INCORPORATING TASTING INTO AN EXPERIMENTAL AUCTION

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Introduction

Many food companies are interested in determining if key product attributes enhance consumers’ perception of value (Menkhaus, 1992). Traditional research techniques, such as surveys, focus groups, test markets, and purchase intent questions have been used to assess the consumer appeal of new products. However, in recent years, experimental auctions have become a popular approach to elicit value information for economic research of food products (Umberger, 2004). Experimental auctions are considered better indicators of product purchase intent than previous techniques because economic consequences are enforced.

Although the sensory properties of a food product can significantly affect purchase decisions, few experimental auction protocols have incorporated product tasting. Previous studies incorporating product tasting have primarily done so by first introducing product information followed by product consumption. A consequence of this method is that the product information may influence the subjective tasting experience. Research assessing consumer liking has shown that liking ratings can be biased by consumer expectations based on prior information about the products (Lee et al., 2006; McClure et al., 2004; Makens, 1965). Our objective was to determine how the order of information presented to panelists in an experimental auction affects bidding prices. We specifically wanted to investigate the relative difference in bidding prices between people who taste organic and conventionally grown apple samples before observing displays with information about the apples and people who observe the information before tasting the apples.
1. Literature Review

1.1 Consumer Willingness to Pay

Many factors influence the price consumers are willing to pay for a product. These include intrinsic factors, such as taste, aroma, flavor and texture, as well as extrinsic factors, such as information on price, brand name, nutrition, packaging, origin, environmental impact, use of genetically modified organisms, safety, organic label, and production ethics (Stefani, 2006; Napolitano, 2010; Lange, 2002). These factors interact to determine a consumer’s perception and willingness to pay for a product. One strategy for understanding the amount consumers are willing to pay for a product with specific factors or attributes is by conducting an experimental auction.

1.1.1 Experimental Auctions

In an experimental auction, consumers are placed in a situation where real money is exchanged for real products. In terms of procedure, experimental auctions are conducted as group sessions. During the session, products are presented to the group and each panelist records the amount of money he/she is willing to pay in exchange for each of the products. Each of the panelists’ bid amounts are kept private from other panelists. Based on the collected bids, one or several identified buyers are required to pay money in exchange for the products. Multiple auction rounds may be in place where different product attributes are disclosed in each auction round. After each disclosure, panelists are asked to place a new bid on the product (Nalley, 2004, Combris 2009).

The core idea of experimental auctions is that choices and preferences declared by participants during a test must have an economic impact. That is, once the experiment is
over, participants must know that they have to face the economic consequences of their decisions and potentially purchase products (Combris, 2009). Experimental auctions are considered advantageous over other methods of determining consumer willingness to pay (WTP) because economic consequences are enforced. Panelists may declare strong preferences and purchase intent for products with high perceived quality with other methods determining consumers WTP; however, panelists may not actually purchase these products when placed under economic constraints (Lange, 2002).

1.1.2 Vickrey Auction Procedure

The Vickrey n\textsuperscript{th} price uniform auction has been a widely used experimental auction mechanism to assess consumers’ WTP for real goods (Combris, 2009; Umberger, 2004). The principle of an n\textsuperscript{th} price Vickrey auction consists of asking individuals to submit the maximum price they would be willing to pay for a particular product. The winners of the auction are the highest bidders. These bidders actually have to pay for the product. The price the winners pay, however, is not their individual bid amount. Instead, they pay the nth highest price. For example, suppose six panelists were participating in a fourth-price Vickrey auction and they placed the following bids on a product: $2.00, $1.90, $1.80, $1.70, $1.60, and $1.50. The winning panelists would be those who placed the three highest bids. However, they wouldn’t purchase the product at their individual bidding prices, they would purchase the product at the fourth highest price, $1.70. The nth price or the numerical selection of “n” can be determined randomly during the auction session, or determined by the experimenter prior to the study.
Using this procedure gives participants an opportunity to buy a product at a price lower than, or at the most, equal to the value they were willing to pay (Lange, 2002). With the Vickrey auction mechanism, people have an incentive to truthfully reveal their private preferences because consumers who underbid risk forgoing a profitable purchase, while consumers who overbid risk overpaying for the item (Vickrey, 1961).

Rather than determining the winners for each product within each auction round, many researchers take the approach of randomly choosing one product and one auction round in which bids are effective and from which the winners are determined (Lange, 2002; Combris, 2009; Yue, 2009; Chern, 2003; Nalley, 2006). This ensures that one panelist cannot win all products and prevents strategic behavior leading subjects to submit exceptionally high prices only in the auction round they prefer.

1.1.2 Previous studies combining Vickrey $n^{th}$ price experimental auctions and product tasting

Studies that have combined experimental auctions with product tasting have done so in a variety of ways. Several studies have used a single round experimental auction to elicit consumer willingness to pay based only on the sensory properties of a product when other extrinsic factors were unknown (Umberger, 2002; Killinger, 2004). Other studies have used multiple auction rounds to reveal different product information in each round and in one of the auction rounds panelists tasted the products (Chern, 2003; Nalley, 2006; Melton, 1996; Lang, 2002; Combris, 2009; Napolitano, 2008). This literature review discusses auctions that have combined tasting within a single auction round as well as within a multi-round auction.
Studies using a single round experimental auction to elicit consumer willingness to pay for product sensory properties found that consumers who indicated a product preference, based on overall acceptability ratings, were willing to pay more for the product that they preferred. Umberger et al. (2002) used an experimental auction to measure consumers’ willingness to pay for the sensory properties of domestic, corn-fed beef versus Argentine, grass-fed beef. After consumers tasted each steak sample, they rated the sample on sensory traits and then bid on each steak. Based on overall acceptability ratings, consumers were willing to pay a premium for their preferred steak. Sixty-two percent of consumers preferred the domestic beef compared to the Argentine beef and were willing to pay an average of $1.61 more per pound for their preference. Twenty-three percent of consumers preferred the Argentine sample compared to the domestic sample and were willing to pay an average of $1.36 more per pound for their preference. Additionally, consumers with strong preferences generally had a larger bid differential between the two samples. Killinger et al. (2004) examined consumer sensory acceptance and value of beef strips differing in marbling level but similar in tenderness using a Vickrey auction mechanism. Based on overall acceptability ratings, consumers were categorized into three groups: 1) those who consistently found high marbling more acceptable, 2) those who consistently found low marbling more acceptable, and 3) those who were indifferent. Consumers who found high-marbled steaks more acceptable and those who found low-marbled steaks more acceptable were willing to pay more for the product they found more acceptable. Additionally, bids were highly correlated with overall acceptability ratings.
Studies consisting of multiple auction rounds to reveal different product information, including product sensory properties, demonstrate that the sensory properties of food products have a large influence on consumer willingness to pay. Chern et al. (2003) used a second-price Vickrey auction to elicit consumers’ WTP for four types of orange juice differing in processing technique. The study consisted of two auction rounds. In the first round, participants received descriptions of the main characteristics of each product, including processing technique, and were allowed to inspect the products visually. In the second round, participants were allowed to taste the four types of orange juice. Despite the positive aspects described for the novel pulsed electric field (PEF) processing technique, bids for the PEF juice declined significantly between auction rounds by 17% ($0.46) after tasting.

Nalley et al. (2006) also found significant differences between consumers’ WTP for sweet potatoes before and after tasting. Three auction rounds were conducted based first on visual inspection, then taste, and finally health information. Subjects participated in one of two experimental auction treatments in which location of origin was unknown or location of origin was known for the first auction round. For two out of three products tested, there was a significant decrease in WTP between the visual inspection and tasting conditions for the unknown-location of origin treatment group. In the treatment group in which the location was known, there was a statistically significant negative impact for only one of the products.

Melton et al. (1996) demonstrated that predicting consumer demand for fresh pork chops based on photographs without tasting is unproductive. A second-price Vickrey
auction was used to determine consumers’ WTP for pork chops varying in color, marbling, and size under three situations: while viewing photographs of the pork chops, while inspecting fresh chops, and after tasting freshly cooked product corresponding to the fresh chops. There were significant differences between pre- and post consumption WTP for pork chops when pictures were used for visual appraisals, but no significant differences when the actual products were used in visual inspection.

