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Sensory and Hedonic Evaluation in Response to Food-Cue Exposure: The Case of Juicing Demonstration of Fresh Oranges

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Abstract

This study evaluated whether observing the orange squeezing (juicing) process can influence consumers' sensory evaluations and hedonics of different forms of orange juice. The juicing process delivers cognitive (freshness) and physical (olfactory/visual) food cues. Three forms of orange juice were used in the experiment: fresh squeezed, not-from-concentrate, and from-concentrate. Participants were divided into two groups, with only one group observing the juicing process using a specially designed table-top juicer. Sensory evaluations of participants who did not observe the juicing process were not significantly different with the exception of color. The demonstration of the juicing process primed consumers to identify and evaluate fresh squeezed orange juice in terms of color, aroma, flavor, sweetness, and acidity. The results of an ordered logistic model indicated that consumer acceptance of orange juice was significantly linked to internal attributes such as flavor, sweetness, acidity, and pulp, and the acceptances were not significantly different by juice forms. This implied that food cues from the juicing process can affect human sensory evaluation of the cued food, but the food cues may not overwhelm, in particular when attributes of alternatives are almost homogeneous.

Keywords: fresh squeezed juices, visual effect, freshness, food cue, sensory evaluation, orange juice

1. Introduction

Food-associated external cues can be potent enhancers of food consumption (Fedoroff, Polivy, & Herman, 1997). Food scientists found that food-cues such as visual (watching) (Lambert, Neal, Noyes, Parker, & Worrel, 1991), olfactory (smelling) (Gaillet, Sulmont-rossé, Issanchou, Chabanet, & Chambaronl, 2013 and 2014), oral (brief tasting) (Sobell, Schaefer, Sobell, & Kremer, 1970; Lambert et a., 1991) and cognitive (thinking) modality (Fedoroff et al., 1997) influence consumers' intention to eat. Even non-conscious cues were associated with consumers' behavior (Gailet et al., 2013 and 2014; Holland, Hendriks, & Aarts, 2005). That is, food cues can stimulate implicit consumer propensity and induce priming effects despite inattentive motivation to do so. As an example of the visual senses, Harris, Bargh, & Brownell (2009) found that exposure to food advertising on television primes automatic eating behaviors. Usually, television advertising conveys positive essentials of products through sight and sound, which stimulate consumers' desires for the products. Consumers' appetites may be strongly stimulated by smelling and seeing the food at a real spot rather than through media equipment. Hill, Magson, & Blundell (1984) measured the differences in consumers' appetites indicating desire to eat right after being presented with food, in this case a highly preferred and less preferred meal made for each individual. The study observed increased appetite after observing the food regardless of consumers' preferences, even though the increments were larger for preferred meals than for less preferred meals. That is, consumers were immediately influenced by the smell and appearance of the food.

In everyday life, consumers encounter food demonstration at grocery stores that deliver information through visual and olfactory modalities, and even sometimes oral modality. One attribute of food demonstration is the freshness of the food and the ingredients. Freshness of food is one important attribute when consumers make decisions about fresh food choices (Torjusen, Lieblein, Wandel, & Francis, 2001). However, few studies consider freshness on its own as a possible attribute influencing consumer choices. A study used freshness as an implicit attribute of appearance (Kader, 1999). This may be due to the difficulty of assessing freshness for consumers. Fenko, Schifferstein, Huang, & Hekkert (2009) stated that "freshness is a multisensory product

experience that includes visual, olfactory, tactile, and, in some cases, also gustatory and auditory components." In addition, the study found that the dominant sensory modality of freshness depends on the characteristics of the particular product. Consumer ranks of important attributes were different with/without freshness in selection lists. When Poole and Baron (1996) did not include freshness as an important attribute of citrus, participants rated juiciness, skin quality, sweetness and texture as the most important attributes. Contrary to the study, Gao et al. (2011) included freshness as an important attribute of fresh citrus, and consumers selected freshness, flavor, and appearance as the most important attributes of fresh citrus.

The citrus industry is interested in increasing sales of fresh fruit and juice through restaurants (i.e., away from home) while most orange juice is consumed at home. One possibility would be to provide fresh squeezed orange juice with customers observing the juicing process used to create a glass of juice. Observing the juicing process not only stimulates the consumers' physical senses of both sight (visually observing the process) and smell (the aroma created while the juice is made), but provides an impression of freshness (i.e., just squeezed) through cognitive modality, which might be a way to influence consumers positively. Although many studies have investigated the effect of newly developed processing technologies or juice packages on sensory characteristics of orange juice (Leizerson & Shimoni, 2005; Ayhan, Yeom, Zhang, & Min, 2001; Moshonas & Shaw, 1997), no studies pursued the effect of observation of the juicing process. Also, previous sensory evaluation studies found that fresh orange juice obtained higher flavor scores than processed orange juice (Aparicio, Medina, & Rosales, 2007; Moshonas & Shaw, 1997). We will test the hypothesis that freshness and aroma influence sensory evaluation of fresh squeezed orange juice. Furthermore, we test if demonstration of the juicing process plays a role in priming consumers to prefer fresh squeezed orange juice over processed juice.

