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What are domestic apples worth? Hedonic responses and sensory information as drivers of willingness to pay

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Abstract

The effects of written information of key sensory characteristics of apple cultivars on hedonic ratings and willingness to pay (WTP) were measured in an experimental auction. Participants (n=118, 95F, 23M, mean age 37 y.) rated, in three subsequent rounds, pleasantness and WTP based on 1) appearance only (n=25), 2) appearance, written information and tasting (n=44), or 3) appearance, tasting and written information (n=49). Four domestic cultivars were described as medium sour & crispy ('Amorosa'), sour & medium crispy ('Konsta'), medium sweet & medium crispy ('Lobo') and sweet & medium crispy ('Tobias'). The differences between the cultivars in pleasantness and WTP were minimal when the evaluation was based on appearance only. The effect of tasting after visual inspection was positive in three cultivars and negative in one ('Konsta'). Written information after tasting did not affect pleasantness or WTP. For one cultivar ('Tobias'), information given before tasting created expectations that were not fulfilled, thus tasting decreased hedonic ratings and WTP. Mean WTP was 2.36 euro/kg. When pleasantness increased by one point, WTP increased by 0.31-0.45 euro/kg. Regression models showed that pleasantness explained 38-55% of WTP. Respondents who reported consuming domestic apples more often than once a week had 0.52-0.74 euro/kg higher WTP than those who consumed them less frequently, suggesting that familiarity with the product increases WTP. Results indicate that both written information and tasting contribute to the ratings of pleasantness and WTP.

Keywords: hedonic ratings; willingness to pay: BDM auction; apple; information

1 Introduction

Producers, industry and retail sector strive to create added value for their products within a category and capture attention from new customer segments. In this setting, locally produced foods have gained attention. Grebitus, Lusk, & Nayga (2013) showed that respondents considered local apples to be fresher, tastier and safer than non-local apples. According to Jaeger et al. (2011), horticultural markets are highly competitive and characterised by numerous poorly differentiated and low-priced products. This is the case also in Finland. Domestic apples are seasonal products and poorly differentiated or branded in retail stores, and imported apples of good quality are often sold at a low price (1–2 euro/kg). Apples are regarded domestic when they are grown and harvested in Finland although the cultivar strain itself may be of non-domestic origin. The market share of local production (4.8 million kg) is 4-6% of the total consumption of apples in Finland (Finnish Customs, 2013; Tike, 2013).

Consumers' willingness to spend money on a commodity can be studied with a range of hypothetical (e.g. contingent valuation, hypothetical choice experiment) and non-hypothetical value elicitation methods (VEMs). Non-hypothetical VEMs, such as experimental auctions, have gained rising popularity in the last two decades as a tool for the valuation of private and public goods mainly because of their ability to mimic real market situations by using real products and allowing for exchange of real money. This is probably why non-hypothetical VEM tends to provide more accurate willingness to pay (WTP) values than their hypothetical counterparts (Lusk & Shogren, 2007). Various combinations and designs have been used, the common feature being that real products need to be present, which may be accompanied with tasting of some or all of the samples by some or all respondents (e.g. Combris, Bazoche, Giraud-Héraud, & Issanchou, 2009; Lange, Martin, Chabanet, Combris, & Issanchou, 2002; McCluskey, Mittelhammer, Marin, & Wright, 2007; Yue & Tong, 2011).

In experimental auctions, a set of rules are used to determine, based on participants' bids, who the winner of the auctioned good is and what price is to be paid. Different auction mechanisms have been used in empirical studies such as Vickrey 2nd (Grebitus et al., 2013; Lange et al., 2002; Noussair, Robin, & Ruffieux, 2004) and nth price auction (Stefani, Romano, & Cavicchi, 2006; Zhang & Vickers, 2014) and Becker-Degroot-Marschack (BDM) auction (Becker, Degroot, & Marschack, 1964; Combris et al., 2009; Ginon,

Combris, Lohéac, Enderli, & Issanchou, 2014; Lusk, Fox, Schroeder, Mintert, & Koohmaraie, 2001; Lusk & Shogren, 2007; Noussair et al., 2004).

Experimental auctions have been applied in specialty products such as Champagne (Lange et al., 2002), region-of-origin labelled spelt (Stefani et al., 2006), GM-foods (Jaeger et al., 2004), and everyday commodities like apples (Costanigro, Kroll, Thilmany, & Bunning, 2014; Lund, Jaeger, Amos, Brookfield, & Harker, 2006; Zhang & Vickers, 2014), steaks (Lusk et al., 2001), orange drink, cookies and chocolate (Noussair et al., 2004), and wine (Combris et al., 2009; Grebitus et al., 2013). Lusk et al (2001) examined the effect of sensory information for steak tenderness on consumer WTP in a grocery store setting. When relying on tasting alone, an average premium was less than in condition in which samples were tasted and written information about tenderness was provided.

