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Abstract: A non-hypothetical Becker–DeGroot–Marschak (BDM) auction-like mechanism was utilized to determine consumer characteristics, attitudinal factors, and product sensory attributes that affect willingness-to-pay (WTP) for a nutraceutical-rich juice blend (75%Concord+12%Pomegranate+13%Black Cherry). Participants (n=228) were recruited for a BDM mechanism that included four treatment groups: Info (received a potential health statement), Taste (evaluated the sensory attributes of the juice blend), InfoTaste (evaluated the sensory attributes of the juice blend and received the potential health statement), and Control (neither tasted nor received the potential health statement about the juice blend). As part of the post-auction questionnaire, participants completed incentivized risk and time preference survey tasks. The participants' average WTP for the nutraceutical-rich juice blend was $3.45/bottle. Average overall liking for all participants for the nutraceutical-rich juice was 7.42 (on a 9-point

scale), which indicated general consumer acceptance. The time preference coefficient (-8.87) indicated that higher time discount rates (lower future orientation) were associated with lower WTP within the Info group. Risk preference did not affect WTP. WTP increased by $0.25 for every unit increase in sweetness toward just-about-right (JAR) on the 5-point scale, $0.20 per every unit decrease in black cherry flavor toward JAR, and $0.29 per every unit decrease in bitterness toward JAR. Non-hypothetical WTP mechanisms offer realistic valuations and alternative insights about consumers and products.

Keywords: experimental auction, risk aversion, time preference, just about right, willingness to pay, optimization
JEL codes: D12; I10

Introduction

The food industry is striving to make healthier alternatives for the market due to increasing concerns among consumers about nutrition and health issues (Nayga, 2008). Determining the emphasis that consumers place on product attributes is a critical phase of product development. Consumers may assign differing importance to nutraceutical content and taste attributes, which may contribute to what the consumer is willing to pay for the product (Di Monaco et al., 2005). Thus methods which reveal the connection among sensory attributes, health-related characteristics, and willingness-to-pay and establishing the hierarchy of these impacts is beneficial to the product development process. Intergrating principles from behavioral economics with sensory evaluation can increase the scope of the sensory methodology.

Valuation tasks/mechanisms are techniques used by economists that seek to elicit consumers' true value of products in terms of dollars (Lusk and Shogren 2008). With valuation tasks, the maximum price point at which the consumer is willing to purchase the product is identified and this is known as willingness-to-pay (WTP). Valuation tasks can be hypothetical or non-hypothetical. Non-hypothetical valuation methods can be used to determine how consumers value specific product characteristics in a more realistic setting than is typically used in other forms of market research (e.g., choice designs) that are subject to hypothetical bias, which can

lead to inflated willingness-to-pay values (List & Gallet, 2001; Grebitus et al., 2013). Non-hypothetical methods of valuation allow participants to reveal more realistic willingness-to-pay values since the participant has to actually pay for the evaluated product if purchased (Harrison and Rutström, 2008).

Willingness-to-pay elicitation mechanisms have been used in many examples relating to food safety and nutrition such as determining the value of enhanced safety of infant formula and the nutrients in grass-fed beef (Lund et al. 2006, Goldberg et al. 2009, Xue et al. 2010). However, the integration of non-hypothetical valuation methods and sensory studies is less well-established. Feuz et al. (2004) estimated the impact of instrumental measures related to sensory attributes (i.e., shear force, % fat) beef on willingness-to-pay, which is notable because it initiates the use of non-hypothetical valuation tasks in understanding product attributes. Additionally, the literature contains examples of overall liking (i.e., overall acceptability) being measured during auctions along with WTP (Sitz et al. 2006; Sitz et al. 2005; Killinger et al., 2004; Lawless et al., 2012); however, great potential exists to expand sensory analysis in WTP studies. Specifically, the combined use of sensory evaluation and non-hypothetical valuation tasks to understand product diagnostics (i.e., recommendations for how the product should be improved) has great opportunity. For example, overall liking can be measured along with just-about-right questions to facilitate understanding of how a sensory attribute is important and how to adjust the attribute to increase willingness-to-pay. Penalty analysis is a method developed to determine the effect of attributes' intensities on overall liking, but can be adapted to determine how WTP is affected by specific sensory attributes (Meullenet, Xiong, & Findlay, 2007), which to these authors' knowledge, has not yet been attempted. This information may lend the advantages of non-hypothetical methods (e.g., lowered hypothetical bias and subsequently less inflated values) more directly to product optimization.

Consumer attitudes and characteristics that drive non-hypothetical willingness-to-pay can be calculated through regression techniques, which give researchers valuable information about their target consumer. A number of factors have been associated with purchase intent, acceptance, and WTP for nutraceutical-based products. These factors include attitudinal and demographic variables as well as health information on packaging (Onwezen and Bartels, 2011; Maynard and Franklin, 2003; Gadioli et al. 2013). A consumer's time preference or risk preference may also influence WTP for nutraceutical products. Time preference is a measure of

future orientation and is quantified with the time discount rate (Frederick et al. 2002). Higher time discount rates indicate less future orientation. Risk preference, on the other hand, simply measures the consumer's degree of aversion to risk. Risk preferences can be used to classify individuals as risk-averse, risk -neutral, or risk-loving.