Other than freshness, external and internal attributes of products may also affect consumer preference. External appearance factors such as shape, color, and smell provide first impressions about products to consumers which may attract them to try or buy products, while internal attributes such as flavor and texture may influence consumers to purchase those products again. External attributes such as size, grade, cosmetic defects, and storage played a key role in price determination and product demand (Carew, 2000; Kim & House, 2012; Tronstad, Huthoefer, & Monke, 1992). On the other hand, eating-quality factors (internal food attributes) such as crispness, sweetness, acidity, and juiciness considerably influence whether consumers will repeat fruit purchases (McCluskey, Mittelhammer, Marin, & Wright, 2007).

Factors influencing consumer choices at restaurants may differ from at-home consumption, given the opportunity for different influences at the point of purchase. Since fresh squeezed oranges juices may compete with chilled and ready to drink orange juices in market, we included substitutable processed orange juices in the experiment. We measured hedonic ratings and Just-About-Right (JAR) ratings of internal and external attributes of orange juices as well as participants' overall liking score (hedonic measurement) for each orange juice. To determine if such a process would influence consumer evaluation, a study was conducted to investigate consumer reaction to a specially designed table-top juicer that allows customers to observe (see and smell) the juicing process. Participants were randomly placed in one of two groups: a control group (did not observe the juicing process) and a treatment group (observed the juicing process). Using the results from the control group (no food-cues), we verified whether consumers prefer fresh squeezed orange juice to processed orange juice. Using control and treatment group data, this study examined the priming effect of the juicing process on consumer sensory and hedonic evaluation. Finally, we built an ordered logit model with overall liking scores using a five-point scale to explore which sensory characteristics were closely linked to consumers' orange juice acceptance. The study results will contribute to our understanding of which attributes of orange juice consumers prefer, assist restaurant owners interested in knowing how much fresh squeezed orange juice attracts consumers, and provide basic reference and empirical evidence of the food demonstration effect on consumers' sensory evaluation and acceptance.

2. Experimental methods for evaluating orange juice attributes

2.1 Samples

We selected chilled processed orange juices to compare sensory attributes with fresh squeezed orange juice. These chilled processed orange juices should be ready-to-serve to compete or substitute for fresh squeezed orange juice to consume away from home. Three major types of processed orange juice are distributed in the United States: frozen concentrate orange juice (FCOJ); orange juice from concentrate (FC), and not-from-concentrate (NFC) orange juice. FCOJ is distinguished from FC and NFC as FCOJ is not ready-to-serve. Even though FC (or Recon RTS [reconstituted ready to serve]) is made by adding water and flavor oils to bulk FCOJ, the manufacturing process maintains a consistent brix level and taste for each single end product. In addition, FC and NFC can be

purchased at grocery stores ready to drink, while FCOJ requires extra steps to be drinkable. As this experiment focused on juice provided at restaurants, FC and NFC orange juices were included as a comparison to fresh squeezed (FS) orange juice. To provide consistent juice attributes, the same brands of NFC and FC orange juices with pulp were selected and both orange juices and fresh oranges were refrigerated (temperature between 32-40˚F) until serving or juicing. Orange juices were served using 4 fl. oz. opaque white cups. It should be noted that commercial brand orange juice, even of the same brand, comes in different varieties, depending on availability. While orange varieties can affect sensory properties (Buettner & Schieberle, 2001), Lotong, Chambers, & Chambers (2003) found that the flavor of most commercial orange juice brands is not differentiable based on sensory characteristics.

2.2 Participants

A mall intercept survey was conducted with a random sample of consumers recruited by a market research firm. Participants were recruited in two Florida malls located in Tampa and Orlando (n=100 each) in June 2009, and were required to be adult primary grocery shoppers who had consumed orange juice within the last thirty days. In each location, participants were randomly assigned either to the control (did not observe the juicing process) or treatment group (observed the juicing process).