Hedonic ratings have been combined with WTP, either in within- or between-subjects settings. For example, Lange et al. (2002) had two respondent groups, one of which reported hedonic ratings of the samples, while the other rated WTP. In their study, Yue & Tong (2011) considered 14 apple cultivars, and respondents stated their WTP and liking of attributes (such as juiciness) for 6-7 samples, but not their overall liking. Lund et al. (2006) measuring liking after tasting, found that tasting had small effect on the mean WTP, but the distribution of the bids was different before and after tasting the samples. Ginon et al. (2014) observed a slightly better discrimination between cheese and bread samples with WTP mechanism than with ratings of liking.

Previous studies have mainly concentrated in studying discrimination ability of WTP compared to hedonic ratings. Apart from Lange et al. (2002) and the very recent articles by Zhang & Vickers (2014) and Ginon et al. (2014), who studied the relationship of WTP and liking with correlations, studies with direct comparison of WTP and hedonic responses are, to our knowledge, rare. Lange et al. (2002), studying WTP for Champagne, found that higher product discrimination was reached with bid prices than with hedonic ratings. Zhang & Vickers (2014) studied apples using two information conditions (taste first or information first). They measured both WTP and liking, but focused their discussion mainly on the effect of information condition, cultivar and growing conditions on bid price.

Liking a food product has been shown to be a major driver of choice (e.g. Arvola, Lähteenmäki, & Tuorila, 1999; Seppä, Railio, Vehkalahti, Tahvonen, & Tuorila, 2013a;

Huotilainen, Seppälä, Pirttilä-Backman, & Tuorila, 2006), and thus pleasantness, measured through hedonic rating, may be a predominant driver of WTP. Consequently, hedonic rating may be highly correlated with WTP. When designing this experiment we were interested in finding out how perceived pleasantness is shown in WTP.

The shoppers are typically able to examine only the extrinsic properties of the product i.e. visual information, such as colour and size, while repeated purchases ultimately depend on whether the inner sensory properties (flavour, texture) of the fruit were well-liked (Harker, Gunson, & Jaeger, 2003; Jaeger et al., 2011; Jaeger & MacFie, 2001; McCluskey et al., 2007). The timing of information may markedly affect expectations and actual perceptions of a product (Kähkönen, Tuorila, & Rita, 1996; Lange, Issanchou, & Combris, 2000; Zhang & Vickers, 2014). Kähkönen et al. (1996) showed that nutritional information offered before exposures increased pleasantness ratings. However, use of sensory descriptions as a type of information is rare. To our knowledge, only Lusk et al. (2001) has used this kind of information in WTP research. In addition, previous consumption practices and involvement in the product play a role in pleasantness, purchase intention and WTP (Hollebeek, Jaeger, Brodie, & Balemi, 2007; Kähkönen & Tuorila, 1999; Lange et al., 2002). Lange et al. (2002) observed that brand information increased WTP in respondents who consumed Champagne unfrequently, while frequent consumers of Champagne relied more on their individual hedonic expectations.

Based on the above papers, we have identified the following gaps: First, there is very little information on the effects of sensory descriptions on the hedonic ratings or WTP. Secondly, previous research has not explicitly analysed functional relationship between hedonic ratings and WTP. Furthermore, previous consumption has not been paid attention to except by Lange et al. (2002), while their samples were not an everyday commodity.

Therefore, the present study compares the effect of information provided at different phases (appearance of the product, written descriptive sensory information, tasting) on hedonic ratings and WTP, using a familiar local product frequently used as a snack (i.e. apple) with distinct sensory properties. The research questions were formulated as follows: 1) do the information of the product attributes and the timing of the information affect hedonic ratings and WTP, 2) what is the functional relationship between pleasantness and WTP, i.e. $F(plea) = a + b*plea$, and 3) how does previous domestic and general apple consumption affect hedonic ratings and WTP.

2 Materials and methods

2.1 Samples

Four domestic apple cultivars (‘Amorosa’, ‘Konsta’, ‘Lobo’, ‘Tobias’) were selected for the study based on their distinct sensory characteristics representing major sensory variations of cultivars in production and their availability during the study. ‘Lobo’ is the most widely cultivated domestic cultivar and ‘Amorosa’ is rapidly gaining popularity. ‘Konsta’ and ‘Tobias’ are novel cultivars. Each cultivar was harvested from one orchard in South-Western Finland. The apples were kept in the cold storage (+3°C, relative humidity 80–92%) of the research orchard of MTT (Agrifood Research Finland) until evaluations. Just before the first session, the apples were transferred to the cold storage (+4°C) at the University of Helsinki, where the evaluations were carried out.