Combris et al. (2009) used an experimental auction procedure to evaluate the effects of sensory characteristics and label information on consumer’s WTP for Chardonnay wines. Two groups of panelists participated in the experiment: participants selected from the general population and a group of sensory experts. Panelists participated in sequential auction rounds: first to assess their WTP for the wines based on label information, and second to assess WTP on label information in conjunction with product tasting. There was not a significant difference in the mean bid prices for each wine between the auctions for the general population, but there were significant differences between conditions by the sensory experts. After examination of the product labels, bids from the sensory experts were highest for the label with “Appellation of Origin” information. However, after product tasting, WTP decreased to amounts that did not represent significant differences in bid prices between the samples. The authors concluded that participants are sensitive to labels, but when fully informed they relied more on their sensory evaluations than on the labels.

Napolitano et al. (2008) used an experimental auction to verify whether consumers are willing to pay extra costs for higher animal welfare standards. Consumers
were asked to rate their WTP for plain and low-fat yogurts when presented with information about animal welfare for each of the samples and when tasting the products with the information still visible. Information about animal welfare was provided using labels indicating the level of animal cleanliness and freedom of movement. Consumers expressed a higher WTP for products with labels indicating high welfare standards as compared to yogurts with labels reporting intermediate and low welfare standards. However, consumers lowered their WTP after tasting for the low-fat yogurts that indicated high welfare standards. The authors concluded that consumers would be willing to pay more for higher animal welfare standards only when they find the sensory properties of the products acceptable.

Lange et al. (2002) incorporated product tasting into an experimental auction to compare consumer WTP to hedonic measurements for five brut non-vintage Champagnes. Consumers evaluated the Champagnes in three information conditions: first tasting of the products without external information, second presenting external information about the products without connection to the prior tasting experience, and lastly tasting the products while observing the information presented in the prior condition. When the distributions of prices and hedonic scores were compared under the same information conditions, results indicated that fewer high prices than high scores were submitted; however, the two methods lead to the same hierarchy of Champagnes.
1.2 The influence of conceptual information on consumer preferences

Previous research has found that conceptual information has an influence on subjective experiences. In a study by Lee et al. (2006), patrons of a pub evaluated a regular beer and a beer with a low concentration of balsamic vinegar in one of three conditions. The first group tasted the samples blindly while the second and third groups were informed of the added vinegar either before or after tasting the samples. The balsamic vinegar was a beer flavoring that most participants found conceptually offensive, but at the concentration added, actually improved the flavor. When the information about the added vinegar was disclosed before product tasting, only 30% of participants preferred the beer with added vinegar. When the information was disclosed after tasting, 52% of participants showed a preference for the beer with vinegar. The percent of participants showing a preference for beer with the added ingredient in the after condition was not significantly different from the percent of participants indicating a preference for it in the blind condition. The authors suggested that disclosure of the information affected panelist preferences by influencing the experience itself. Makens (1965) also found that a well-known brand name of turkey positively affected taste preference. Participants were asked to taste two samples that were taken from the same roasted turkey. Fifty-six percent of participants indicated they preferred the well-known brand, 34% of participants indicated they preferred the unknown brand, and 10% indicated the samples were equally preferred. Additionally, McClure et al. (2004) found that panelists who consumed Coke from a cup bearing the brand logo had higher preference ratings for the beverage than panelists who consumed the beverage from an
unmarked cup. These studies demonstrate that providing consumers with product information before evaluation significantly affected their liking ratings.

1.3 Consumer perceptions and willingness to pay for organic foods

The purchase of organic food has been a popular trend among consumers in recent years. Sales of organic food products in the United States grew by 17% in 2007 and nearly 16% in 2008 (Organic Trade Association, 2009). The motivation to purchase organic products is derived from the consumer perception that organic foods are environmentally friendly, safer, and more nutritious (Goldman et al., 1991; Hughner et al., 2007; Shepherd et al., 2005; Zhao et al., 2007). Additionally, many organic buyers believe that organic produce tastes better than conventionally grown produce (Hughner et al., 2007; Zhao et al., 2007).

Many studies have demonstrated that people are willing to pay a premium price for organic foods. Weaver et al. (1992) reported that 56 percent of consumers indicated they were willing to pay at least a 10% premium to obtain pesticide-free tomatoes. Wang et al. (2003) found that Vermont consumers were willing to pay more for organic apples and milk certified by Northeast Organic Farming Association by conducting a conjoint analysis. A study by Yue et al. (2009) used an experimental auction to investigate how cosmetic damage affects consumers’ willingness to pay for apples. Seventy-five percent of the participants were willing to pay more for organic than for conventionally grown apples given identical appearance.

Research indicating that organic and conventional fruits and vegetables differ in consumer acceptability is widely inconsistent (Harker, 2004). These inconsistencies may
be attributed to confounding effects from both production and postharvest factors, such as soils, microclimates, harvest dates, storage, and processing (Harker, 2004). Two recent studies involving well-controlled experimental production systems had not found significant differences in overall acceptability between organic and conventional produce. Zhao et al. (2007) used side-by-side plots to produce organic and conventional vegetables for consumer sensory studies. The vegetables in the study included red loose leaf lettuce, spinach, arugula, mustard greens, tomatoes, cucumbers, and onions. Overall, organically and conventionally grown vegetables did not show significant differences in consumer liking. Additionally, Reganold et al. (2001) found that apples produced by organic, conventional, and integrated systems did not differ in overall acceptance when rated by untrained sensory panels.
Objective

Previous studies incorporating tasting into experimental auctions have done so by revealing product information to the panelists followed by product tasting with reference to the characteristic product information. Because conceptual information influences subjective experiences, presenting product information in an experimental auction before allowing panelists to taste the products may bias bid amounts in the tasting round of the auction. To prevent the product information bias, panelists could taste the products before receiving the additional product information.

The objective of this study was to determine how the order of information presented to panelists in an experimental auction affects bidding prices. Specifically, we wanted to determine the relative difference in bidding prices between people who taste apple samples before observing displays with information about the apples and people who observe the information before tasting the apples. We had two hypotheses:

1.) There would be a greater difference in bid prices between auction rounds by panelists who first observe the display information compared to panelists who first taste the products.

2.) Panelists will place higher bids on the organic apples than on the conventionally grown apples when they have not tasted the products.
2. Materials and Methods

2.1 Subjects

Panelists were recruited from students, faculty, and staff of the University of Minnesota who expressed an interest in participating in sensory tests. Please refer to Appendix I for the screener used for recruiting. To qualify for the study, participants had to be the primary grocery shopper of their household, be at least 18 years old, have no food allergies, consume apples at least twice per month, and have purchased apples within the last six months. The percentage of panelists indicating that they had purchased each of the apple varieties listed on the screener within the last 6 months is listed in Appendix I. Students who purchased their food from a dormitory cafeteria were excluded in this study. Eighty-six people participated in this experiment; 66 of the panelists were female, 19 were male, and one panelist did not indicate his/her gender. The ages ranged from 19 – 69 years, with 48% of participants in the age 20-29 category, 20% age 30-39, 13% age 40-49, 15% age 50-59, and 1% age 60-69 (Figure 1). Thirty percent of panelists reported an annual household income of $0-$20,000, and 51% of participants had earned a bachelor’s degree (Figures 2 and 3). Forty-seven percent of participants indicated they purchased apples a couple of times a month and 33% of participants indicated they purchase apples 1-3 times per week (Figures 4). All recruiting and experimental procedures were approved by the University of Minnesota’s Institutional Review Board. Panelists were paid for their participation.
Figure 1: Histogram of panelist age distribution (n=85; one panelist did not indicate his/her age).

Panelist Age Distribution

Figure 2: Histogram of panelist income distribution (n=85; one panelist did not indicate his/her income bracket).

Panelist Income Distribution
The participants were not representative of the general population in terms of demographics or purchasing behavior. However, it was not the purpose of this study to make predictions about the market behavior of the apples. Rather, the purpose of the study was to test the methodology of how the order of information panelists receive during an experimental auction affects bidding price.
2.2 Products

The four apple varieties chosen for this study, Honeycrisp, Braeburn, Pink Lady, and Red Delicious, were chosen to represent a heterogeneous sample in terms of apple quality and characteristics. The Braeburn apple is considered to have a high overall liking among consumers while Red Delicious is a traditional apple cultivar that has received lower preference ratings when compared to newer apple cultivars such as Braeburn, Pink Lady, and Honeycrisp (Miller, 2005; Stebbins, 1991; Daillant-Spinnler, 1996; McCraken, 1994). Miller et al. (2005) reported that Honeycrisp was rated significantly higher in juiciness than Braeburn. Corrigan et al. (1997) reported that Pink Lady apples were rated as less juicy but sweeter than Braeburn. In a study by McCracken et al. (1994), Braeburn was rated higher in firmness, sweetness, and tartness than Red Delicious.