Juice blends are a prime candidate for the growing nutraceutical market due to their inherent healthfulness and convenience. The objective of this research was to use behavioral economics with sensory evaluation techniques to identify consumer characteristics, attitudinal factors, and product sensory attributes that affect WTP for a novel nutraceutical-rich juice blend. Due to consumer trade-offs between health and taste, understanding consumer characteristics that drive purchase behavior is essential for health-oriented product categories. Consumer characteristics such as time and risk preferences have not yet been examined in the context of willingness-to-pay for nutraceutical-rich products. Furthermore, understanding the cost (in terms of consumer willingness-to-pay) of specific sensory attributes not being "optimal" may provide more concrete direction to product formulators because willingness-to-pay is less abstract than more common measures such as overall liking. Therefore, this research fills the void of the limited literature in this field.

Materials and Methods

Non-hypothetical auction-like mechanism

A type of non-hypothetical valuation task is an experimental auction, which can be used to elicit WTP through incentive compatible methods and simulate market situations in which consumers decide to buy a product and then purchase the product (Jaeger et al. 2004). Experimental auctions are incentive compatible because underbidding and overbidding in these methods are not advantageous. The non-hypothetical auction-like mechanism, the Becker–DeGroot–Marschak (BDM) was used to determine WTP. In the BDM mechanism, the participant formulates a bid which is compared to a price randomly drawn from a pre-determined range established by experimenters (Becker et al., 1964; Lusk and Shogren, 2008). If the participant's bid is greater than the price, he/she pays the price and receives the auction item, but if the participant's bid is lower than the price, he/she pays nothing and receives nothing. The BDM mechanism does not involve interaction with other subjects in the experiment, and it is possible that all participants could potentially buy a unit of the product (Noussair et al., 2004).

Time Discount Rates/Risk Preferences Assessments

To determine time discount rates, consumers completed a survey and were asked to make a series of choices between smaller, more immediate rewards and larger, delayed rewards (Coller and Williams. 1999, Harrison et al. 2002, Andersen et al. 2008). To motivate consumers to reveal their true preferences, a fraction of participants were selected to have one of their choices awarded. Conceivably, highly future-oriented individuals (those with low time discount rates) may be willing to pay more for health-maintaining products as these individuals may be more willing to invest in the present to maintain future health.

To determine risk preferences, individuals responded to a series of choices between two gambles, one riskier but with a potentially larger reward and one less risky with a smaller reward (Andersen et al. 2008, Holt and Laury 2002). Risk aversion refers to an individual's preference for a smaller, more certain reward rather than a larger, less certain reward. As the individual progresses through the exercise, the chance of receiving the larger gamble improves. The point at which an individual switches from the less risky gamble to the riskier one can be used as an indication of risk preference.

Product

The nutraceutical-rich juice blend product (75% Concord juice, 13% black cherry juice, and 12% pomegranate juice) auctioned in this experiment was produced based on consumer-oriented choice and mixture experimental designs in which the juice blend was optimized based on consumer perceptions of the tastes and health-oriented statuses of Concord, black cherry, and pomegranate juice blends (Lawless et al. 2013 a, b). Black cherry, Concord grape, and pomegranate juices used in this study have been shown to be polyphenol- and antioxidant-rich (Seeram et al. 2008). Black cherry, Concord grape, and pomegranate juice concentrates were reconstituted to 16.5% soluble solids, bottled, and pasteurized in the University of Arkansas Food Science Department, Fayetteville as described in (Lawless et al. 2012). The juice blend was pasteurized to 90°C in 32 oz (946 mL) glass bottles, sealed, and used for the study.

Testing Facility and Panelists

The experiment was performed at the University of Arkansas Sensory Service Center, Fayetteville, AR. Panelists (n=228) were recruited from the Sensory Service Center Database (n=5,636) based on juice consumption habits (three times per week) and liking of black cherries,

Concord grapes, and pomegranates. Panelists received monetary compensation in the form of a gift card for their participation; they were asked to bring $10 in case they had to purchase the juice.

Experimental Design

The moderator gave written and oral instructions and led a practice valuation task to familiarize consumers with the BDM mechanism. Since the BDM mechanism in this experiment was non-hypothetical, winners had to pay cash for the 32 oz (946 mL) bottles of a nutraceutical-rich juice. The BDM mechanism with two bidding rounds was used so that participants could learn more about their true WTP through experience with the mechanism (Shogren. 2006). The binding round was then randomly selected in each session. That is, to avoid demand reduction effects, only one of the two rounds was considered binding since no participant can purchase more than one unit of the product. Participants were not given information about what other people were bidding between rounds. The participants were given the reference prices for 32 oz (946 mL) bottles of a commercial 100% black cherry juice ($5.11), 100% Concord juice ($2.10), and 100% pomegranate juice ($8.57) for informational purposes. The nutraceutical-rich juice blend (75% Concord juice, 13% black cherry juice, and 12% pomegranate juice) was presented to the panelists.

For the BDM mechanism, a price distribution was established based on the endpoints of the highest and lowest reference prices ($2.10 and $8.57). For each session, a price was randomly drawn from this distribution. Participants who had WTPs higher than the drawn price in the binding round purchased the juice blend at the randomly drawn price. Participants who had equal or lower WTPs in the binding round compared to the drawn price did not purchase the product.

The experiment utilized a between-subjects design with four treatment groups (Figure 1). The experimental design included four sessions of each treatment with participants evenly distributed in each session, but make-up sessions were held for treatment groups with low-turnout. Treatment group 1 (Info) received a potential health statement written based on a previous research on a functional juice blend, "*This juice blend is rich in polyphenolic antioxidants, which are thought to support health"* (Lawless et al. 2012a). The statement was written to indicate that the literature suggests, but does not prove, the described benefit. Treatment group 2 (Taste) evaluated the sensory attributes of the juice blend. Treatment group 3

(InfoTaste) evaluated the sensory attributes of the juice blend and received the potential health statement. The order in which participants tasted the juice blend and received the potential health statement was balanced across sessions for this treatment group to control for the possibility of order effects. The control group (Control) neither tasted nor received the potential health statement about the juice blend. At the beginning of the experiment, all treatment groups (including the control group) received a product description as follows.

