strong preference for fat in milk continue to choose consume whole milk in spite of both the high energy density of whole milk, and the sustained public health messaging about reducing fat intake. This assertion is buttressed by the observation that every single participant who reported typically drinking whole milk also stated they preferred the taste of whole milk (see Table 3). In contrast, two percent drinkers and those who stated a preference for 2% milk did not actually prefer this level of fat over a low fat control in blind tasting (although they did significantly prefer 3.5% fat milk to a low fat control). This raises an interesting question – would those consumers who regularly drink 2% milk accept a change to skim milk without a loss in satisfaction? The taste test data would seem to suggest so, but many other factors affect food satisfaction and choice including expectation. Knowledge of fat content from the label is reinforced by visual cues of milk fat content, thereby creating different contexts and expectations than a blind taste test. Alternatively, this result

could merely reflect Type II error, as it remains possible that testing even more two percent consumers beyond the 45 tested here may potentially reveal a significant preference for 2% milk in blind testing, especially given that these individuals did prefer 3.5% milk over the very low fat control. Also, we should note that our test only measured preferences for fluid milk within a beverage context. Many consumers use milk as an ingredient and complex interactions with other food components may render milk fat more important in those contexts (Raats & Shepherd, 1992; Raats & Shepherd, 1991). Consumers may choose to keep only one type of milk in the household, and therefore select the fat level that provides satisfactory results across a variety of contexts. Nevertheless, it may still be worth challenging consumers' beliefs that they prefer higher fat milks. If consumers were presented with evidence that they might find lower fat milk acceptable, they may be more willing to switch to lower fat milk choices (e.g., I tried it and I like it). Fat is the most energy dense of the macronutrients, contributing more than twice as much energy per gram as protein or carbohydrates, so switching to lower fat milks may lead to positive health outcomes. A diet lower in energy density has been associated with positive health outcomes (Rolls, Drewnowski, & Ledikwe, 2005), but observational studies of fat consumption from dairy have not shown the same findings (Kratz et al., 2013). More research into the role of dairy fat in the diet is needed.

4.2 Limitations

The health consciousness questionnaire used in this study was relatively short and not all items were directly related to milk consumption. There were a noticeably limited number of whole milk drinkers in our study, as it was very difficult to recruit these individuals. The extent to which these results apply to dairy fat preferences in the general population is potentially limited: these data were collected in a university

environment at a major land grant institution, leading to a participant pool that may not generalize to the general population. For example, the whole milk drinkers have have come disproportionally from farming or other agriculture production backgrounds, whereas other work suggests education level can influence health seeking behavior (Lantz et al., 1996). Nonetheless, the discordance between stated and revealed preferences were striking and deserve additional study. Finally, the only product used here was unsweetened fluid milk. Different results could potentially be found in flavored milk (Li, Hayes, & Ziegler, 2015) or other dairy products (Drewnowski, Shrager, Lipsky, Stellar, & Greenwood, 1989).

5. Conclusions

While fat is generally assumed to be a pleasant stimulus, there appears to be a segment of the population that truly prefers lower fat levels milks and is not simply choosing them for health reasons. Similar group differences have been observed in response to sweetness, a taste that is generally considered pleasant by most but disliked by a portion of the population (Looy, Callaghan, & Weingarten, 1992; Lundgren, Jonsson, Pangborn, & Sontag, 1978). These results add to extant literature by showing that some individuals may prefer lower fat products from a sensory standpoint in addition to a health standpoint. Future work on fat preferences could include further stratifications of test populations in a number of ways. Potentially meaningful data could be generated by dividing participants by their total fat intake (Pangborn & Giovanni, 1984), by their general fat preferences (Ledikwe et al., 2007), their ability to detect and discriminate between varying fat levels (Liang et al., 2012), or by their ability to detect free fatty acids (Running, Craig, & Mattes, 2015; Stewart, Feinle-Bisset, & Keast, 2011).