There were 200 participants in the survey. As background information, we collected respondents' orange juice consumption patterns and demographics, shown in Table 1. Approximately 80% of participants indicated that they drink, on average, more than three glasses of orange juice in a week. Respondents indicated that NFC orange juice (56%) was the most frequently consumed, followed by FC (28%) and FS (19%) orange juice. Overall 39% of respondents indicated that they purchased orange juice at a restaurant or fresh juice bar in the past 6 months. A detailed description of the demographics of the sample, separated by group (did or did not observe the juicing process) is shown in Table 1. An independent test using the chi-square test was conducted to see any significant difference between the control and treatment groups. The p-values of the chi-square test were greater than 0.05 for all demographics and orange juice consumption habits which indicated no significant differences could be found between two groups. Overall, this study will focus on exploring the effect of observation of the juicing process on respondents' sensory evaluation.

Table 1. Participant socioeconomics/orange juice drinking habits and independence test by control and treatment group

Socio-economic variables	Variable description	Treatment group[a] (N1=100)	Control group[a] (N2=100)	Chi-square statistics[b] (P-value)
Gender	Male	56	48	1.28(0.26)
	Female	44	52	
Education	High school or less	48	39	1.29(0.26)
	Some college	37	53	
	College degree	9	5	
	Post graduate	4	3	
Household income	Under $30,000	16	18	0.48(0.49)
	$30,000–$49,999	46	37	
	$50,000–$74,999	18	22	
	$75,000–$99,000	3	7	
	$100,000 or more	7	2	
Age (years)	30 or under	42	31	2.15(0.14)
	31–50	37	42	
	Over 50	21	27	
Frequency of drinking	3 glass more a week	77	80	4.74(0.19)
Drinking juices	Fresh squeezed juice	20	18	1.32(0.86)
	Not from concentrated	58	54	
	From concentrated	15	21	
Place to buy	Restaurant or juice bar	41	37	0.34(0.56)

[a] Participants in the treatment group observed the juicing process, while participants in the control group did not.

[b] Chi-square statistics for testing independence of association between groups and socio-economic variables.

2.3 Study Overview

Using a between-subjects design, participants were randomly assigned to one of two groups; one group observed the juicing process prior to answering sensory evaluation questions on three types of juice (treatment group), and the other group evaluated the same products without observing the juicing process (control group), as shown in the interview flows in Figure 1. A survey company located inside each of the shopping malls and equipped with kitchen facilities was used. The table-top juicer shown in Figure 1 was installed in the kitchen area of each facility (not visible from the interview area) to demonstrate the juicing processing.

In the first part of the interview, all participants were asked a series of questions about demographics, as well as their orange juice purchase behaviors. After that, participants assigned to the treatment group were asked to walk to the kitchen area where the table-top juicer was installed, while the participants in the control group remained in the interview area through the whole interview. Participants were recruited individually, thus only one person at a time observed the juicing process and had a clear view of the machine. When participants entered the kitchen area, a demonstrator operated the juicing machine. Participants observed the process until a cup of orange juice was filled. After observing the juicing process, the participants in the treatment group walked back to the interview room. The interview and kitchen areas were separated by enough distance such that the smell from the process would not be noticeable in the interview area. In the second part of the interview, all participants were served three individual cups of orange juice (fresh squeezed [FS], not-from-concentrate [NFC], and from concentrate [FC]), one at a time. Each juice was labeled with a randomly selected three-digit sample number in order to remove bias from subjects' recognition of types of orange juice. The three juices were presented in random order to avoid order effects of sample presentation (Gacula, Davis, Hardy, & Leiphart, 1986). Neither the control group nor the treatment groups were told different types of juice were being presented. Hence, the survey and experimental process was identical for both groups except for the observation of the juicing process. In between tasting each juice, participants were asked to eat a cracker and drink water to cleanse their palate before tasting the next sample.

Participants rated sensory properties before and after tasting each of the FS, NFC, and FC orange juices: 1) external attributes measured before tasting included overall appearance, color of juice, and aroma and 2) internal attributes measured after tasting included overall flavor, texture, sweetness, acidity, and amount of pulp. A nine-point Likert scale applied to overall appearance, aroma, overall flavor, and texture, with 1 denoting "dislike extremely", 5 denoting "neither like nor dislike", and 9 denoting "like extremely", and a JAR scale for color, sweetness, acidity, and pulp. (JAR scales for color, sweetness, acidity, and pulp are 1 for much too pale/not at all sweet enough/not at all sour enough/much too little pulp, 3 for just right, and 5 for much too dark/much too sweet/much too sour/much too much pulp). At the end of each sensory test, subjects rated how likely they were to buy the juice, if it were available, using the five-point Likert scale.