The sensory profiles of the four samples (**Figure 1**) were determined by a trained panel (n=13, 11F, 2M, 24-57 years) using generic descriptive analysis as described by Seppä, Railio, Mononen, Tahvonen, & Tuorila (2012). All cultivars are red with some yellow or green colour. ‘Amorosa’ and ‘Lobo’ are crispy and juicy. Sourness of ‘Amorosa’ and ‘Konsta’ is typical for domestic cultivars. ‘Tobias’ is the least sour and least crispy of the four cultivars. Analysis of variance showed that the cultivars differed in all attributes except sweetness ($p<0.001$). The written apple descriptions provided (**Table 1)** were based on the descriptive analyses of the four cultivars reported in Seppä et al. (2012) and Seppä, Peltoniemi, Tahvonen, & Tuorila (2013b), evaluated in 2009 and 2010.

An unexpected difficulty was that the written sensory information, based on descriptive analysis of apples from the years 2009-2010, did not fully correspond to the actual sensory properties of the cultivars of the present study (apples of the year 2011). Slight changes, such as decreases in sweetness (‘Tobias’) and crispiness (‘Konsta’) were observed due to the rainy weather of the growing season in 2011. General apple information (process/dessert apple, colour of jam) was from Tahvonen (2007).

2.2 Participants

The respondents (n=118, 95F, 23M, mean age 37 years, range 19–79) were recruited by posters, e-mail posting lists and personal on-site contacts at the campus and neighbouring workplaces and residential areas. They randomly signed up for 13 separate sessions, each

participant to one session according to his or her schedule. The sessions were carried out either in the morning, mid-day or late afternoon. The late afternoon times were chosen so that those with full-time jobs were able to take part in the study. At the end of a session, each participant completed a questionnaire including demographic information and apple eating habits (**Table 2**).

The study protocol followed the ethical guidelines of the sensory laboratory, approved by the Ethical Committee of Viikki Campus, University of Helsinki. A written informed consent was obtained from each participant before entering the study. They used their own money in the study and received a gift card with a value of 10 euros after completing the task as a compensation for participating in the study.

2.3 Procedure

The data were collected in a classroom at the University within two weeks during the apple season. The arrangements followed the normal practices of sensory evaluation, in that the cultivars, evaluated at room temperature, were coded with three-digit numbers and presented in randomised order. The randomised order was printed individually in each ballot. The respondents were asked to evaluate the apples in the order provided in their individual ballots.

In each round, two types of responses were elicited. First, the respondents rated the pleasantness of the cultivars on a nine-point scale (1 ‘extremely unpleasant’ to 9 ‘extremely pleasant’) and then indicated their WTP, expressed as the maximum amount of money in euros each participant was willing to pay for a kilogram of apples (euro/kg). One paper ballot for reporting pleasantness and WTP was used in each round and collected after the round. A new ballot was given for the next round which followed immediately the previous round. Respondents were instructed to drink water after tasting each sample. Unflavoured corn snacks were also available for rinsing the mouth.

The procedure used in the auction was the BDM-mechanism (see 2.3.2). Each participant signed up for one session, comprising three hedonic ratings and auction rounds (**Figure 2**). Three treatments (TR1, TR2, TR3) were used, and each session was randomly assigned to one treatment type. The total number of sessions was 13. The number of participants per session varied from 6 to 14. To offer different types of treatments at different times of the

day, more than one session was conducted per treatment. TR1 was used in three sessions, and TR2 and TR3 in five sessions.

Each of the three treatments was conducted in three rounds (R1, R2, R3). In each round participants were allowed to either look at the samples or taste them or they were given written information on the sensory characteristics of each sample. The type and order of the cues depended on the treatment and the round and was provided sequentially (**Figure 2)**.

The unpeeled cultivars were on display in open bowls (visual and written information phases) or given in four separate closed paper bags (tasting). The three-digit codes of the apples were written on the edge of the bowls, on the bags and above the written information. Following Combris et al. (2009), respondents were requested not to talk to each other during the session. In addition, they were asked not to inform other people about the experiment before the end of data collection. To avoid the problem of bid affiliation and to carry out a clean assessment of the information effect, we did not post participants' bids after each round (Corrigan & Rousu, 2006).