This study shows that stratifying participants by both their stated preferences and their typical food consumption patterns can lead to better understanding of food choices. As has been pointed out previously, using group means to summarize overall preferences may not be ideal as the mean may not actually represent the response of anyone in the group (Pangborn, 1981). Stratifying groups by stated preference and typical intake might lead to more accurate understanding of preference patterns. Recent research by Sharafi et al. (Sharafi et al., 2015) took a novel approach examining concepts of discordance (consuming foods that you do not like and/or disliking foods that you consume) and food hedonism (the relative liking of high-fat/sweet/salty food compared to other pleasurable activities). They found that children showing higher levels of discordance and food hedonism had higher BMIs. While there is a long history of encouraging consumers to change their dietary consumption habits, less effort has been focused on actually changing consumers' dietary preferences. Their work seems to suggest that more research into changing preferences is warranted. Work by Chung and Vickers (Chung & Vickers, 2007a) demonstrates that it is possible to increase consumers' preferences for a less liked, lower calorie beverage over time, although later work failed to show the increase in liking translated to more frequent consumption in a choice experiment (Chung & Vickers, 2007c). However, participants in that study were not provided with information about the nutrition content of their choices, which would also presumably alter real world choices. More research into the feasibility of changing consumer preferences and the resulting outcomes on actual consumption in informed conditions is warranted.

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Figure 1: Proportion of participants preferring the treatment (added fat) sample to the 0.1% fat sample for each milk fat %; all participants (solid red squares) as well as participants stratified by drinking milk type: whole milk (solid navy circles), 2% milk (blue half-filled circles), and skim milk (blue quarter-filled circles). Dotted lines representing chance probability, rejection of low-fat milk, and rejection of high-fat milk are shown.

Figure 2: Proportion of participants preferring the treatment (added fat) sample to the 0.1% fat sample for each milk fat %; all participants (solid red squares) as well as participants stratified by stated milk preference, based on its taste: whole milk (solid navy squares), 2% milk (blue vertically half-filled squares), and skim milk (blued horizontally half-filled squares)..

Figure 3: Comparison of Health Consciousness Component Scores by type of milk typically consumed. The lightest bars represent participants who typically drink skim milk, the darkest bars represent participants who typically drink whole milk. The medium shaded bars represent participants who typically drink 2% milk. Bars within a grouping that share a letter designation are not significantly different at $p \leq 0.05$.

Table 1: Fat Content of Assorted Commercially Available Dairy Products

Product	Milk fat (%)
Skim/nonfat milk	0.0 - 0.5
Low fat milk	0.5-3.25
Whole milk	>3.25
Half and half	10.5 - 18
Light cream	18- 30
Light whipping cream	30-36
Heavy cream	>36
Butter	80

Table 2: Health Consciousness Statements

When thinking about your own health, how concerned are you about the following issues?
Getting a lot of salt in my food
Getting a lot of fat in my food
Getting a lot of sugar in my food
Getting many calories
Getting sufficient energy from my food
Food additives in my food
Risk for high blood pressure
Risk for coronary heart disease
Getting a lot of cholesterol in my food
Gaining weight

Table 3: Proportions of Subjects who Preferred the Added Fat Sample to a 0.1% Fat Control Stratified by Reported Milk Preference, Drinking Milk Type, and Health Consciousness Group

Stratification	Number of subjects	Propotion preferring 0.1%*	Propotion preferring 0.5%*	Propotion preferring 1.0%*	Propotion preferring 2.0%*	Propotion preferring 3.5%*
Total Group	104	0.50	0.51	0.55	0.55	**0.63**
Prefer Skim	22	0.50	0.45	0.50	0.41	**0.27**
Prefer 2%	45	0.49	0.49	0.56	0.56	**0.67**
Prefer Whole	31	0.45	0.58	0.61	0.65	**0.84**
Drink Skim	45	0.53	0.47	0.53	0.44	0.47
Drink 2%	40	0.48	0.53	0.55	0.63	**0.73**
Drink Whole	15	0.40	0.60	0.73	**0.80**	**1.0**
Low HC	34	0.50	0.47	0.47	0.42	0.56
Medium HC	34	0.47	0.53	0.56	0.56	0.65
High HC	36	0.53	0.53	0.62	**0.68**	**0.71**

* vs. a control sample containing 0.1% Fat

Bolded proportions are significant at $p < 0.05$ using the binomial distribution for paired preference tests.