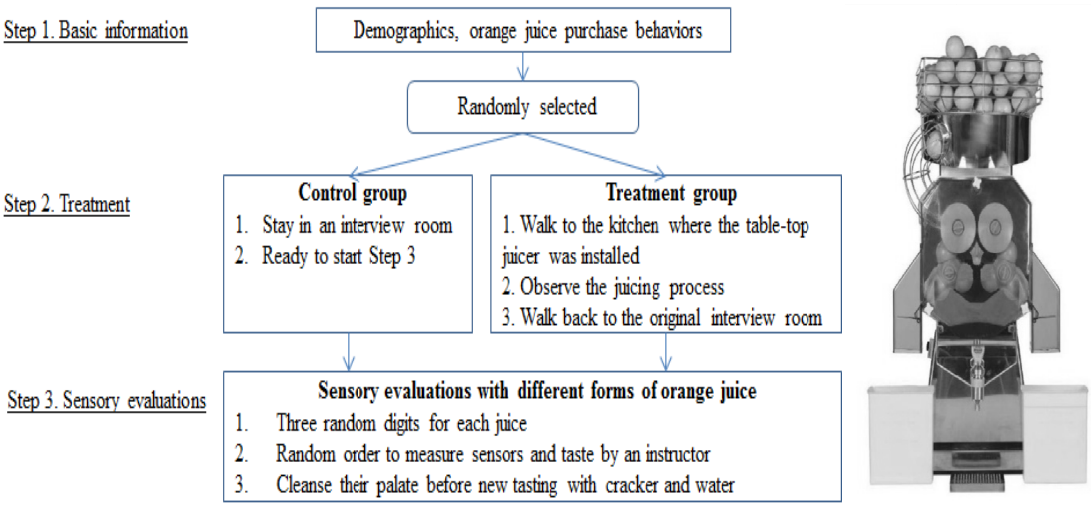

Figure 1. Study flowchart and table-top juicer

2.4 Statistical Analysis

The JAR scales have two regions with both ends anchored by opposite sensory description and the middle category anchored as "just about right". An evaluation below JAR usually indicates that the product has too little

of the attribute, while an evaluation above JAR denotes that the product has too much of the attribute. JAR represents the average between the two characteristics and provides a favorable direction for developing the attribute. Since JAR scales utilize two different directions, interpretation of the meaning of JAR and analysis of the scale compounding respondents' heterogeneity preferences always require attention. Gacula et al. (2007) found that consumers generally revealed the meaning of 'just-about-right' as their preference and acceptability about the attributes. In the same study, Gacula, Rutenbeck, Pollack, Resurreccion, & Moskowitz (2007) introduced two analysis methods of JAR scales: 1) dividing analysis below and above-JAR deviation and 2) signal-to-noise ratio (SNR) statistics. The first method is useful to provide heterogeneity preference and the direction of developments. Gacula (1993) introduced Taguchi (1986)'s concept of robustness of products and process to optimize sensory evaluation. Taguchi focused on estimating variability between process and the target value due to the difficulty of generating a real measure of process variability. Since Taguchi's signal-to-noise ratio (SNR) measures the dispersion of acceptability from the target value (here is the JAR), the nature of directions disappears. In spite of this limitation, the SNR enables transformation of the bipolar scales to a unipolar one targeted on 'just right'. Taguchi's "nominal-is-better" quality characteristics can be applied to the JAR, in which a product is considered as the best quality when it contains neither too little nor too much of a particular characteristic. By adopting the method of Gacula (1993), the SNR values for corresponding JAR ratings was computed by the formula, $\mathrm{SNR} = \sum\{-10 \times \log[(x_i - 3)^2 + \mathrm{k}]\}/\mathrm{n}$, where the value "3" is the JAR target value, the constant *k* value ranges from 0.1 to 1.0 which is used to avoid taking the logarithm of zero (we set k=0.25), and n is panelists (in our study, n=1). Larger SNR values indicate lower variability, or greater robustness. In other words, respondents' acceptability regarding a specific attribute is reliable. In the descriptive analysis, we provide both basic statistics of original JAR rating scales and SNR to indicate general intentions and reliability of acceptance related attributes. For the analysis of variance, we only used the SNR values.

A one-way within subject analysis of variance (ANOVA) was constructed to compare consumer's sensory evaluations of differently processed orange juices (FS, NFC, and FC). If a sensory evaluation is significantly different (p=0.05) among types of orange juice, multiple comparisons were conducted using Tukey's test. From the result, we tested the null hypothesis that differently processed orange juices will have no significant effect on consumer sensory evaluation.

A two-way ANOVA was used to analyze the data with one within-subject factor (types of orange juices) and one between-subject factor (observed juicing process). An interaction term between types of orange juices and treatment was included. We tested two main effects and one interaction effect. The interaction term was used to test the null hypothesis that the juicing process will have no significant effect on consumers' sensory evaluation across types of orange juice. Multiple comparisons for the interaction term were conducted using least squares means (LS-means) to verify the treatment effect on different types of orange juice. The ANOVA was performed using the GLM procedure in SAS (Version 9.2) in which Tukey and LSMEAN were used for a multiple comparison test of the means of the main effect and the interaction effect, respectively.