Each variety of apple was obtained under two growing conditions (conventional and organic) for a total of eight different apple samples (4 apple varieties x 2 growing conditions = 8 samples). Organic apples (Braeburn, Pink Lady, and Red Delicious) were purchased from Mississippi Market in St. Paul, MN. Conventional apples (Braeburn, Pink Lady, and Red Delicious) were purchased from Cub Foods in Roseville, MN. Conventional Honeycrisp apples were provided by the University of Minnesota’s Horticultural Research Center located in Chanhassen, Minnesota and organic Honeycrisp apples were provided by Hoch Orchard located west of LaCrescent, Minnesota. Conventional and organic apples of the same apple variety were purchased from the same
growing region (Washington State, New Zealand, etc.). Displayed apples were chosen to be as similar as possible in size and blemish level.

**Tasting Auction:** Each subject received ~ 1/16 of an apple from each of the eight apple samples dipped in Fruit Fresh® (Ball, Muncie, IN) to prevent browning. The Fruit Fresh solution was prepared at a concentration of 14.1g/L filtered water. Samples were served in a 60 ml plastic cup labeled with a random 3-digit code.

**Information Auction:** Three apples were placed on a white display plate, and a card with their random 3-digit code, name, and growing condition (organic or conventional) was placed next to the products (Figure 5). The total weight of the 3 apples was also listed on the card, so panelists had a weight reference for the displayed products. The eight apple displays ranged in weight from 1.0-1.3 pounds. Panelists were instructed that they were to place bids for 1 pound of the product.

### 2.3 Experimental procedure

Qualified panelists were assigned to a 60 minute time slot. Approximately eight panelists were scheduled per session. At the beginning of each session, panelists were handed a folder with all of the forms needed for the study (consent form, quiz, survey, and ballots). Participants were asked to read the consent form and provide verbal consent for their participation in the study. They were also asked to fill-out a survey regarding their age, gender, household income, and frequency of apple purchase (appendix II). Participants were then paid $10 for their participation, and the moderator explained the procedure for the study. Payment at the beginning of the study was provided so that panelists had money available to bid on the apples. The moderator read the protocol from a script to ensure consistency between panel groups (appendix III). Panelists were then
quizzed on the protocol before beginning the experiment to ensure they understood the auction procedure (appendix IV). Answers to the quiz were discussed as a group.

All of the auctions were conducted over two testing days. During the first day of testing, groups began with the tasting auction followed by the display auction. This group will be referred to as ‘Taste First’. For the second day of testing, panelists began with the auction for the displayed information followed by the tasting auction. The second group will be referred to as ‘Information First’. The procedure outlined below is for the group starting with the tasting auction. The process was reversed for the panelists who received the information first in that the auction for the displayed product information was conducted before the tasting auction.

Tasting Auction Protocol

Samples for each of the eight apple varieties were placed at stations around the room identified by the products’ random 3-digit codes. Panelists were instructed to begin the sample tasting at one of the eight stations and rotate around the room until they had tasted all of the samples. During the tasting, subjects rated the samples for overall liking, flavor liking, and texture liking based on the 9-point hedonic scale (Peryam et al, 1952) by writing down the number that best corresponded to their liking (left most end labeled dislike extremely=1; right most end labeled like extremely=9). Panelists were asked to record their liking ratings so that they would think about the sensory properties of the product as well as have information for comparing the apple samples within the same auction round (and subsequent auction rounds for panelists who first participated in the taste auction). For each apple sample evaluated, panelists also had the opportunity to
write their own comments. The moderator encouraged panelists to write detailed notes to help compare samples within the tasting auction and to help panelists who tasted the samples first remember the sensory properties in the subsequent auction round. The moderator also emphasized that this was the only opportunity panelists had to taste the samples. Panelists recorded their bidding price for 1 pound of each apple variety next to their liking ratings on the ballot (Appendix V). A display of 1 pound of apples was presented at the front of the room as a weight reference. Carbon paper was used for panelists to record a copy of their bids on an identical score sheet for themselves. One copy of the bid sheet was collected at the end of the first auction so that panelists could not change their bids between auction rounds. This also allowed panelists to have a record of their bids and their tasting notes for the second auction. Extra samples were discarded, so panelists could not re-taste the samples in the second auction. Panelists then participated in the information auction.

*Information Auction Protocol*

Three apples were on display for each of the eight apple varieties. Each display was labeled with the apple name, growing condition (conventional or organic), total weight of the three apples (in pounds), and the 3-digit code from the tasting portion of the study. Displays were in the same location and sequence as the samples in the tasting auction. Panelists again rotated through the displays and wrote down their bidding price for one pound of each apple variety on a sheet similar to the score card for the tasting auction. Panelists were encouraged to reference their notes from the tasting portion of the study when placing their bids. Carbon paper was again used for the panelists to
record a copy of their bids on an identical score sheet for themselves. After panelists had
the opportunity to observe all of the displays, the bid sheets were collected. Panelists
kept their folders as a reference of their bid prices as the auction winners were
determined.

An example of the display set-up is shown in Figure 5 (left). For the panelists
that first tasted the apples, the displays were covered with boxes and the apple samples to
be tasted were placed on top of the boxes. For the panelists who tasted the apples in the
second auction, the apple samples were placed on the box behind the apple displays
(Figure 5, right).

**Figure 5:** (Left) Set-up of apple displays for panelists who participated in the
information auction first. The displays contained information about the apple name,
weight of the 3 apples, growing condition (organic or conventional) and 3-digit code to
identify the apple variety. (Right) Set-up of tasting auction for panelists who
participated in the tasting auction second. Cut apples to be tasted were placed on a box
behind the displays.
After the bids were collected for both auction rounds, one auction round and one product were randomly determined in which bids were effective and from which the winners were determined. This was done by having one of the panelists randomly select a slip of paper from a bowl containing both auction options and a second slip of paper from a bowl containing the 3-digit codes identifying the samples. The winners were required to purchase approximately 1 pound of the product (3 apples).

To determine the winners of the auction, the moderator wrote down the bidding prices and the panelist identification numbers for the randomly selected product in descending order on a board for panelists to see. Winners were assigned according to the 4th price Vickrey auction procedure as follows: The participants with the three highest bids for each product were considered winners. The price they paid for the selected apple variety was set equal to the forth-highest bid for that sample. After the moderator determined the winners, transactions for the apples were made. To ensure a fair comparison of products and bids between sessions, the same apple samples were on display for each session. The winning panelists purchased samples that were approximately the same in size and appearance as the apples on display. In the event of a tie, a coin was flipped to determine the winner.
3. Data Analysis

For each judge, the bid price for each apple in both the information and tasting auction rounds was recorded in a master data sheet. Overall, flavor, and texture liking ratings were also recorded. The difference in bid prices between auction rounds was determined by subtracting the information auction bid amount from the taste auction bid amount for all panelists. SAS (version 9.1) was used for analyses. The syntax for analysis can be found in appendix VI.

*Hypothesis 1:*

To determine if the difference in bid prices between auction rounds differed significantly between the group that received the information first compared to the group that tasted the product first, a mixed model analysis of variance (PROC MIXED) was used. Unequal variance between the groups was identified through jitter-plots constructed in R (version 2.7.2) (appendix VII). Therefore, the model was constructed to allow each group to have its own variance. Fixed predictors in the model included group (information first or taste first), product (apple), condition (organic or conventional), group*product, group*condition, product*condition, group*product*condition. Judge was included as a repeated measure. Tukey HSD multiple comparison tests were used to determine which products (apples and growing conditions) differed significantly from which others.

*Hypothesis 2:*

A mixed model analysis of variance (PROC MIXED) was used to determine if bid prices were higher for the organic apples in comparison to the conventional apples for
the information auction only for the information first group. Fixed predictors in the model included product (apple), condition (organic or conventional), and product*condition. Judge, judge*product, and judge*condition were random predictors in the model. Tukey HSD multiple comparison tests were used to determine which condition and which products in each condition differed significantly from which others.