2.3.1 Treatments

TR1 was designed to serve as a control group, which allows testing round-effect and whether there was over-bid or under-bid in the first rounds. The control group helps to evaluate whether any change in pleasantness or WTP in TR2 or TR3 between rounds was caused by the round or by other effects such as learning (Lusk & Shogren, 2007). Hence, participants in TR1 (n=25) did not receive any other information than visual cues nor did they taste the apples throughout the three rounds. They rated pleasantness and WTP based only on the visual inspection of the four apple cultivars. At the beginning of each round, participants were invited to inspect the apples in the bowls placed at the front and back of the room.

Similar to TR1, the other two treatments had visual exposure in the first round. In the second round, participants in TR2 (n=44) received written information about sensory characteristics of the apples (**Figure 2, Table 1**), and those in TR3 (n=49) were invited to taste the four cultivars. In the third round, participants in TR2 were instructed to taste the apples, while those in TR3 were given the written information. Thus, the main interest was finding out the effect of individual and cumulating information as well as its type and timing on pleasantness and further on WTP.

2.3.2 BDM auction

The auction followed the BDM-mechanism. In BDM-mechanism, participants report their WTP for a single unit of a specific product. Then, the experimenter randomly chooses one of the participants to randomly draw a single price from a price distribution. All participants with a bid higher than the randomly drawn price are declared buyers. Each buyer obtains one unit of the auctioned product and pays a price equal to the randomly drawn price.

BDM-mechanism was chosen because it is insensitive to the number of participants in auction sessions and the simplicity of its implementation with inexperienced participants (Combris et al., 2009; Jaeger et al., 2004; Lusk & Shogren, 2007). The main advantage of BDM is that it does not require the same number of participants in each session because participants in the same session are not competing as it is the case in Vickrey auction. This makes practical arrangement easier than with some other methods. It is also theoretically incentive-compatibility (i.e. the best bidding strategy for participants is to truthfully report their bids for the auctioned product).

Before the first round, an explanation of the BDM-procedure was given (a tailored power point presentation for each treatment type). First, the sequence of the rounds in each treatment and the importance of following the individual presentation order of the samples (printed in the ballots) were explained. Next, the evaluation and drawing procedures were explained. Then, to ensure that participants had understood the procedures, a practical training session was conducted with a snack bar. The training was important, since the BDM-mechanism was unfamiliar to participants, and those who are not well trained are likely to underestimate their WTP (Drichoutis, Nayga, & Lazaridis, 2011). After the training phase, participants were encouraged to ask questions if anything was left unclear. Then the three rounds were conducted, followed by the identification of buyers and the price that has to be paid.

After the training and before the starting of the first round, participants were given the range of domestic apple market prices during the previous season (1.80–6.00 euro/kg), obtained from the Association of Finnish Fruit and Vegetable Producers. It was explained thoroughly that the price depends on the time of the season and the type and quality of apples. The range of market prices was given for several reasons: a) not all participants

were familiar with the market prices, since the market share of the domestic apples is low, b) domestic apples are sold only during the apple season (end of August to late December), and people may lose their price consciousness if domestic apples are not an everyday food item, c) apples are often obtained free of money from own garden or that of a relative or friend, which makes it even more difficult to estimate the prices. Providing market price information to participants is not uncommon in valuation studies (see Lusk, Feldkamp, & Schroeder, 2004; Lusk & Shogren, 2007). About 20% of the bids were below 1.80 and the highest was 5.00 euros.

At the end of the session, one of the three rounds was randomly selected to be the binding round. Next, one of the auctioned products in the binding round was randomly chosen to determine the binding product. Finally, the price was randomly drawn from a price distribution ranging from 1.00 to 6.00 euro/kg with an increment of 20 cents. All three draws were done by randomly selected participants. The respondent purchased apples, if her/his bid was greater than the randomly drawn price in the binding round. For practical reasons, apples were packed beforehand into transparent plastic bags, weighting between 500-600 g, and containing 5-6 apples. Participants were able to choose the bag they wanted if they won the bid, and paid the randomly drawn price.

2.4 Data analysis

Mean pleasantness ratings and WTP were calculated across treatments and rounds for each cultivar and also for each treatment and round separately. Differences in pleasantness and WTP were analysed using two-way repeated measures analysis of variance for each treatment separately with the factors cultivar (4) and round (3). Main effects and interactions were studied at the significance level $p=0.05$. Least significance difference (LSD) test was used for multiple comparisons of cultivars and rounds. Difference in pleasantness and WTP between TR2 and TR3 in the last round (R3) was tested with t-test for independent samples. The functional relationship between pleasantness and WTP was assessed using the linear regression analysis.