Finally, ordered logistic regression analysis was used to investigate the linkages between sensory characteristics and consumers' juice acceptance. A five-point Likert scale was applied (1 for not at all likely, 2 for not very likely, 3 for somewhat likely, 4 for very likely, and 5 for extremely likely) in which higher rating indicated greater likelihood to purchase the juice. In the model, we also included a treatment factor and types of juice as covariates, as well as interaction terms between treatment and sensory characteristics. The LOGISTIC procedure in SAS (Version 9.2) was used to estimate the model.

3. Results

3.1 Descriptive Data

Summary statistics of consumers' ratings for the sensory characteristics by treatment groups are shown in Table 2. The table includes two descriptive statistics for attributes measured by the JAR ratings. One is based on the original JAR ratings and the other uses the SNR values. The average of original JAR ratings indicated the general inclinations of consumers to the associated orange juice attributes. If the average ratings were greater than 3, which is the middle point of the JAR scales, average consumers were inclined to feel the orange juice possessed too much of the attributes. In the SNR formula, larger SNR values are generated when the observation was close to the target value (in this case, the JAR). The greater average values from the SNR indicated consumers felt the attributes were much more acceptable. Participants in the treatment group (observed the juicing process) generally had higher sensory ratings and liking scores for the FS orange juice compared to the control group, while average ratings for FC orange juice were lower. Standard deviations (SD) of FS orange juice

in the treatment group were generally smaller than the control group, while SDs of NFC and FC orange juice varied.

In the control group, all three types or orange juices obtained relatively similar levels of sensory evaluations for each of the eight attributes with the exception of color. Consumers were more satisfied with the color of NFC (average SNR color rating=3.40) and FC (average SNR color rating=3.27) orange juices compared to FS (average SNR color rating=1.29) orange juice. The average color ratings from the original JAR ratings indicated that average consumers evaluated the color of FS orange juice as a little too dark (average rating = 3.45). Approximately 45% evaluated FS orange juice as having a darker color than NFC and FC. The two statistics implied that respondents were less accepting of the dark color of orange juice.

In the treatment group, ratings for FS orange juice were higher, as were the average scores for most sensory characteristics. In addition, all the JAR ratings of FS orange juice leaned toward 'just right' and the overall appearance, aroma, flavor, and texture were also increased compared to results from the control group. Even though the average SNR rating of color for FS orange juice increased from 1.29 to 2.96, FC orange juice had the highest average scores for color in the treatment group. In addition, overall liking scores of FS orange juice increased in the treatment group, while NFC and FC liking scores simultaneously decreased.

Based on the summary statistics, the treatment seems to lead to wider variance in sensory evaluations and to influence consumers' sensory evaluation of orange juices, not only for fresh squeezed orange juice, but also processed orange juices.

Table 2. Descriptive statistics (mean/std.) of sensory ratings for orange juice with/without visual treatment

	Descriptive statistics Mean/Standard deviation					
	Control group			Treatment group		
	FS	NFC	FC	FS	NFC	FC
Appearance	5.95/2.48	6.28/2.10	6.56/1.70	6.52/2.31	6.34/1.77	6.33/2.03
Color[a]	3.45/0.89	2.77/0.68	2.66/0.59	3.24/0.77	2.73/0.66	2.64/0.63
Color[b]	1.29/4.48	3.40/3.94	3.27/3.71	2.96/4.25	3.08/3.83	3.17/3.90
Aroma	6.70/2.19	6.21/1.89	6.12/1.76	6.91/1.79	6.12/1.86	5.95/1.84
Flavor	6.45/2.59	6.15/2.20	5.99/2.36	7.10/2.09	6.06/2.20	5.73/2.29
Texture	6.43/2.35	6.34/2.11	6.20/2.15	6.76/2.05	6.17/2.08	6.02/2.12
Sweetness[a]	3.10/0.86	2.76/0.73	2.70/0.86	3.04/0.74	2.79/0.81	2.68/0.94
Sweetness[b]	2.73/4.50	3.06/4.08	2.17/4.49	3.34/4.04	2.61/4.28	1.52/4.61
Acidity[a]	3.07/0.84	3.28/0.74	3.04/0.82	3.00/0.74	3.21/0.80	3.21/0.88
Acidity[b]	2.48/4.28	2.78/4.11	2.97/4.33	3.50/4.08	2.75/4.27	1.77/4.21
Pulp[a]	3.21/0.97	2.87/0.94	3.59/0.83	3.05/0.78	2.99/1.02	3.59/0.98
Pulp[b]	1.75/4.72	1.99/4.61	1.64/4.84	2.85/4.11	1.48/4.74	1.07/5.23
Liking score	3.23/1.41	3.09/1.31	2.92/1.30	3.53/1.26	3.02/1.25	2.87/1.21

a and b indicated descriptive statistics of attributes measured by JAR scale: 'a' was calculated based on original JAR ratings and 'b' was calculated based on values by SNR transformations.