**Additional Analysis:**

To determine the influence of the additional product information, bid prices from the tasting auction were compared between the group that tasted first without the information bias and the group that tasted second using a mixed model analysis of variance (PROC MIXED). Fixed predictors in the model included group (information first or taste first), product (apple), condition (organic or conventional), group*product, group*condition, product*condition, group*product*condition. Judge, judge*product, and judge*condition were random predictors in the model. Tukey HSD multiple comparison tests were used to determine if bids from the tasting auctions for the same product and condition differed between groups.

To determine if bids in the final full information auction round differed between the group that received the information first and the group that tasted first, a mixed model analysis of variance (PROC MIXED) was used. Fixed predictors in the model included group (information first or taste first), product (apple), condition (organic or conventional), group*product, group*condition, product*condition, group*product*condition. Judge, judge*product, and judge*condition were random
predictors in the model. Tukey HSD multiple comparison tests were used to determine if final bids for the same product and condition differed between groups.

To determine if overall, texture, and flavor liking ratings differed by product, condition, and group, a mixed model analysis of variance (PROC MIXED) was used. Fixed predictors in the model included group (information first or taste first), product (apple), condition (organic or conventional), group*product, group*condition, product*condition, group*product*condition. Judge, judge*product, and judge*condition were random predictors in the model. Tukey HSD multiple comparison tests were used to determine if ratings differed by product, condition, and group.
4. Results

Panelists who saw the information first significantly lowered their bids for the Braeburn apples after tasting by $0.38 for the conventional apples and $0.47 for the organic apples on average, while panelists who tasted the apples first, increased their bids for the Braeburn apples by only $0.01 for the conventional and $0.06 for the organic apples after learning the apple name and growing condition ($F_{\text{group}\times\text{product}\times\text{condition}} = 2.2, p = 0.09; t_{\text{Con,Info First:Con, Taste First}} = 3.7, p = 0.024; t_{\text{Org,Info.First:Org, Taste First}} = 4.2, p = 0.004; \text{Figure 7, Table 2})$. Differences in bid prices between the group that tasted first and the group that saw the information first were not significant for the Honeycrisp, Pink Lady and Red Delicious apples of either condition. Table 3 displays the skeleton ANOVA table for this analysis. However, the group that received the information first decreased their bids for the organic Honeycrisp by $0.30 on average and increased their bids for the organic Pink Lady by $0.19 on average. Both of these differences were significantly different from zero ($t_{\text{Honeycrisp, Org., Info. First}} = -3.29, p=0.001, t_{\text{PinkLady, Org., Info. First}} = 2.1, p=0.04$).

Additionally, panelists who tasted the organic Honeycrisp apples first increased their bids by $0.19 on average after receiving the product information, a difference which was also significantly different from zero ($t_{\text{Honeycrisp, Org., Taste First}} = -5.0, p<0.0001$).
Figure 7: Mean bid prices for each product and growing condition in each auction round (taste auction or information auction) by group (information first or taste first). Bars represent standard errors.
**Figure 7 (continued):** Mean bid prices for each product and growing condition in each auction round (taste auction or information auction) by group (information first or taste first). Bars represent standard errors.
Table 2: Mean difference in bid price by product, condition, and group. Difference in bid price between auction rounds was determined by subtracting the bid amount for the display auction from the bid amount for the tasting auction for all panelists. A positive difference indicates products received higher bids in the tasting auction than in the display auction. A negative difference indicates products received higher bids in the display auction than the tasting auction. T-values and adjusted p-values are from Tukey HSD multiple comparisons test for comparisons of differences in bid price between groups by product and condition. Significant differences in bid prices between groups are highlighted.

<table>
<thead>
<tr>
<th>Apple Name and Growing Condition</th>
<th>Braeburn</th>
<th>Honeycrisp</th>
<th>Pink Lady</th>
<th>Red Delicious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>Con</td>
<td>Org</td>
<td>Con</td>
<td>Org</td>
</tr>
<tr>
<td>Taste First</td>
<td>-0.01</td>
<td>-0.06</td>
<td>0.06</td>
<td>0.19</td>
</tr>
<tr>
<td>Info. First</td>
<td>-0.38</td>
<td>-0.47</td>
<td>0.06</td>
<td>0.30</td>
</tr>
<tr>
<td>Test Statistics</td>
<td>t-value</td>
<td>p-value</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.7</td>
<td>0.024</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.2</td>
<td>0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.6</td>
<td>0.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.1</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.4</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-2.2</td>
<td>0.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.4</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.7</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Adjusted for multiple comparisons

Table 3: Skeleton ANOVA table for the mixed model analysis of variance used to determine if difference in bid prices differed between groups (information first or taste first). Significant effects are highlighted.

<table>
<thead>
<tr>
<th>Effect</th>
<th>F-Value</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>group</td>
<td>1.6</td>
<td>0.21</td>
</tr>
<tr>
<td>product</td>
<td>16.6</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>condition</td>
<td>2.1</td>
<td>0.15</td>
</tr>
<tr>
<td>group*product</td>
<td>13.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>group*condition</td>
<td>0.4</td>
<td>0.51</td>
</tr>
<tr>
<td>product*condition</td>
<td>5.4</td>
<td>0.0012</td>
</tr>
<tr>
<td>group<em>product</em>condition</td>
<td>3.1</td>
<td>0.09</td>
</tr>
</tbody>
</table>
Panelists who observed the displays in the first auction round bid significantly higher for the organic Honeycrisp apples compared to the conventional Honeycrisp by $0.24 on average ($F_{\text{condition}} = 8.76, p=0.0050, t = -4.4, p = 0.001$, Figure 8, Table 4). Additionally, there was a trend for panelists to bid higher for the organic Braeburn compared to the conventionally grown Braeburn ($t = -2.8, p = 0.11$, Figure 8, Table 4). Bid prices did not differ between organic and conventional growing conditions for the Red Delicious or Pink Lady apples.

**Figure 8:** Mean bids by product and condition for display auction by panelists who received the information first and had not tasted the apples. Bars represent standard errors.
Table 4: Mean bids by product and condition for display auction by panelists who received the information first and had not tasted the apples. T-values and adjusted p-values are from Tukey HSD multiple comparisons test for comparisons of bid price between organic and conventional apples of the same product. Significant differences in bid prices between conditions are highlighted.

<table>
<thead>
<tr>
<th>Product</th>
<th>Braeburn</th>
<th>Honeycrisp</th>
<th>Pink Lady</th>
<th>Red Delicious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>Organic</td>
<td>Conventional</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$1.18</td>
<td>$1.56</td>
<td>$1.07</td>
<td>$0.64</td>
</tr>
<tr>
<td></td>
<td>$1.02</td>
<td>$1.32</td>
<td>$1.07</td>
<td>$0.56</td>
</tr>
<tr>
<td>Test Statistics</td>
<td>t-value</td>
<td>-2.8</td>
<td>-4.4</td>
<td>-0.56</td>
</tr>
<tr>
<td></td>
<td>p-value*</td>
<td>0.11</td>
<td>0.001</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Adjusted for multiple comparisons

When comparing the bids from the tasting auctions between groups, there was a trend for the group that received the information first to bid higher on the apples than the group who tasted first without the information bias ($F_{group} = 3.5$, $p = 0.061$). Bids were on average $0.16 higher for the group who tasted the products with the presence of the additional information. There was also a trend for final bids to be higher in the group that received the information first ($F_{group} = 1.8$, $p = 0.15$, $F_{group*product*condition} = 2.84$, $p = 0.04$, Table 5). The largest difference in final bid price between groups was $0.33 for the organic, Pink Lady apples ($t_{finalbid,Taste First:Info. First} = -2.5$, $p = 0.22$).
Table 5: Actual price per pound paid for each apple variety and mean bids for each auction round by group, product, and condition. Highlighted columns indicate the final information auction within each group.