> *We will give you the opportunity to participate in an auction to obtain an optimized black cherry, Concord grape, and pomegranate juice blend. This juice blend was created from the help of consumers like you. Consumers tasted several juice blends made from these fruits. Consumers also received information about antioxidants for each of those juice blends. Based on that information, this optimized juice blend was created.*

After completing the juice valuation task, panelists completed a questionnaire that included a series of risk and time preference tasks (Appendix 1 and 2). The moderator explained that for each row, participants had to indicate whether they preferred Option A or Option B. The order of the risk and time preference tasks and the order in which each participant received the subtasks (3 month time horizon vs. 6 month time horizon, 1x risk task vs. 10x risk task) were randomized. The moderator informed the panelists that they had a 10% chance of having one of their preferences awarded. Consumers who were randomly selected received a gift card that represented their corresponding preferred amount and time point.

Panelists then completed post-auction questionnaires, which included a series of health-related statements. Respondents indicated their agreement to each statement based on a 5-point Likert scale anchored by *strongly disagree* and *strongly agree*. Demographics such as household size, age, income, education, marital status, employment status, and gender were included. Mood, exercise frequency, home inventory of juice, and fruit juice consumption habits questions were also asked because these may also affect willingness-to-pay.

Consumer sensory evaluation

Before beginning the BDM valuation task, Taste and TasteInfo treatment groups were served two oz (59 mL) of the juice blend to taste. Thus, when consumers were determining their

WTP for the juice blend, they were considering the juice's taste. During the post-auction questionnaire, consumers evaluated overall liking for the juice blend with the 9-point verbal hedonic scale and diagnostic variables with 5-point just-about-right scales (JAR). The context of the overall liking scores evaluated by the participants was based on participants' treatment group. For Taste and InfoTaste groups, participants evaluated overall liking regarding the product based on a description of the optimization process and the sensory evaluation. Since subjects in the Taste and Infotaste groups tasted the product, they completed diagnostic just-about-right questions, which examined if the levels of sweetness, sourness, pomegranate flavor, Concord grape flavor, black cherry flavor, astringency, bitterness were each just-about-right, too much, or too little. Just-about-right questions have previously been used to assess the appropriateness of attribute levels (Vázquez-Araújo et al., 2010). Info and Control groups evaluated overall liking on the 9-point hedonic scale. For these groups (Info and Control), overall liking scores were elicited based on a description of the optimization process and antioxidant information (for the Info group only); consumers in these groups did not taste the product.

Statistical analysis

Treatment groups were initially compared with t-test analysis (JMP 9.0.2, Cary, NC). Initial analysis included hierarchical cluster analysis with Ward's criterion, which did not reveal segmentation for WTP or overall liking based on agreement to potential health statements (JMP 9.0.2, Cary, NC). WTP data analysis was divided into two main parts, 1) *WTP regression modeling*, which identified consumer characteristics that drive WTP and 2) *Calculating the Penalty in Dollars and the Penalty in Overall Liking for Variables not JAR,* which established the specific sensory attributes most responsible for increasing or decreasing overall liking and WTP.

WTP Regression Modeling. Regression techniques can be used by researcher to determine drivers of WTP while controlling for covariates (e.g., gender, income) that may affect WTP results. Random effects regression was used due to the panel nature of the data. The covariates in the random effects regression model included relative risk aversion, discount rates, treatment variables (Taste, Info, InfoTaste, Control) and other variables that could potentially influence WTP (Stata 11.0, College Station, TX). Relative risk aversion and discount rates were estimated from a joint estimation model of risk and time preferences. The procedures followed are similar to Andersen, Harrison, Lau and Rutstrom (2008) which showed that it is essential to have one

experimental task for measuring the curvature of the utility function (risk preference task), another task to identify the discount rate (time preference task) conditional on knowing the utility function, and then jointly estimate the structural model defined over the parameters of the utility function and discount rate. The routines made available as a supplemental material in Andersen, Harrison, Lau and Rutstrom (2008) were used in this analysis with appropriate modifications.

Calculating the Penalty in Dollars and the Penalty in Overall Liking for Variables not JAR. To determine how an attribute not being optimal (i.e., not being JAR) affects WTP and overall liking, two partial least squares regression models (PLSR) were used on data elicited from treatments groups who tasted the product (Taste and InfoTaste). For each participant, WTP was averaged from rounds 1 and 2 to parallel how overall liking means are used in traditional penalty analysis (Meullenet, Xiong, & Findlay, 2007). All PLSR models contained JAR variables converted to continuous variables, as developed by (Xiong and Meullenet. 2006). Conversion to *too little* and *too much* dummy variables is necessary because the middle category (just-about-right) of the 5-point JAR scale is the ideal response. In contrast, the ideal category of the 9-point hedonic scale is the highest category (like extremely). In the conversion process, responses valued 4 and 5 on the *too much* side of the JAR attribute are changed to 1 and 2 respectively (as illustrated for sweetness in Figure 2). All other responses become 0 for the *too much* dummy variable. For the *too little* dummy variable, JAR responses valued at 1 and 2 are converted to -2 and -1 respectively, and all others become 0 (illustrated in Fig. 2).