Table 4: Distribution of Stated Preference versus type of milk typically consumed

		Type of milk typically consumed		
		Whole (n=15)	**2% (n=40)**	**Skim (n=45)**
Stated preference for milk type based on taste	**Whole (n=31)**	15	10	6
	2% (n=45)	0	29	14
	Skim (n=22)	0	0	22
	Other (n=6)	0	1	3

Table 5: ANOVA for Health Consciousness Scores, By type of milk typically consumed, Stated Milk Preference, and Gender

	Typically Consumed		Stated Preference		Gender	
Concern	F	p	F	p	F	p
Composite	1.2	0.3	1.4	0.3	**5.2**	**0.03**
Too Much Fat	**5.8**	**0.004**	2.1	0.1	**9.0**	**<0.001**
Too Much Sugar	**3.5**	**0.03**	**3.7**	**0.03**	2.0	0.2
Too Many Calories	**3.8**	**0.03**	2.5	0.09	**11.4**	**0.001**
Gaining Weight	**4.0**	**0.02**	1.5	0.2	**6.4**	**0.01**

Bolded values are significant at $p < 0.05$

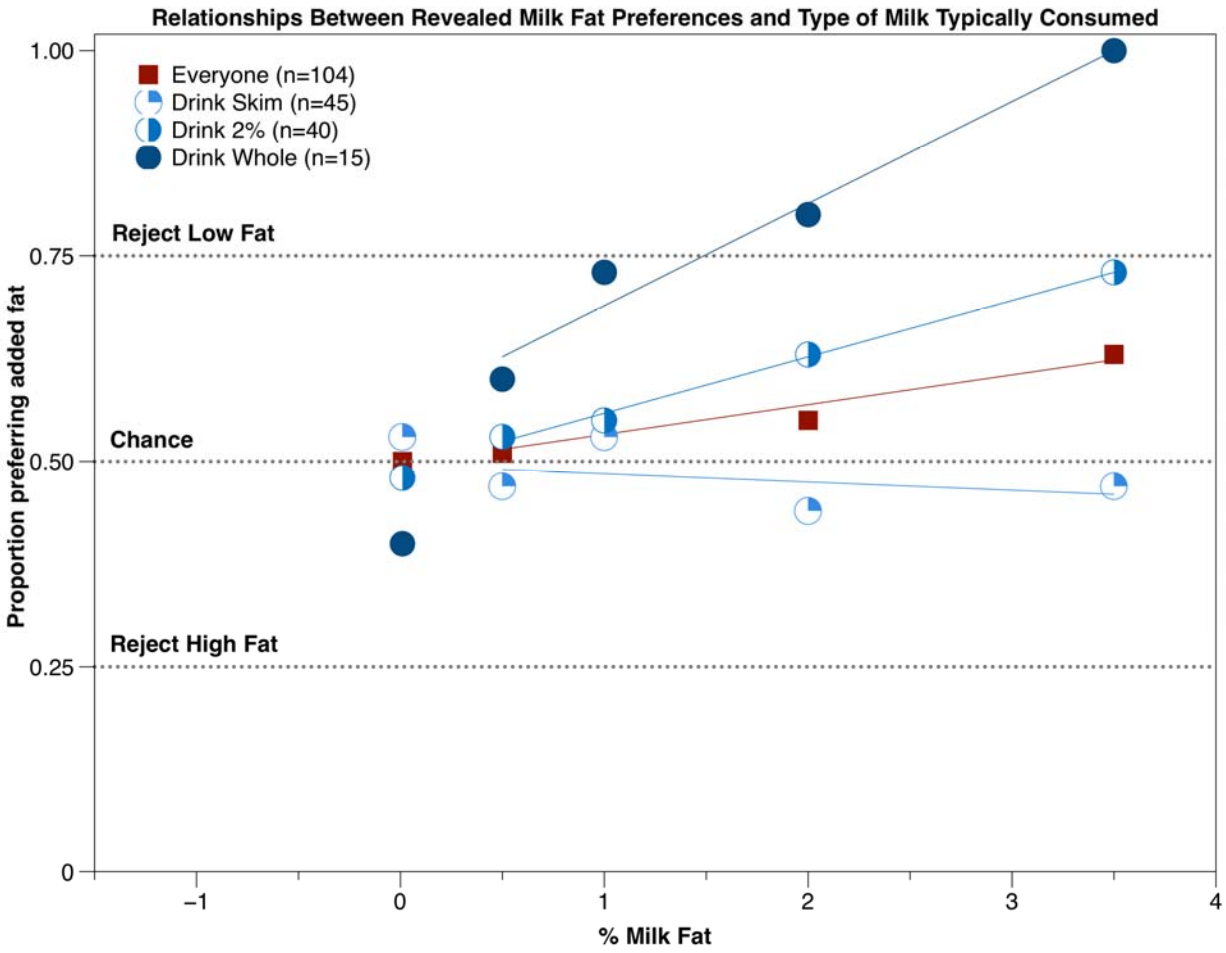

Figure 1

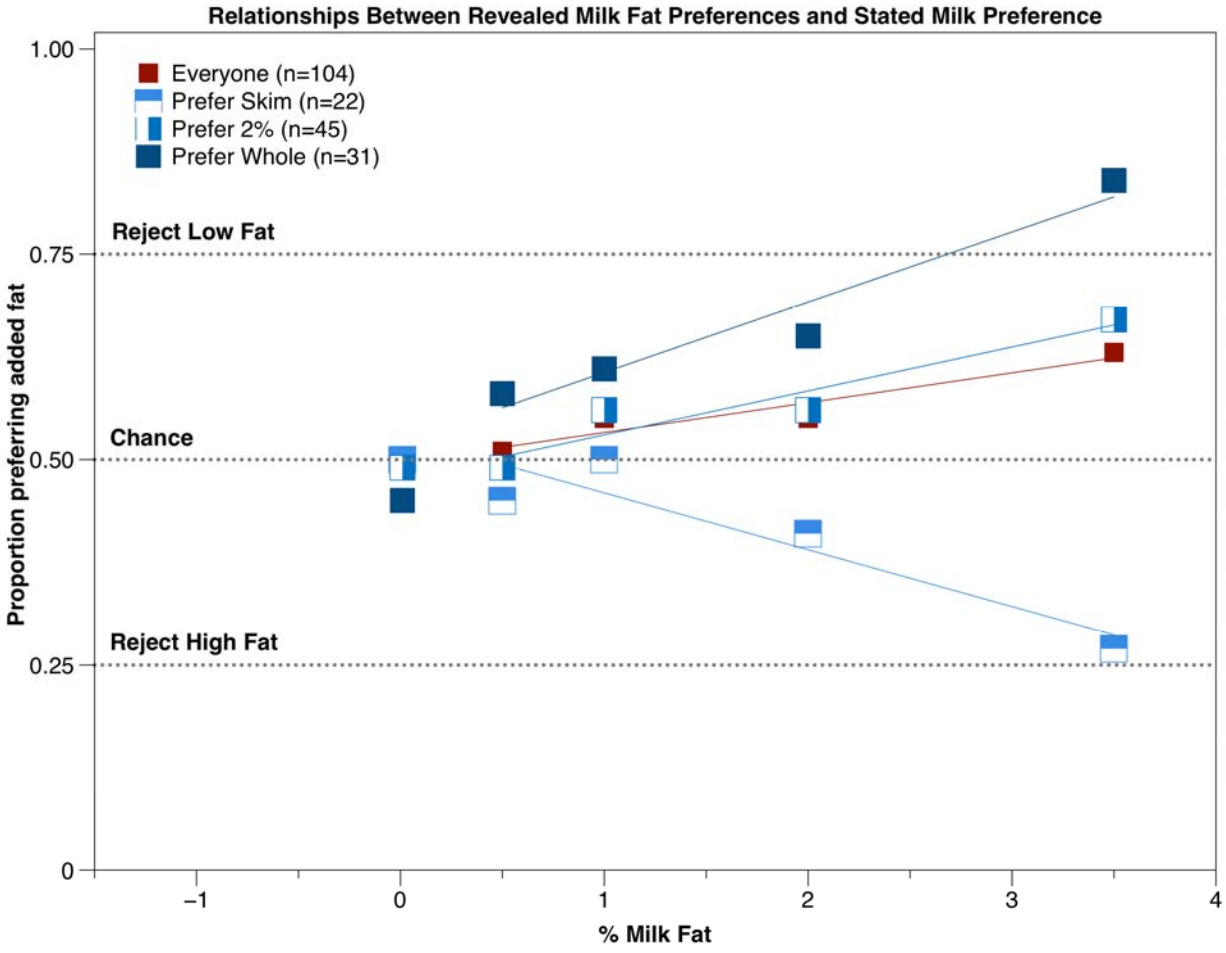
Relationships Between Revealed Milk Fat Preferences and Stated Milk Preference
Everyone (n=104)
Prefer Skim (n=22)
Prefer 2% (n=45)
Prefer Whole (n=31)
Reject Low Fat
Chance
Reject High Fat
Proportion preferring added fat
1.00
0.75
0.50
0.25
0
−1
0
1
2
3
4
% Milk Fat