<table>
<thead>
<tr>
<th>Product and Condition</th>
<th>Actual Price Paid per Pound</th>
<th>Taste First</th>
<th>Information First</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Taste Auction</td>
<td>Display Auction</td>
</tr>
<tr>
<td>Braeburn - Con</td>
<td>$1.49</td>
<td>$0.54</td>
<td>$0.55</td>
</tr>
<tr>
<td>Braeburn - Org</td>
<td>$1.99</td>
<td>$0.46</td>
<td>$0.52</td>
</tr>
<tr>
<td>Honeycrisp – Con*</td>
<td>$2.09</td>
<td>$1.17</td>
<td>$1.27</td>
</tr>
<tr>
<td>Honeycrisp – Org*</td>
<td>$2.66</td>
<td>$1.24</td>
<td>$1.43</td>
</tr>
<tr>
<td>Pink Lady - Con</td>
<td>$1.49</td>
<td>$0.81</td>
<td>$0.86</td>
</tr>
<tr>
<td>Pink Lady - Org</td>
<td>$1.79</td>
<td>$0.90</td>
<td>$0.93</td>
</tr>
<tr>
<td>Red Delicious - Con</td>
<td>$1.49</td>
<td>$0.48</td>
<td>$0.44</td>
</tr>
<tr>
<td>Red Delicious - Org</td>
<td>$1.79</td>
<td>$0.62</td>
<td>$0.56</td>
</tr>
</tbody>
</table>

*Apples were donated for the study. Prices for the donated apples were determined from the respective purchase locations of the organic and conventional apples of the other varieties.

Panelists liked Honeycrisp more than the other apple varieties overall and for flavor and texture ($F_{product,overall}=64.7, p<0.0001; F_{product,flavor}=36.80, p<0.0001$; $F_{product,texture}=117.5, p<0.0001$ (Tables 6, 7 & 8)). Panelists liked Pink Lady second best for overall, flavor and texture (Tables 6, 7 & 8). The Braeburn and Red Delicious apples were liked the least for all attributes. Ratings for overall and flavor liking did not differ by group or condition.

Table 6: Mean overall liking scores by apple name, growing condition, and group. Ratings were made on a 9-point hedonic scale (left most end labeled dislike extremely=1; right most end labeled like extremely=9). Honeycrisp apples were liked significantly more than the Pink Lady apples ($F_{product}=64.69, p<0.0001$, $t_{Honeycrisp:PinkLady}=5.7$, $p<0.0001$). The Braeburn and Red Delicious apples were liked the least $t_{Braeburn:RedDelicious}=-0.0$, $p=1.000$).

<table>
<thead>
<tr>
<th>Apple Name and Growing Condition</th>
<th>Braeburn</th>
<th>Honeycrisp</th>
<th>Pink Lady</th>
<th>Red Delicious</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Con</td>
<td>Org</td>
<td>Con</td>
<td>Org</td>
</tr>
<tr>
<td>Group</td>
<td>5.5</td>
<td>4.7</td>
<td>7.2</td>
<td>7.4</td>
</tr>
<tr>
<td>Taste first</td>
<td>5.4</td>
<td>5.4</td>
<td>7.8</td>
<td>7.4</td>
</tr>
<tr>
<td>Info. first</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Liking Mean by Apple Name</td>
<td>5.3</td>
<td>7.5</td>
<td>6.4</td>
<td>5.2</td>
</tr>
</tbody>
</table>

31
Table 7: Mean flavor liking scores by apple name, growing condition, and group. Ratings were made on a 9-point hedonic scale (left most end labeled dislike extremely=1; right most end labeled like extremely=9). Honeycrisp apples were rated significantly higher for flavor liking than the Pink Lady apples ($F_{product}=36.80$, $p<0.0001$, $t_{Honeycrisp:PinkLady}=4.5$, $p<0.0001$). The Braeburn and Red Delicious apples were liked the least $t_{Braeburn:RedDelicious}=-0.4$, $p=0.97$).

<table>
<thead>
<tr>
<th>Apple Name and Growing Condition</th>
<th>Braeburn</th>
<th>Honeycrisp</th>
<th>Pink Lady</th>
<th>Red Delicious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>Con</td>
<td>Org</td>
<td>Con</td>
<td>Org</td>
</tr>
<tr>
<td>Taste first</td>
<td>5.4</td>
<td>5.3</td>
<td>7.1</td>
<td>7.2</td>
</tr>
<tr>
<td>Info. first</td>
<td>5.4</td>
<td>5.8</td>
<td>7.6</td>
<td>7.2</td>
</tr>
</tbody>
</table>

Flavor Liking Mean by Apple Name

| 5.5 | 7.3 | 6.4 | 5.6 |

Table 8: Mean texture liking scores by apple name, growing condition, and group. Ratings were made on a 9-point hedonic scale (left most end labeled dislike extremely=1; right most end labeled like extremely=9). Honeycrisp apples were rated significantly higher for texture liking than the Pink Lady apples ($F_{product}=117.5$, $p<0.0001$, $t_{Honeycrisp:PinkLady}=7.7$, $p<0.0001$). The Braeburn and Red Delicious apples were liked the least $t_{Braeburn:RedDelicious}=0.4$, $p=0.96$).

<table>
<thead>
<tr>
<th>Apple Name and Growing Condition</th>
<th>Braeburn</th>
<th>Honeycrisp</th>
<th>Pink Lady</th>
<th>Red Delicious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>Con</td>
<td>Org</td>
<td>Con</td>
<td>Org</td>
</tr>
<tr>
<td>Taste first</td>
<td>5.4</td>
<td>4.2</td>
<td>7.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Info. first</td>
<td>5.0</td>
<td>5.2</td>
<td>8.1</td>
<td>8.1</td>
</tr>
</tbody>
</table>

Texture Liking Mean by Apple Name

| 5.0 | 7.9 | 6.5 | 4.9 |
5. Discussion

The greater differences in bid prices between the group that received the information first compared to the group that tasted first were expected based on the significant differences in bid prices between information and taste auctions from previous research. In previous research, significant decreases in bid prices were observed when products did not meet consumer expectations. For example, bid prices for orange juice processed by a novel pulsed electric field technique declined by 17% after tasting and bids for wine with the label indicating “Appellation of Origin” information decreased significantly after product tasting (Chern, 2003; Combris, 2009). As observed in our study, the apple that failed the most at meeting consumer expectations was the Braeburn apple.

The significant decrease in price for the Braeburn apples by the group that received the information first suggests that panelists had a relatively high expectation of how the Braeburn apples would taste when presented in the display auctions, but their expectations were not met when tasted. This contrasts to the panelists who tasted the products first and made minimal changes to their bids once presented with the product information. Braeburn apples were included in the experimental design due to their high perceived overall liking indicated from previous studies. However, many of the comments on panelists’ ballots indicated that the Braeburn apples used in this study from both the organic and conventional growing conditions were soft and mushy. The decrease in bid price for the Braeburn apples based on inadequate texture is also supported by the texture ratings. Texture liking ratings for the Braeburn apples were
significantly lower than the ratings for the Honeycrisp and Pink Lady apples
\( (F_{product}=117.5, p<0.0001; t_{Braeburn:Honeycrisp}=-15.7, p \ <0.0001; t_{Braeburn:Pink\ lady}=-7.9, p<0.0001; \) Table 8).

The decrease in bid price for the organic Honeycrisp apples by the group that participated in the information auction first may be explained by the popularity of the apple among Minnesota residents. Eighty-six percent of panelists indicated on the study’s screener that they had purchased Honeycrisp apples within the last six months. The significant decrease in bid price by the group that received the information first was caused by four panelists who decreased their bids by $2.15 on average after tasting the apples compared to a decrease of $0.10 for the other panelists. The initial bids placed by these panelists were exceptionally high ($3.02 on average compared to $1.41 for the other panelists), possibly due to the excitement for the Honeycrisp name. The decrease in bid price by the four panelists may be explained by their overall liking scores for the organic Honeycrisp apple, which on average corresponded to the ‘neither like nor dislike’ point on the liking scale.

The significant positive difference in bid price for the organic Pink Lady apples by panelists who received the product information first suggests that the apple surpassed panelists’ taste expectations based on the information provided in the display auction. Panelists may have initially been conservative with their bids for the organic Pink Lady apples based on the appearance of the displayed apples. The appearance of the organic Pink Lady apples was the most different from their conventional counterpart. The organic apples showed uneven coloring of yellow and green spots, which panelists may
have perceived as cues of lower quality, while the conventional Pink Lady apples were nearly a uniform red color (Figure 9). This may explain the significant increase in bid price for the organic Pink Lady apples after tasting since panelists then knew that the apple appearance was not associated with the taste quality of the apple. Pink Lady was not an uncommon apple variety normally consumed by panelists in the study, suggesting that the increase in price would not be attributed to the novelty of the apple. Fifty-two percent of panelists indicated on the study’s screener that it was an apple variety they purchased within the last six months. Additionally, the overall liking ratings of the organic Pink Lady apples for the group that received the product information first were not significantly different from those who tasted the products first ($F_{\text{group*product*condition}}=4.3$, $p=0.006$, $t_{\text{PL,Taste First:PL,Info. First}}=0.0$, $p=1.0$). This suggests that panelists were not biased for the Pink Lady name. Previous studies have also found that people make quality judgments based on the exterior appearance of apples, some of which may be inaccurate. Schechter (2010) found that people often misperceive apple taste based on visual cues by having participants first rank apples according to how they think they will taste followed by blindfolding them and again asking panelists to rank their taste preferences. Additionally, in a study investigating consumer’s willingness to pay for organic and conventional apples with different levels of cosmetic damage, 75% of participants were willing to pay more for organic than for conventional apples given identical appearance (Yue et al., 2006). However, at the first sight of any imperfection in the appearance of the organic apples, the price they were willing to pay was significantly reduced (Yue et al., 2006).
Figure 9: (Left) photograph of conventional Pink Lady apples with uniform coloring. (Right) Photograph of organic Pink Lady apples with uneven coloring and yellow and green spots.