Results and Discussion

The BDM mechanism was used to identify consumer attributes and attitudinal factors that affected WTP for a nutraceutical-rich juice blend. There were four treatment groups in the BDM mechanism, Info (received a potential health statement), Taste (evaluated the sensory attributes of the juice blend), InfoTaste (evaluated the sensory attributes of the juice blend and received the potential health statement), and Control (neither tasted nor received the potential health statement about the juice blend). The average participant was younger than 35 years old, college-educated, and married or had a partner (Table 1).

The participants' average WTP for the nutraceutical-rich juice blend was $3.45/bottle. The average WTP for nutraceutical-rich juice blend was $3.65/bottle for the Info group,

$3.51/bottle for the Taste group, $3.28/bottle for the InfoTaste group and $3.39/bottle for the Control group. Average overall liking for all participants for the nutraceutical-rich juice was 7.42, which indicated general consumer acceptance. The average overall liking for nutraceutical-rich juice blend was 7.61 for the Taste group, 7.0 for the InfoTaste group, 7.45 for the Info group, and 7.65 for the Control group.

WTP Regression Modeling

Random effects regression was performed using relative risk aversion, discount rates, treatment variables (Taste, Info, InfoTaste, and Control) and other covariates that could influence WTP (Table 2). Overall liking scores of 7 or above were significant and positive predictors of WTP; i.e., WTP increased as scores increased. Overall liking scores have previously been shown to be significant predictors of willingness-to-pay (Kukowski et al. 2005, Stefani et al. 2006, Umberger and Feuz. 2004).

The regression results also indicated that participants in the Info treatment have higher WTP than those in the control group. The Info treatment group received potentially positive information about the product through the health statement . Positive information about an antioxidant-enriched wax coating increased WTP for apples (Markosyan et al. 2009), and information about bioactive compounds extracted from grape skins increased consumer acceptance for extract-infused tea (Cheng et al. 2010).

An interaction effect between the Info treatment and time preference was observed (Table 2). The direction of the coefficient (-8.87) indicated that higher time discount rates were associated with lower WTP within the Info group. In other words, individuals in the Info treatment with less future orientation were generally willing to pay less than those with higher future orientation in the Info treatment. Individuals with less future orientation may not be as protective of their health as those with more future orientation and thus are willing to pay less for health-protective products. While the associations between time discount rates and WTP have been studied (Johannesson and Johansson. 1996,Bond et al. 2009,Sunstein. 2004,Johannesson and Johansson. 1997), the effect of time preference on WTP for nutraceuticals had not yet been examined until this study.

Although one might expect risk-averse individuals to be willing to pay more for health-protective products, risk preference was not a significant predictor of WTP. Consumers generally consider eating a positive experience (Desmet and Schifferstein. 2008,King and

Meiselman. 2010) and may not consider it as a risky activity vis-à-vis other types of activity such as smoking, flying, etc. Results have implications in marketing strategy. Highly future-oriented individuals presumably most concerned about living longer, healthier lives are especially receptive of messages containing health information; however, according to the current research, those wishing to avoid risk are not affected and should not necessarily be targeted.

Home inventory was a significant covariate in the random effects model. Households that had at least 14 days worth of juice or more had lower WTP than households with less juice. Demographic variables such as income and gender did not significantly affect WTP for the nutraceutical-rich juice blend, but have been a factor in other studies (Umberger and Feuz. 2004,Lange et al. 2002,Bernard and Bernard. 2009)). Attitudinal variables were stronger predictors of WTP than demographics.

Penalty in Dollars and Penalty in Overall Liking for Variables not JAR

To elicit the effect of an attribute not being optimal (i.e., not being JAR) on WTP and on overall liking, two partial least squares regression models (PLSR) were used on data elicited from treatments groups who tasted the product (Table 3). Identifying the penalty in dollars for attributes not being optimal is beneficial because it connects WTP to specific sensory attributes. Additionally, it could potentially help product developers to better understand the cost associated with their product not being optimal. The Taste and InfoTaste treatments did not affect WTP when covariates were controlled, which validated the PLSR analysis. Patterns were similar for WTP and overall liking when treatment groups were combined. Reductions in overall liking and WTP occurred because of too little sweetness, too much black cherry flavor, and too much bitterness. Reductions in overall liking also occurred because of too much sourness.

Coefficients indicated the magnitude of the effect on the response variable. For example, the 1.16 *not sweet enough* coefficient for combined groups' overall liking indicated that for every unit of increasing sweetness over the *too little* region (1 to 3), overall liking increased by 1.16 (Figure 3). For the same groups and attribute, WTP increased $0.25 for every unit increase in sweetness over the *too little* region. The near 0 *too sweet* coefficients for overall liking and for WTP indicate that the product is not too sweet and that this side of the JAR scale is not where sweetness should be adjusted. To facilitate understanding of Table 3, Figure 3 provides a visual of how overall liking and WTP shift as the product's sweetness moves on the JAR scale. In the case of sweetness, the product developer's goal would be to adjust sweetness two units upward

on the JAR scale. Regarding black cherry flavor, overall liking decreased 0.67, and WTP decreased $0.20 over the *too much* region (3 to 5). Finally, for every unit of too much bitterness, overall liking decreased 0.48 and WTP decreased $0.29. Overall, the product developer would use this information to determine if the product should be sweeter, have less black cherry flavor, and have less bitterness. He or she would also have an idea of which these attributes had the largest "penalty" when that attribute was not optimal. In this case, sweetness has the highest penalty for overall liking, and bitterness has the highest penalty for WTP.