3.2 Sensory Evaluation of Orange Juices within Control Group

Using the control group data (blind test and no treatment), we examined consumers' sensory evaluations across types of orange juices in order to see whether consumers have different sensory evaluations for differently processed orange juices. For the ANOVA, we only considered the values transformed by SNR scales of the attributes measured by the JAR intensity rating scales. Results of the one-way ANOVA are shown in Table 3. By examining the F-values, we failed to reject the null hypothesis that there is no influence on consumers' sensory evaluation on appearance ($p=0.13$), aroma ($p=0.08$), flavor ($p=0.39$), texture ($p=0.76$), sweetness ($p=0.34$), acidity ($p=0.70$), and pulp ($p=0.86$) based on type of orange juice (FS, NFC, and FC). However, we rejected the null hypothesis in the sensory characteristic of color ($p<0.0001$). This result implies that participants have significantly different acceptance of orange juice color across types of orange juices. The Tukey test indicated that the color acceptance of the NFC and FC orange juices were similar but distinguishable from FS orange juices. As shown in Table 2, the color of FS orange juice is dark compared to NFC and FC orange juices and FS orange juice has a lower average SNR score of its color than NFC and FC orange juice which indicated that participants were less satisfied with the color of FS orange juice.

Table 3. One-way ANOVA using within subject factor (types of orange juice) in control group

	F-values (P-values)	Multiple comparisons by Tukey's test[a]		
	Factor: Types of orange juice	FS	NFC	FC
Appearance	2.03 (0.13)			
Color	8.48 (0.00)	A	B	B
Aroma	2.56 (0.08)			
Flavor	0.96 (0.39)			
Texture	0.28 (0.76)			
Sweetness	1.07 (0.34)			
Acidity	0.36 (0.70)			
Pulp	0.15 (0.86)			

[a] Tukey's test was conducted with the level of significance 5% for comparisons among the means. Having an A and B in the same row indicates significant differences among orange juice types for that characteristic.

3.3 Visual Effect on Sensory Evaluation

Results of the two-way ANOVA are shown in Table 4. The F-test results of the main effect indicated that orange juices with different processing methods significantly influenced consumers' sensory evaluation of color ($p=0.01$), aroma ($p<0.0001$), flavor ($p<0.0001$), and sweetness ($p=0.01$), while the treatment did not significantly influence consumers' sensory evaluation of orange juice (p-values of treatment are all greater than 0.05). In addition, F-values of the interaction effect indicated that the interaction between juice types and treatment significantly influenced consumers' sensory evaluation of color ($p=0.03$) and acidity ($p=0.03$) of orange juice. In other words, consumers' sensory evaluation of color and acidity of differently processed orange juices significantly varied with the treatment.

Multiple comparisons based on the LSMEAN were shown in the right-hand section of Table 4. Within the same letters, the means are not significantly different with 5% significance levels. Under the control group, the mean of FS color was significantly different from NFC and FC orange juice, while the mean of FS color within the treatment group was not significantly different from other types of orange juices. The results indicated that the treatment significantly increased the average color rating of FS orange juice. In addition, the treatment led to a clear distinction between FS and FC orange juices for aroma, flavor, sweetness, and acidity. However, the treatment did not enable distinguishing between FS and NFC for some attributes, like sweetness and acidity. For NFC and FC, there were no significant differences between the two groups, implying that observing the juicing process mainly influences sensory evaluations of FS orange juice.

Table 4. Two-way ANOVA using within and between subject factors (types of orange juice and treatment) and multiple comparisons

	Two-way ANOVA F-values (P-values)			Multiple comparisons by LSMEAN test [a]					
	Main effect		Interaction effect	Control			Treatment		
	Juice types	Treatment	Juice types × Treatment	FS	NFC	FC	FS	NFC	FC
Appearance	0.52 (0.60)	0.61 (0.44)	1.87 (0.16)						
Color	5.03 (0.01)	1.59 (0.21)	3.64 (0.03)	A	B	B	B	B	B
Aroma	9.48 (0.00)	0.01 (0.91)	0.56 (0.57)	AB	AB	B	A	B	B
Flavor	8.54 (0.00)	0.29 (0.59)	2.23 (0.11)	AB	A	A	B	A	A
Texture	2.70 (0.07)	0.00 (0.97)	0.92 (0.40)						
Sweetness	4.33 (0.01)	0.21 (0.65)	1.23 (0.29)	AB	AB	AB	A	AB	B
Acidity	1.09 (0.34)	0.04 (0.84)	3.52 (0.03)	AB	AB	AB	A	AB	B
Pulp	2.02 (0.13)	0.00 (0.98)	2.02 (0.13)						

[a] LSMEAN test was conducted with the level of significance 5% for comparisons among the means.