Bid prices in this study were in general lower than the actual price paid for the products at the time of the study. Previous experimental auctions for deli sandwiches and wines have observed similar findings (Drichoitis et al., 2008; Lange et al., 2002). Drichoitis et al. (2008) explained that a rational subject might not agree to obtain the same good in an experiment at a price that he or she perceives can be beaten outside the lab and therefore may bid lower than the current market value of the products.

Many consumers of organic foods believe that organic products taste better (Hughner et al., 2007). If expectations influence the consumption experience itself, it would be expected that liking scores for the organic apples should be higher for those who receive the product information first compared to those who tasted the apples first without the information bias. However, mean liking scores for the organic apples by those who received the product information first were 6.2 and mean liking scores for the organic apples by those who tasted the apples first were 6.1, indicating that there was not
a significant difference in the overall liking of the organic apples between groups 
($F_{condition}=0.4, p=0.55; F_{group*condition}=2.21, p=0.14; $Table 6).

The panel group that was aware of the product information during tasting had indicated higher bids in the tasting auction than the group that tasted without the information bias. Receiving the product information first caused bids to be higher in the final information condition by $0.11 on average compared to the group that tasted first. This suggests that participants are biased by the information first presented to them, and the order of information presented to panelists affects final bid amounts for full product disclosure.

**General Conclusion**

The sensory properties of a product have a large influence on consumer willingness to pay. If the sensory properties of products are presented before the additional product information, this can prevent the measurement of the impact of additional information. However, if product information is presented before the sensory evaluation, this can present bias in the bid amounts. In order to understand the effects of sensory properties and consumer expectations, product information should be presented to separate panel groups both before and after tasting in an experimental auction.
Bibliography


APPENDICES

Appendix I: Screener for Panelist Recruitment

Are you interested in taste-testing apples?

We are recruiting people for a study on consumer acceptance and consumer willingness-to-pay for several apple varieties. The study will be conducted on Thursday, Oct. 29 and Thursday, Nov. 5 in room 1 of the Food Science and Nutrition building on the St. Paul Campus. For participation in this study, your attendance is needed at only one of the two test days.

To participate in the study, we would ask you to do the following things:
- You would attend 1 session (approximately 60 minutes long).
- During the session, you will be asked to participate in two experimental auctions in which you will taste and observe a variety of apples samples and place a bid price for the maximum amount you would be willing to pay for one pound of the apple samples.
  ***In the experimental auctions, you will be given the opportunity to purchase one pound (~3 apples) of the apples evaluated based on your bid amounts. You will receive your panelist compensation of $10 at the beginning of the study and will be expected to use part of this money to pay for any apples for which you have the winning bid***
- You will be asked to indicate your liking of the apple samples.
- You will be asked to complete a short survey regarding your purchasing behavior of apples

Each participant will be compensated $10 less the amount spent purchasing apples.

If you are interested in taking part in this study, please answer the questions below and reply to this e-mail.

Your information will be evaluated to see if you qualify to be part of the study. If you qualify, you will be contacted and assigned a participation time for one of the two test dates (Oct. 29 or Nov. 5). You may choose not to participate, even if you have qualified.

Please provide the following information about yourself. All information you provide is strictly confidential.

First Name:
Last Name:
e-mail address:

What is your age? ____

Do you have any food allergies?
How often do you consume apples?
____Less than once a month
____Once a month
____A couple of times a month
____1-3 times a week
____4-6 times a week
____Daily

Please mark all of the apple varieties that you personally have purchased from a grocery store, farmer’s market, etc. within the last 6 months. (Percentage of panelists selecting each apple variety is listed in parenthesis next to the apple name. Apple varieties used in this study are in bold)
____I have not purchased apples within the last 6 months

(58%) Braeburn
(17%) Jonathan
(30%) Cortland
(20%) Fireside
(51%) Gala
(34%) Golden Delicious
(45%) Granny Smith
(38%) Haralson

(86%) Honeycrisp
(15%) Jazz
(14%) Jonathan
(2%) Keepsake
(30%) McIntosh

(52%) Pink Lady
(14%) Reagent

(30%) Red Delicious
(6%) Sweet Sixteen
(16%) Sweet Tango
(22%) Zestar!
(12%) Other (please specify)________________________

Are you the primary grocery shopper of your household?
____Yes
____No

Do you primarily purchase your food from a dormitory cafeteria?
____Yes
____No
Please indicate the times on Thursday, Oct. 29 that you are available to attend the test session. (Please mark all applicable times)

_____ 9:30 – 10:30am
_____ 10:45 – 11:45am
_____ 12:00 – 1:00pm
_____ 1:15 – 2:15pm
_____ 2:30 – 3:30pm
_____ 3:45 – 4:45pm
_____ 5:00 – 6:00pm

Please indicate the times on Thursday, Nov. 5 that you are available to attend the test session. (Please mark all applicable times)

_____ 9:30 – 10:30am
_____ 10:45 – 11:45am
_____ 12:00 – 1:00pm
_____ 1:15 – 2:15pm
_____ 2:30 – 3:30pm
_____ 3:45 – 4:45pm
_____ 5:00 – 6:00pm

If you qualify for the study, we will assign you a time to meet for the session.

If you have any questions about the study, please respond to this e-mail

Thank you!

*If you would like to be removed from this email list please reply with ‘remove’ in the subject line.
Appendix II: Questionnaire administered during auctions

Thank you for your participation in the Apple Study. Please complete the following survey. All information you provide is strictly confidential.

Please select the age bracket below that corresponds to your age:

_____ 10-19
_____ 20-29
_____ 30-39
_____ 40-49
_____ 50-59
_____ 60-69

What is your gender? _____ Male  _____ Female

Please select the income bracket below that corresponds to your annual household income before taxes and other deductions:

_____ $0 - $20,000
_____ $20,000 – $40,000
_____ $40,000 - $60,000
_____ $60,000 - $80,000
_____ $80,000 - $100,000
_____ $100,000+

Please select the highest degree you earned?

_____ High school diploma or equivalency (GED)
_____ Associate degree
_____ Bachelor’s degree
_____ Master’s degree
_____ Doctorate
_____ Professional (MD, DJ, DDS, etc.)
_____ Other (Please specify: _______________________________)
_____ None of the above (less than high school)

Where do you typically purchase apples? (Please mark all that apply.)

_____ Grocery Store
_____ Farmer’s Market
_____ Other (Please specify: _______________________________)

How often do you purchase apples?

_____ Less than once a month
_____ Once a month
_____ A couple of times a month
_____ 1-3 times a week
_____ 4-6 times a week
_____ Daily
Appendix III: Moderator script for auctions

Protocol for panelists who participated in the tasting auction first

Thank you for your interest and participation in our study on taste testing and experimental auctions of apples. My name is Katie Baures and I will be the moderator for the auction. To get started, each of you were given a white envelope with $10 in it. This is your payment for participation in the study and the money that you will use to buy any apples for which you have the winning bid. I will explain the auction procedures in just a moment. First, I’d like each of you to sign the receipt in the envelope and pass the receipt to me.

To ensure consistency between all of our sessions, I will be reading from a script to explain the tasting and auction procedures and rules. After I explain the procedures used today, we can discuss any questions you have, and then there will be a short quiz on the procedures and methods used today to make sure you understand what we’ll be doing.