Patterns for InfoTaste+Taste, InfoTaste, and Taste treatment groups varied slightly for both WTP and overall liking. Concerning WTP, three attribute sets were significant in InfoTaste+Taste, two in InfoTaste, and 0 in Taste. For overall liking, four attribute sets were significant in InfoTaste+Taste, three in InfoTaste, and two in Taste. The discrepancies could be contributed to the statistical power of the analysis. Student's t-test analysis did not show differences between treatment groups for any of the JAR dummy variables. Increasing statistical power by combining similar groups could have more easily produced variable significance.

Calculating the penalty in dollars instead of overall liking has implications for the product development process (Fig. 3). WTP is measured in a monetary, globally understood unit, whereas the concept of overall liking is more abstract. Other authors have observed higher discrimination with WTP bids than with hedonic scores (Lange et al. 2002). Higher discrimination levels are expected because participants conceptualize their own WTP, whereas overall liking is typically measured in a provided, categorical scale. End of scale avoidance further reduces the discriminatory power of the scale. Lange, Martin, Chabanet, Combris, & Issanchou (2002) also point out that WTPs of 0 clearly indicated that the participant has no intention of purchasing the product, while low overall liking scores are not clearly related to purchase intent. Moreover, the method proposed in the current study suggests that some variables important to overall liking are not important to WTP; thus, using WTP as the response variable may more easily identify the most important variables.

Conclusions

Due to the importance of nutrition and health to consumers, there is now an increasing demand for nutraceutical-rich food products. However, limited information is available on the factors that affect consumers' preferences and valuation for these products. In this study, a non-hypothetical mechanism was used to examine the effect of various factors, including those that

have not yet been directly examined in the past (i.e., risk and time preferences), on consumers' willingness to pay for a new nutraceutical-rich juice blend product. Results suggest that information about potential health information associated with a nutraceutical-rich juice blend increased WTP, which reinforced previous work that showed consumers respond positively to product health information. When given potential health information, individuals with less future orientation (i.e., higher time discount rates) were willing to pay less than those with more future orientation. Hence, functional food benefit information could be incorporated in marketing messages that emphasize protecting health. Moreover, findings imply that novel functional food products could be targeted to those who have lower time discount rates (i.e., those who are more future-oriented).

The method utilized in this study to identify variables not "optimal" could potentially provide more concrete direction to product developers than traditional penalty analysis because monetary units are less abstract than overall liking. Future research could entail validation of the method with a wider range of products than was tested in this study.

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Table 1. Demographic Summary of Panelists[a]

	Gender				
	Female	Male			
Control	36	19			
Info	37	16			
InfoTaste	41	22			
Taste	39	18			
Total	**153**	**75**			
	Domestic Status				
	Married/Partner	Single	Other		
Control	32	19	4		
Info	35	17	1		
InfoTaste	38	25	0		
Taste	28	29	0		
Total	**133**	**90**	**5**		
	Age				
	18-35	35-54	55+		
Control	18	24	13		
Info	19	24	10		
InfoTaste	29	22	12		
Taste	29	18	10		
Total	**95**	**88**	**45**		
	Education[b]				
	High School	Some College	2-year College Degree	4-year College Degree	Graduate Degree
Control	10	10	6	21	8
Info	10	18	3	9	13
InfoTaste	7	17	2	20	17
Taste	3	20	3	17	14
Total	**30**	**65**	**14**	**67**	**52**

[a]Info (n=53) group received the potential health information, "*This juice blend is rich in polyphenolic antioxidants, which are thought to support health"*, Taste (n=57) group completed the sensory evaluation of the juice blend, InfoTaste (n=63) group received the potential health information and completed the sensory evaluation, and Control (n=55) group did not receive potential health information and did not complete the sensory evaluation.

[b]Highest level of education completed

Table 2. Random effects regression modeling on willingness-to-pay for a nutraceutical-rich juice blend

		Coefficient	Standard Error	Z-value	P>|z|[b]
Overall Liking	3	2.10	1.91	1.10	0.270
	4	0.89	1.92	0.46	0.642
	5	2.42	1.76	1.38	0.168
	6	2.06	1.69	1.22	0.224
	7	2.99	1.66	1.80	0.071
	8	3.17	1.65	1.92	0.054
	9	4.30	1.69	2.55	0.011
Treatment[a]	Info	3.58	1.78	2.01	0.045
	InfoTaste	0.66	1.78	0.37	0.712
	Taste	0.18	1.76	0.10	0.918
Risk		2.15	1.55	1.39	0.165
Risk*Treatment	Info	-3.68	2.43	-1.52	0.129
	InfoTaste	-1.91	2.38	0.80	0.424
	Taste	0.41	2.46	0.17	0.868
Time		4.67	3.29	1.42	0.155
Time*Treatment	Info	-8.87	5.15	-1.72	0.085
	InfoTaste	-2.39	5.14	-0.46	0.642
	Taste	-0.44	5.05	-0.09	0.931
Round		0.05	0.03	1.59	0.113
Income	$20-29999	-0.27	0.57	-0.47	0.636
	$30-39999	-0.04	0.58	-0.07	0.942
	$40-49999	-0.37	0.64	-0.57	0.569
	$50-59999	-0.34	0.62	-0.56	0.579
	$60-69999	-0.21	0.64	-0.33	0.741
	$70-79999	-0.29	0.59	-0.49	0.625
	$80-89999	1.01	0.68	1.49	0.137
	$90-99999	-1.11	0.84	-1.32	0.186
	More 100K	0.17	0.70	0.25	0.802
	Under 15K	-0.82	0.56	-1.46	0.145

Gender[c]	0.43	0.33	1.28	0.200
Home Inventory (>14 days)	-0.98	0.39	-2.52	0.012

[a]Info (n=53) group received the potential health information, "*This juice blend is rich in polyphenolic antioxidants, which are thought to support health"*, Taste (n=57) group completed the sensory evaluation of the juice blend, InfoTaste (n=63) group received the potential health information and completed the sensory evaluation, and Control (n=55) group did not receive potential health information and did not complete the sensory evaluation.