3.4 Orange Juice Attributes and Consumer Juice Acceptance

Participants were asked how likely they were to buy each type of orange juice at the end of the sensory evaluation as follows: 1 for not at all likely, 2 for not very likely, 3 for somewhat likely, 4 for very likely, and 5 for extremely likely. This liking score indicates consumers' comprehensive juice acceptance considering all sensory attributes. Since we did not include price information in the experiment, the liking score could not use for purchase intention.

Ordered logistic models were used to examine what attributes significantly influence orange juice acceptance and how observing the juicing process affects consumers' sensory evaluations. The base line of the dependent variable is the lowest (not at all likely) likelihood to purchase of the orange juice. The results of the ordered logistic analysis are shown in Table 5. The dummy variable (treatment) indicates whether or not the participants observed the juicing process; if treatment=1, then participants observed the juicing process (i.e., treatment group). This dummy variable measures the overall effect of observing the juicing process on consumer juice acceptance. Interaction terms between eight sensory evaluations and the dummy variable (treatment) were included to measure the interaction effects of observing the juicing process on the sensory evaluations. All other sensory variables measure the partial effect of sensory variables on consumer acceptance for the participants who did not observe the juicing process. The model also includes two dummy variables, FS and NFC, indicating different types of orange juice (i.e., the base line is FC orange juice). These dummy variables measure differences of consumer acceptance regarding types of orange juice.

The visual effect of the juicing process did not significantly influence consumer acceptance for orange juice. The variable, treatment, and its interaction terms were not statistically significant at the 5% level. In addition, consumers' orange juice acceptance was not significantly different over differently processed orange juices. However, consumer overall liking scores were strongly and positively linked to flavor, sweetness, acidity, and pulp. That is, the more consumers felt the sweetness, acidity, and pulp of a particular orange juice was 'just about right', the more likely they were to accept that orange juice. Interestingly, none of the external attributes of orange juice (aroma, color) significantly influenced consumers' acceptance.

Table 5. Ordered logit model estimated results

Variables		Coef.	Std. Err	Interaction terms	Coef.	Std. Err
Intercept1		2.748**	(0.604)			
Intercept2		5.274**	(0.641)			
Intercept3		7.627**	(0.687)			
Intercept4		9.682**	(0.721)			
FS		0.289	(0.208)			
NFC		0.095	(0.198)			
Treatment		-0.728	(0.804)			
Appearance		0.018	(0.078)	Treatment×appearance	0.016	(0.117)
Color		0.022	(0.035)	Treatment×color	0.009	(0.049)
Aroma		0.085	(0.084)	Treatment×aroma	0.041	(0.130)
Flavor		0.571**	(0.103)	Treatment×flavor	-0.074	(0.141)
Texture		0.158	(0.105)	Treatment×texture	0.231	(0.146)
Sweetness		0.140**	(0.041)	Treatment×sweetness	-0.038	(0.054)
Acidity		0.127**	(0.039)	Treatment×acidity	-0.072	(0.051)
Pulp		0.123**	(0.029)	Treatment×pulp	-0.076	(0.040)
Likelihood Ratio	621.35**					
N	590					

** indicating significantly different from zero at the 0.05 level.

4. Discussion

Fresh squeezed (FS) orange juice is often preferred to processed (NFC and FC) orange juice in terms of flavor and aroma. The aroma of fresh squeezed orange juice has been perceived as one characteristic distinguishing it from processed orange juices (Buettner & Schieberle, 2001). The one-way ANOVA results (within the control group) indicated that consumers did not significantly distinguish the flavor ($p=0.39$) and aroma ($p=0.08$) of fresh squeezed orange juice but, they significantly distinguished the color ($p<0.0001$). This result seemingly indicated empirical evidence contradicting the popularity of fresh squeezed orange juice by Aparicio et al. (2007) and the general belief that the concentration process (diluting the juice with water and adding aqueous and oil essences) alters the flavor from fresh squeezed orange juice. Our result is more similar to the study by Moshonas and Shaw (1997), where hedonic flavor of freshly extracted juice could be significantly differentiated from heavily pasteurized juice but not from lightly pasteurized juice, implying that the processing level is an important factor for sensory analysis As Perez-Cacho and Rouseff (2008) noted, fresh juice odor from fruit picked directly from the tree and juiced within 24 hours would not be the same as supermarket fruit, and the aroma in the experiments may not make a strong impression on the participants. This may result from the effort of the fruit juice industry to improve quality. However, participants, in general, rated the color of FS orange juice as dark which was not

attractive to respondents. Wei, Ou, Luo, & Hutchings (2012) indicated that consumers were more likely to expect darker orange juice to be bitter.