Today, you will have the opportunity to evaluate apples in different information conditions. The apple varieties you will evaluate will be made available for purchase according to the methods of a fourth-price Vickrey auction. The procedure for this auction is as follows: for each product evaluated, you will write on paper the maximum price that you would be willing to pay for one pound of apples. The winners for each product in the auction will be the participants who submitted the three highest bids. The winning participants may be required to purchase the product, but not at the price he(she) submitted, but at the fourth highest price of all the bids submitted for that product.

For example, suppose that there are six participants taking part in a Vickrey auction for one pen. The results of the bids are as follows:

Participant 1 = $1.25
Participant 2 = $1.04
Participant 3 = $0.95
Participant 4 = $0.94
Participant 5 = $0.88
Participant 6 = $0.70

The winners of the auction are participants 1, 2, and 3 because they placed the 3 highest bids. However, they would each purchase the pen for $0.94, the 4th highest price, not at the price each of the participants submitted. This procedure means that you have the opportunity to purchase a product at a price lower than, or equal to the price you were willing to pay. In the auctions, you may place a bid of $0.

Are there any questions about how the winners of the auction are determined?

This study is divided into two phases: first a phase where you will taste eight apple samples and record your liking ratings and bid amounts for 1 lb. of each of the products. In the second phase, you will be shown a display of the products with additional information about the samples and will again record your bid for 1 lb. of each of the apple samples.

One pound of apples is approximately equal to 3 medium sized apples. The display in the front of the room is an example of exactly 1 lb of apples. Each of the
displays of the whole apple samples will indicate the total weight of the apples in the display. As you are observing the samples, please keep in mind that you are placing bids for 1 lb. of apples.

The sheets on which you will be recording your bids and liking scores are in your folder. For the liking ratings, please take at least one bite of the sample and record your overall liking and liking of flavor and texture on the appropriate lines under each sample number. Ratings are based on a 9-pt. scale where 1 = dislike extremely and 9 = like extremely. You will place your bid amounts on the same sheet next to the sample ID number. You are also encouraged to take notes regarding the flavor and texture of the samples because this will be the only opportunity you have to taste the samples. To allow you to have a copy of your bids after each auction, there are two identical score sheets in your folders for Auction I and Auction II. I will hand out carbon paper for you to place between the two identical score sheets. We will collect the top score sheet after each auction.

For the second phase of the auction, you will be shown displays of the samples and you will record your maximum bid amounts on the sheets labeled Auction II in your folder. The samples in the second auction are the same as the samples evaluated in the first auction.

Any questions about how to record your liking scores or bid amounts?

At the end of the two phases in the study, we will re-group and randomly choose one auction round and one product in which the winners will be required to purchase 1 lb. of the apples. I have all of the 3-digit codes indentifying the products in a bowl, which is how we will choose the product that will be purchased. I also have papers labeled as Auction I and Auction II. So, at the end of the session, three individuals will be purchasing 1 lb. of the apples evaluated in the session. In the event of a tie, we’ll toss a coin.

We kindly request that you do not talk amongst yourselves during the study. If you have any questions, please ask one of the monitors.

Do you have any questions about the auction procedures?

To make sure that you understand the procedure of this auction, you will now take a short quiz before we begin the auctions.
Protocol for panelists who participated in the information auction first

Thank you for your interest and participation in our study on taste testing and experimental auctions of apples. My name is Katie Baures and I will be the moderator for the auction. To get started, each of you were given a white envelope with $10 in it. This is your payment for participation in the study and the money that you will use to buy any apples for which you have the winning bid. I will explain the auction procedures in just a moment. First, I’d like each of you to sign the receipt in the envelop and pass the receipt to me.

To ensure consistency between all of our sessions, I will be reading from a script to explain the tasting and auction procedures and rules. After I explain the procedures used today, we can discuss any questions you have, and then there will be a short quiz on the procedures and methods used today to make sure you understand what we’ll be doing.

Today, you will have the opportunity to evaluate apples in different information conditions. The apple varieties you will evaluate will be made available for purchase according to the methods of a fourth-price Vickrey auction. The procedure for this auction is as follows: for each product evaluated, you will write on paper the maximum price that you would be willing to pay for one pound of apples. The winners for each product in the auction will be the participants who submitted the three highest bids. The winning participants may be required to purchase the product, but not at the price he(she) submitted, but at the fourth highest price of all the bids submitted for that product.

For example, suppose that there are six participants taking part in a Vickrey auction for one pen. The results of the bids are as follows:

- Participant 1 = $1.25
- Participant 2 = $1.04
- Participant 3 = $0.95
- Participant 4 = $0.94
- Participant 5 = $0.88
- Participant 6 = $0.70

The winners of the auction are participants 1, 2, and 3 because they placed the 3 highest bids. However, they would each purchase the pen for $0.94, the 4th highest price, not at the price each of the participants submitted. This procedure means that you have the opportunity to purchase a product at a price lower than, or equal to the price you were willing to pay. In the auctions, you may place a bid of $0.

Are there any questions about how the winners of the auction are determined?

This study is divided into two phases: first a phase where you will be shown displays of eight different apple varieties with information about the apples, which includes the apple name and growing condition (i.e. organic or conventional) and you will record your maximum bid for 1 lb. of each of the apples. In the second phase, you will taste each of the eight apple varieties from the first phase and again record your bid amounts for 1 lb. of each of the products. In the second phase, you will also record your liking ratings for each of the samples.

One pound of apples is approximately equal to 3 medium sized apples. The display in the front of the room is an example of exactly 1 lb of apples. Each of the
displays of the whole apple samples will indicate the total weight of the apples in the display. As you are observing the samples, please keep in mind that you are placing bids for 1 lb. of apples.

The sheets on which you will be recording your bids and liking scores are in your folder. For the first phase, you will record your bids on the green sheets, labeled Auction I. You will place your bid amounts in the box next to the sample ID number. For the second phase, or Auction II, you will taste the eight apple samples and record your liking ratings and bid amounts for each of the samples. For the liking ratings, please take at least one bite of the sample and record your overall liking and liking of flavor and texture on the appropriate lines under each sample number. Ratings are based on a 9-pt. scale where 1 = dislike extremely and 9 = like extremely. You will place your bid amounts on the same sheet as your liking ratings in the box next to the sample ID number. You are also encouraged to take notes regarding the flavor and texture of the samples.

To allow you to have a copy of your bids after each auction, there are two identical score sheets in your folders for Auction I and Auction II. I will hand out carbon paper for you to place between the two identical score sheets. We will collect the top score sheet after each auction. The samples in the second auction are the same as the samples evaluated in the first auction. I will discuss how to record your liking ratings for the second phase after the first auction.

Any questions about how to record your bid amounts?

At the end of the two phases in the study, we will re-group and randomly choose one auction round and one product in which the winners will be required to purchase 1 lb. of the apples. I have all of the 3-digit codes indentifying the products in a bowl, which is how we will choose the product that will be purchased. I also have papers labeled as Auction I and Auction II. So, at the end of the session, three individuals will be purchasing 1 lb. of the apples evaluated in the session. In the event of a tie, we’ll toss a coin.

We kindly request that you do not talk amongst yourselves during the study. If you have any questions, please ask one of the monitors.

Do you have any questions about the auction procedures?

To make sure that you understand the procedure of this auction, you will now take a short quiz before we begin the auctions.
Appendix IV: Quiz given to panelists to test their understanding of the auction protocol. Answers are in bold

**Quiz on Auction Procedure**

1. **True** or False: At the end of the test session, I may be required to purchase product evaluated during the study.

2. According to the procedure of a 4th-price Vickrey auction, how many winners are there?
   a. One
   b. Two
   c. **Three**
   d. Four
   e. Five
   f. All panelists are winners!

3. In the auctions today, I will be placing 16 bids, each for:
   a. 3 oranges
   b. 2 lbs. of oranges
   c. **1 lb. of apples**
   d. 1 apple

4. The following bids have been placed for one pen. Who is/are the winner(s) according to a 4th-price Vickrey auction?
   a. Panelist A - **$0.60**
   b. Panelist B - **$0.50**
   c. Panelist C - **$0.40**
   d. Panelist D - $0.30
   e. Panelist E - $0.20
   f. Panelist F - $0.10

5. In question 4, at what price is/are the winner(s) required to purchase the pen?
   a. $0.60
   b. $0.50
   c. $0.40
   d. **$0.30**
   e. $0.20
   f. $0.10
   g. Their individual bid amounts

6. **True** or **False**: I will be required to buy more than one lb of apples if I win multiple auctions.