[b]Shading indicates significance of the effect at $\alpha<0.10$

[c]Gender Dummy (1=male)

Table 3. Partial least squares regression modeling on willingness-to-pay (WTP) from and overall liking for converted just-about-right variables for a nutraceutical-rich juice blend

Treatment [a]	InfoTaste + Taste		InfoTaste		Taste	
	WTP	Overall Liking	WTP	Overall Liking	WTP	Overall Liking
Intercept	$3.56	8.23	$3.44	7.7	$3.66	8.33
Too Sweet	0.03	-0.04	-0.03	0.06	0.12	-0.44
Not Sweet Enough	0.25[b,c]	1.16	0.25	0.84	0.32	1.15
Too Sour	-0.09	-0.56	-0.12	-0.59	-0.32	-0.59
Not Sour Enough	-0.03	0	-0.06	-0.03	-0.05	-0.23
Too Much Pom Flavor	-0.03	-0.39	-0.11	-0.17	0.37	-1.51
Not Enough Pom Flavor	0.08	0.13	0	-0.06	0.14	0.28
Too Much Concord Flavor	0.1	-0.34	-0.07	-0.17	0.25	-0.05
Not Enough Concord Flavor	0.11	0.45	0.16	0.28	0.03	0.13
Too Much BlkCh Flavor	-0.2	-0.67	-0.29	-0.7	-0.31	-0.01
Not Enough BlkCh Flavor	-0.06	0.24	-0.17	-0.14	-0.01	0.23
Too Astringent	-0.13	0.1	-0.18	-0.17	0.17	0.08
Not Astringent Enough	-0.02	0.15	0.04	-0.03	-0.19	0.88
Too Bitter	-0.29	-0.48	-0.23	-0.59	-0.6	0.26
Not Bitter Enough	-0.06	0.12	-0.16	0.06	-0.07	-0.37

[a]Taste (n=57) group completed the sensory evaluation of the juice blend, InfoTaste (n=63) group received the potential health information, "*This juice blend is rich in polyphenolic antioxidants, which are thought to support health,* and completed the sensory evaluation. Pomegranate (Pom), Concord (Con), Black Cherry (BlkCh). These are the only two treatment groups who tasted the product.

[b]Shading indicates significance of the variable in the Partial Least Squares Regression model at $\alpha<0.05$

[c]Student's T-test models with treatment as x-variable and either overall liking, average WTP, or Just-About-Right dummy variables as y-variables indicated differences between treatment groups for overall liking only (Infotaste: 7.0, Taste: 7.6).

Appendix 1. Time Preference Tasks

Task A: Please choose which option you prefer for each row in the table below (3 months interval):

Option A		Option B		Interest rate
$300 in one month		$304 in 4 months		5%
$300 in one month		$308 in 4 months		10%
$300 in one month		$311 in 4 months		15%
$300 in one month		$315 in 4 months		20%
$300 in one month		$319 in 4 months		25%
$300 in one month		$323 in 4 months		30%
$300 in one month		$326 in 4 months		35%
$300 in one month		$330 in 4 months		40%
$300 in one month		$334 in 4 months		45%
$300 in one month		$338 in 4 months		50%

Task B: Please choose which option you prefer for each row in the table below (6 months interval):

Option A		Option B		Interest rate
$300 in one month		$308 in 7 months		5%
$300 in one month		$315 in 7 months		10%
$300 in one month		$323 in 7 months		15%
$300 in one month		$330 in 7 months		20%
$300 in one month		$338 in 7 months		25%
$300 in one month		$345 in 7 months		30%
$300 in one month		$353 in 7 months		35%
$300 in one month		$360 in 7 months		40%
$300 in one month		$368 in 7 months		45%
$300 in one month		$375 in 7 months		50%

Payoff

To determine winners and payoffs, one of the two tasks will be randomly selected as binding.

If **Task 3** is selected as binding, one of the rows will be selected as binding and subject's choice will be realized with 10% chance across all tasks.

If **Task 4** is selected as binding, one of the rows will be selected as binding and subject's choice will be realized with 10% chance across all tasks.

Appendix 2. Risk Preference Tasks

Task A: Please choose which option you prefer for each row in the table below:

Option A		Option B	
10% chance of winning $2, 90% of winning $1.60		10% chance of winning $3.85, 90% of winning $0.10	
20% chance of winning $2, 80% of winning $1.60		20% chance of winning $3.85, 80% of winning $0.10	
30% chance of winning $2, 70% of winning $1.60		30% chance of winning $3.85, 70% of winning $0.10	
40% chance of winning $2, 60% of winning $1.60		40% chance of winning $3.85, 60% of winning $0.10	
50% chance of winning $2, 50% of winning $1.60		50% chance of winning $3.85, 50% of winning $0.10	
60% chance of winning $2, 40% of winning $1.60		60% chance of winning $3.85, 40% of winning $0.10	
70% chance of winning $2, 30% of winning $1.60		70% chance of winning $3.85, 30% of winning $0.10	
80% chance of winning $2, 20% of winning $1.60		80% chance of winning $3.85, 20% of winning $0.10	
90% chance of winning $2, 10% of winning $1.60		90% chance of winning $3.85, 10% of winning $0.10	
100% chance of winning $2, 0% of winning $1.60		100% chance of winning $3.85, 0% of winning $0.10	