Figure 2

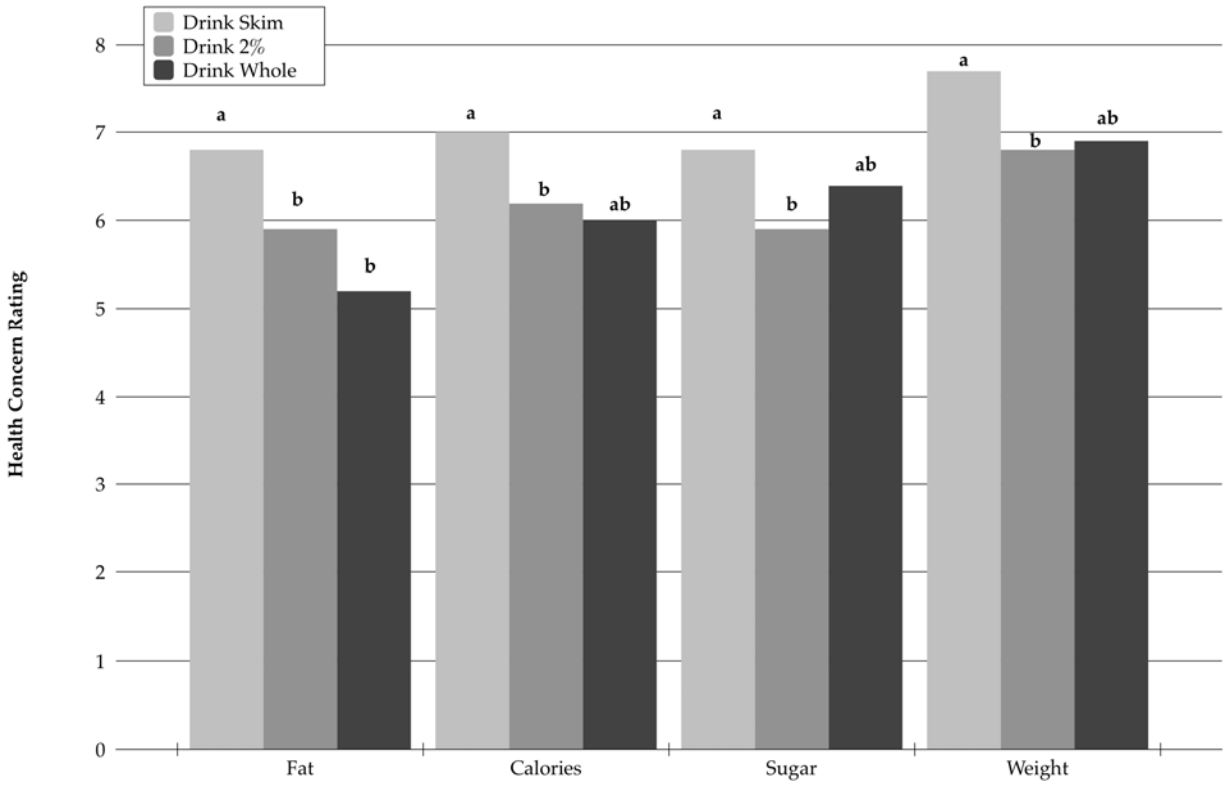
Drink Skim
Drink 2%
Drink Whole
Health Concern Rating
0
1
2
3
4
5
6
7
8
a
b
b
a
b
ab
a
b
ab
a
b
ab
Fat
Calories
Sugar
Weight

Figure 3