7. **True** or False: I may place a bid of $0.
Appendix V:
Ballots for the group that tasted first

Welcome to the Apple Study!

Auction I

Please take at least one bite of each sample and rate your overall liking and liking of flavor and texture by indicating the point value on the lines provided that correspond to the categories on the scale below (1 = dislike extremely; 9 = like extremely). Please also indicate the maximum price you would be willing to pay for 1 lb. of apples (~3 apples) in the colored box. You may write comments under your ratings for each sample to help remind you of the sample flavor and texture. This will be the only opportunity you have to taste the samples. Note that the sample order listed below may not be the order in which you evaluate the samples. Please take care to ensure the sample tasted corresponds to the 3-digit code on the evaluation sheet.

1  2  3  4  5  6  7  8  9
Dislike  Dislike  Dislike  Dislike  Neither Like  Like  Like  Like  Like
Extremely  Very Much  Modestly  Slightly  nor Dislike  Slightly  Modestly  Very Much  Extremely
<table>
<thead>
<tr>
<th>Sample</th>
<th>Bid Price</th>
<th>Overall Liking</th>
<th>Flavor Liking</th>
<th>Texture Liking</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>870</td>
<td>$________/lb</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>969</td>
<td>$________/lb</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>712</td>
<td>$________/lb</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>632</td>
<td>$________/lb</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>274</td>
<td>$________/lb</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>465</td>
<td>$________/lb</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>041</td>
<td>$________/lb</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
</tr>
<tr>
<td>319</td>
<td>$________/lb</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
<td>_______</td>
</tr>
</tbody>
</table>

Panelist ID: __________
Auction II

Please observe the displays for each apple sample and indicate the maximum price you would be willing to pay for 1 lb. of apples (~3 apples) in the colored box. Each display corresponds to one of the apple samples tasted from Auction I and contains additional information about the apples (name - growing condition (conventional or organic)). You may reference your notes from Auction I when placing your bid.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Bid Price: $_____/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>870</td>
<td></td>
</tr>
<tr>
<td>969</td>
<td></td>
</tr>
<tr>
<td>712</td>
<td></td>
</tr>
<tr>
<td>632</td>
<td></td>
</tr>
<tr>
<td>274</td>
<td></td>
</tr>
<tr>
<td>465</td>
<td></td>
</tr>
<tr>
<td>041</td>
<td></td>
</tr>
<tr>
<td>319</td>
<td></td>
</tr>
</tbody>
</table>

Panelist ID #: ____________________
Ballots for group that received the information first

Welcome to the Apple Study!

Auction I

Please observe the displays for each apple variety and indicate the maximum price you would be willing to pay for 1 lb. of apples (~3 apples) in the colored box. Each display contains information about the apples (name + growing condition (conventional or organic)).

Sample: 870  Bid Price: $_____/lb

Sample: 969  Bid Price: $_____/lb

Sample: 712  Bid Price: $_____/lb

Sample: 632  Bid Price: $_____/lb

Sample: 274  Bid Price: $_____/lb

Sample: 465  Bid Price: $_____/lb

Sample: 041  Bid Price: $_____/lb

Sample: 319  Bid Price: $_____/lb

Panellist ID #: ___________
Auction II

Please take at least one bite of each sample and rate your overall liking and liking of flavor and texture by indicating the point value on the lines provided that correspond to the categories on the scale below (1 = dislike extremely; 9 = like extremely). Please also indicate the maximum price you would be willing to pay for 1 lb. of apples (~3 apples) in the colored box. You may write comments under your ratings for each sample. The apple samples in front of each display correspond to the same information conditions evaluated in Auction I. Note that the sample order listed below may not be the order in which you evaluate the samples. Please take care to ensure the sample tasted corresponds to the 3-digit code on the evaluation sheet.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dislike</td>
<td>Dislike</td>
<td>Dislike</td>
<td>Dislike</td>
<td>Neither</td>
<td>Like</td>
<td>Like</td>
<td>Like</td>
<td>Like</td>
</tr>
<tr>
<td>Extremely</td>
<td>Very Much</td>
<td>Moderately</td>
<td>Slightly</td>
<td>not Dislike</td>
<td>Slightly</td>
<td>Moderately</td>
<td>Very Much</td>
<td>Extremely</td>
</tr>
<tr>
<td>Sample</td>
<td>Bid Price</td>
<td>Overall Liking</td>
<td>Flavor Liking</td>
<td>Texture Liking</td>
<td>Comments</td>
<td></td>
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<tr>
<td>870</td>
<td>$</td>
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<tr>
<td>969</td>
<td>$</td>
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<tr>
<td>712</td>
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<td>274</td>
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<tr>
<td>465</td>
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<td></td>
</tr>
<tr>
<td>041</td>
<td>$</td>
<td></td>
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<td></td>
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<td></td>
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<td>319</td>
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<td></td>
</tr>
</tbody>
</table>

Panel ID #: __________
Appendix VI: Syntax for Data Analysis

Hypothesis 1: To determine if there was a difference in bid prices between auction rounds by panelists who participated in the tasting auction first compared to panelists who participated in the information auction first.

```sas
proc sort data=appletaste;
   by product condition group;
run;

proc mixed data=appletaste;
   class judge group product condition;
   model bidchange = group product condition group*product group*condition
                   product*condition group*product*condition;
   repeated product*condition / sub=judge(group) type=cs group=group;
   lsmeans product group condition group*product group*condition
       product*condition group*product group*product*condition / diff
       adjust=tukey;
   run;
   quit;
```

Hypothesis 2: To determine if bid prices were higher for the organic apples in comparison to the conventional apples for the group that received the information first when the apples were not tasted.

```sas
proc sort data=appletaste2;
   by product condition;
run;

proc mixed data=appletaste2;
   class judge group product condition;
   model biddisplay = product condition product*condition;
   random judge judge*product judge*condition;
   lsmeans product condition product*condition / diff adjust=tukey;
   run;
```

To determine if bids for the tasting auctions differed between groups

```sas
proc mixed data=appletaste;
   class judge group product condition;
   model bidtaste = group product condition group*product group*condition
                   product*condition group*product*condition;
   random judge judge*product judge*condition;
   lsmeans group product condition group*product group*condition
       product*condition group*product group*product*condition / diff
       adjust=tukey;
   run;
```
To determine if bids in the final, full information auction round differed between groups

``` Sas
proc mixed data=appletaste;
class judge group product condition;
model finalbid = group product condition group*product group*condition product*condition group*product*condition;
random judge judge*product judge*condition;
lsmeans group product condition group*product group*condition product*condition group*product group*product*condition / diff adjust=tukey;
run;
```

To determine if overall liking scores differed among groups, products, or conditions

``` Sas
proc mixed data=appletaste;
class judge group product condition;
model overliking = group product condition group*product group*condition product*condition group*product*condition;
random judge judge*product judge*condition;
lsmeans group product condition group*product group*condition product*condition group*product group*product*condition / diff adjust=tukey;
run;
```

To determine if texture liking scores differed among groups, products, or conditions

``` Sas
proc mixed data=appletaste;
class judge group product condition;
model textliking = group product condition group*product group*condition product*condition group*product*condition;
random judge judge*product judge*condition;
lsmeans group product condition group*product group*condition product*condition group*product group*product*condition / diff adjust=tukey;
run;
```

To determine if flavor liking scores differed among groups, products, or conditions

``` Sas
proc mixed data=appletaste;
class judge group product condition;
model flavliking = group product condition group*product group*condition product*condition group*product*condition;
random judge judge*product judge*condition;
lsmeans group product condition group*product group*condition product*condition group*product group*product*condition / diff adjust=tukey;
run;
```
To obtain means

```
proc sort data=appletaste;
by group product condition;
run;

proc means data = appletaste;
by group product condition;
var bidchange bidtaste biddisplay overliking flavliking textliking finalbid;
output out = means mean = bidchange bidtaste biddisplay overliking flavliking textliking finalbid
stderr = sbidchange sbidtaste sbiddisplay soverliking sflavliking stextliking sfinalbid;
run;
quit;
```
Appendix VII: Jitter-plot illustrating the unequal variance in the difference in bid price between the panel group that tasted first and the panel group that saw the information first.

Figure 10: Jitter-plot of the differences in bid price by panel group (taste first or information first), apple variety, and growing condition (organic or conventional). Darkened circles on the plot indicate an overlap of responses in that region.