Task B: Please choose which option you prefer for each row in the table below:

Option A		Option B	
10% chance of winning $20, 90% of winning $16		10% chance of winning $38.50, 90% of winning $1	
20% chance of winning $20, 80% of winning $16		20% chance of winning $38.50, 80% of winning $1	
30% chance of winning $20, 70% of winning $16		30% chance of winning $38.50, 70% of winning $1	
40% chance of winning $20, 60% of winning $16		40% chance of winning $38.50, 60% of winning $1	
50% chance of winning $20, 50% of winning $16		50% chance of winning $38.50, 50% of winning $1	
60% chance of winning $20, 40% of winning $16		60% chance of winning $38.50, 40% of winning $1	
70% chance of winning $20, 30% of winning $16		70% chance of winning $38.50, 30% of winning $1	
80% chance of winning $20, 20% of winning $16		80% chance of winning $38.50, 20% of winning $1	
90% chance of winning $20, 10% of winning $16		90% chance of winning $38.50, 10% of winning $1	
100% chance of winning $20, 0% of winning $16		100% chance of winning $38.50, 0% of winning $1	

Payoff

To determine winners and payoffs, one of the two tasks will be randomly selected as binding.

If **Task 1** is selected as binding, one of the rows will be selected as binding and subject's choice will be realized with 10% chance across all tasks.

If **Task 2** is selected as binding, one of the rows will be selected as binding and subject's choice will be realized with 10% chance across all tasks.

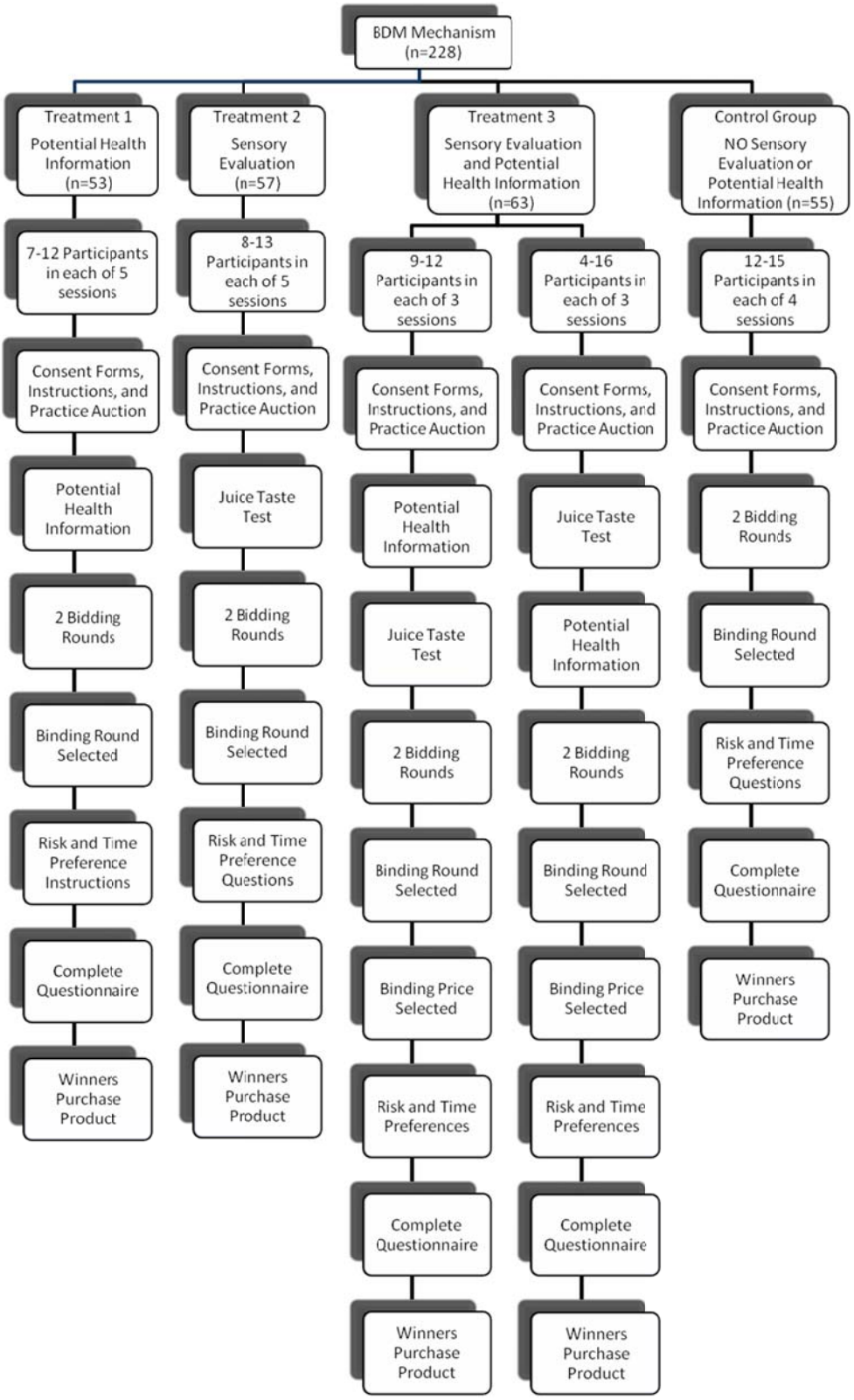

Fig. 1. Becker–DeGroot–Marschak (BDM) mechanisms treatment design to evaluate a nutraceutical-rich juice blend