The juicing process delivered both cognitive food cues (freshness) and physical food cues (olfactory/visual) at the same time. Demonstrating the juicing process primed consumers to distinguish color, aroma, flavor, and sweetness of differently processed orange juices. In particular, the effect was larger in fresh squeezed orange juice. Although the experiment did not provide particular orange juice information, participants in the treatment group might have been able to distinguish which one was fresh squeezed orange juice. Especially, the table top machine used in the survey had a transparent body and an open nozzle. Thus, participants might recognize the color and aroma of fresh squeezed orange juice among the presented samples when they returned to the interview area. Cognitive food cues of freshness (recognized through color) was reflected in increased sensory evaluations of fresh squeezed orange juice. This implies that the juicing process enhances the attributes of fresh squeezed orange juice which attract consumers. Internal attributes such as flavor, sweetness, acidity, and pulp were positively and significantly related to consumers' orange juice acceptance, whereas external attributes such as appearance and color did not considerably impact orange juice acceptance. This result implies that consumers' orange juice acceptance may be strongly linked to what they experience when drinking the orange juice. Thus, if individuals have a good impression of an orange juice, they may repeat purchasing that orange juice (McCluskey et al., 2007). This also implies the importance of consumers' juice brand loyalty.

Even though the juicing process did impact consumer evaluation of the sensory attributes, it was not enough to impact their acceptance for fresh squeezed orange juice. Fedoroff, Polivy, & Herman (2003) pointed out that even though food cues generally increased food intakes, the cue was only significantly effective when consumers had previously been cued with that food. Participants in the control group did not show significant special preference for fresh squeezed orange juice compared to processed orange juice. Extra effort such as demonstrating the juicing process seems to slightly influence consumer acceptance but remains unlikely to lead consumers to change their acceptance from processed to fresh squeezed orange juice. This finding may be consistent with the work of Köster and Mojet (2007) who suggest that initial reactions to sensory tests may not accurately reflect behavior because of the novelty and complexity of a product. In other words, although one product might be initially rated higher in a sensory test, this does not necessarily imply changes to purchasing behavior (especially over time). In this case, we immediately find no expected change in purchasing behavior, even with a slightly improved reaction in a sensory test.

Extending to cue specificity, external cues elicited cravings for specific foods (Fedoroff et al, 2003; Gaillet et al, 2013 and 2014). However, our findings reinforce that even though food related cues, such as freshness (cognitive cue) and olfactory (physical cue) cues for orange juice, create a desire for orange juice, the food cues may not lead to a specific kind of orange juice dominating consumer preferences when alternatives are almost homogenous. For instance, smelling pizza may increase the intention to eat pizza or pizza intake while not leading to consumption of specific kinds of pizza such as cheese pizza or pepperoni pizza.

Overall, this study indicated that implementation of the table top juicer in restaurants may not fully attract consumers to prefer fresh squeezed orange juice to processed orange juice. Even though consumers who are conscious of the freshness appear to prefer freshly squeezed orange juice, if consumers repeatedly experience both freshly squeezed orange juice and processed orange juice over the long term, they will eventually not differentiate attributes between the two.

5. Conclusions

Based on the experiments, this study examined the effect of demonstrating the juicing process on consumer senses and their acceptance for orange juices. Interestingly, consumers who did not observe the juicing process (no food-cues) did not clearly distinguish sensory attributes across orange juices with the exception of color. This result indicates that the juicing process may have developed to the point that human senses cannot differentiate attributes from freshly squeezed juice. Although some sensory evaluations for the cued food were increased due to the food cues (freshness and olfactory), consumer acceptance by the forms of orange juice was not significantly different. Rather, internal attributes such as sweetness, acidity, and pulp were more closely related to the probability of liking. This result implies that the importance of freshness is underwhelming given an absence of prior-cue for fresh squeezed orange juice.

Alternative measurements such as willingness-to-pay (WTP) may be more effective at discriminating among variants than a hedonic measurement and may capture the effect of the juicing process on WTP by those who already prefer the fresh squeezed product, although the juicing process did not encourage consumers who preferred other types of juice to switch their preferences. A limitation is the experimental design and method of

data collection. Ideally, to test response to an in-store juicer, the experimental design would occur in restaurants. Mall intercepts were used in place of in-store experiments in order to obtain a more representative sample, as well as due to budget constraints.

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