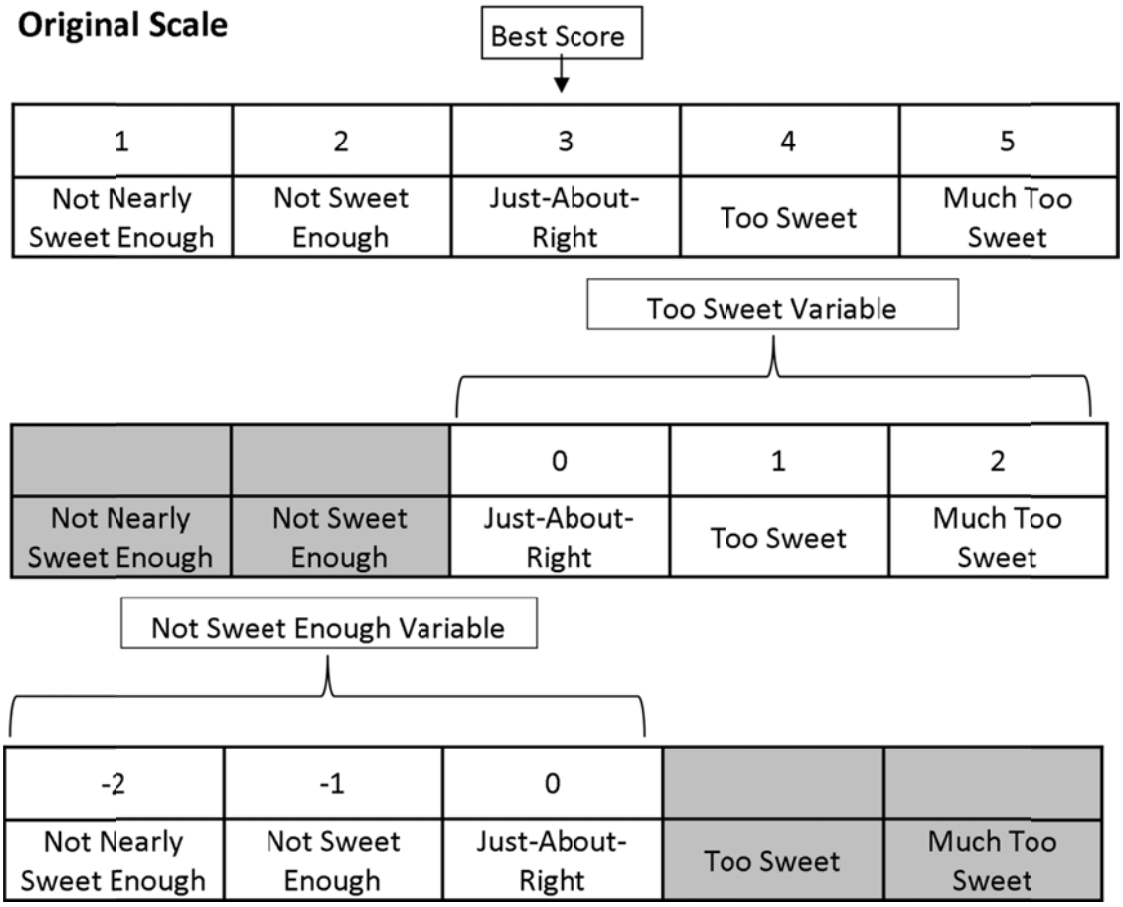

Fig. 2. Conversion of just-about-right scale for the sweetness attribute

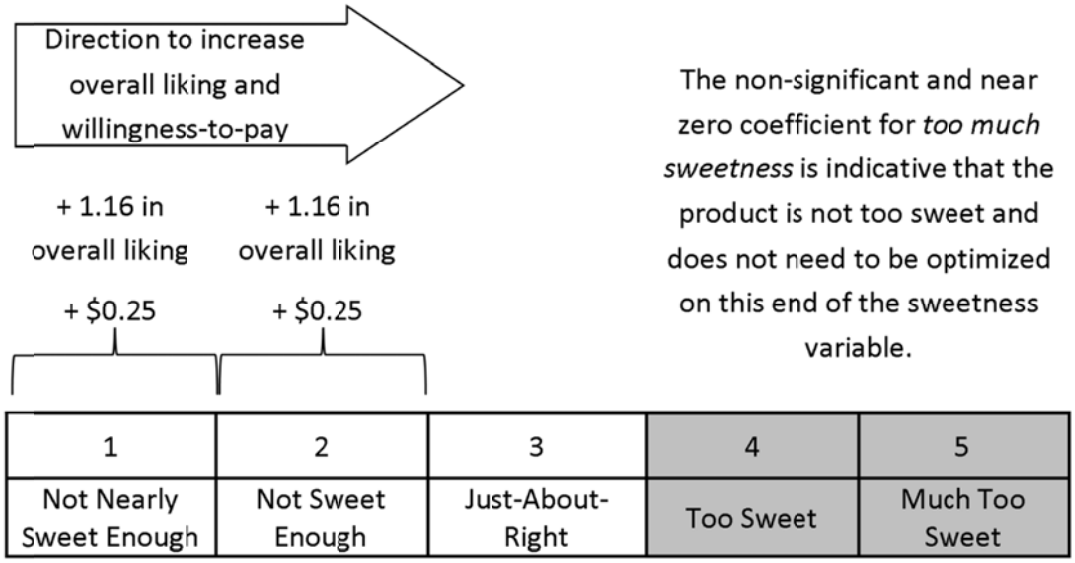

Fig. 3. Penalty analysis of sweetness based on scores from combined treatment groups