Two age groups were formed for the purpose of the analyses: 34 years or younger (n=66, 56%) and older than 34 years (n=52, 44%). Two new variables were generated for apple eating frequency, “heavy eaters” (more than once a week) and “light eaters” (once a week or less), for domestic apples and apples in general. In the following text, the term “apple

consumption" refers to apple eating, as respondents were asked only about eating apples. Using apples for cooking or other processes such as making jam were excluded.

The effect of gender, age group and dichotomised apple eating frequency on pleasantness and WTP was tested using t-test. Differences in the demographic background of respondents between treatment groups were tested with analysis of variance.

All respondents who reported their age, frequency of eating domestic apples and WTP for the samples were included in the analyses, leading to 118 participants. One of them did not rate pleasantness of the cultivars in TR2, round 1, one did not report frequency of eating apples in general, and four answered the question concerning income class "don't want to tell". The missing data were not imputed. PASW 18 was used to carry out the statistical analyses (PASW Statistics 18.0.2, IBM SPSS Software, Chicago, IL, USA).

3 Results

3.1 Participants

All participants reported to be living in Helsinki metropolitan area. Overall they were highly educated, as 67% had at least college education (**Table 2**). Little over 40% were students, but half of them were part-time workers. One third (32%) earned 20 000 euros or less, and 45% earned between 20 001 and 60 000 euros a year. There was no significant difference in age, frequency of eating apples, hedonic ratings or WTP between female and male participants, nor were there differences in hedonic ratings or WTP between the two age groups (≤34 y., >34 y.), with the exception of the group of younger participants who perceived the sour cultivar 'Konsta' as slightly less pleasant ($p=0.018$). There were no major differences in participants' demographic background between the treatments. No systematic difference appeared between evaluations either when comparing hedonic ratings or WTP between the first rounds of the three treatments ($p>0.6$).

All respondents were regular apple consumers, and 87% ate apples frequently ("2-4 times a month" to "daily"). Domestic apples and apples in general were eaten daily by 37% and 25% of the respondents, respectively. Among all respondents, 56% (n=66) were heavy eaters of apples in general, while 64% (n=76) were heavy eaters of domestic apples. The frequency of consumption did not differ between the treatments for domestic apples or apples in general (p-values from 0.281 to 0.651 and from 0.182 to 0.706, respectively).

3.2 Hedonic ratings and WTP

The average hedonic rating and WTP over all cultivars, rounds and treatments were 6.6 (SD ± 1.7), and 2.36 euro/kg (SD ± 0.91), respectively. Eight respondents reported zero WTP (0.00 euro/kg) for one or more cultivars in one or more sessions, but none gave zero to all offers. In total, there were only 27 zero bids among 1416 bids. The means of pleasantness and WTP were quite similar for 'Amorosa', 'Lobo', 'Tobias', whereas they were lower for 'Konsta'. Taking into account only the results from TR1 (all rounds) and R1 in TR2 and TR3, where the assessment was based on appearance only, differences between the cultivars were found to be small **(Table 3).** Mean pleasantness ranged from 6.1 ('Konsta' and 'Amorosa') to 7.0 ('Amorosa') and mean WTP ranged from 2.18 ('Konsta') to 2.47 euro/kg ('Amorosa', 'Lobo', 'Tobias').

3.3 Effect of information on hedonic ratings and WTP

To study the effect of the type, timing and acccumulation of information (Research Question 1), data was organised in treatments and rounds (**Figure 2**). There was no main effect of round in hedonic ratings but WTP differed between rounds in TR1 and TR2 **(Table 4)**. Differences between cultivars were clear in TR2 and TR3 in terms of both pleasantness and WTP. In TR2 and TR3, interaction between cultivar and round was significant for both pleasantness and WTP ($p<0.001$ for all), indicating that they changed between rounds depending on the cultivar, when written information and taste were involved.

When pleasantness and WTP were studied between cultivars in each treatment and round separately, no difference was observed in all rounds in TR1 or R1 in TR2 (i.e. visual cues) (**Table 3**). In the second and third round of TR2 and TR3, differences between cultivars were all significant. 'Konsta' and 'Tobias' got the lowest and highest ratings, respectively. In TR2, between R2 and R3 (written information followed by tasting), pleasantness and WTP for 'Tobias' decreased by 0.6 units (on the 9-point pleasantness scale) and 0.29 euro/kg, respectively, but the difference is not significant ($p=0.054$ and $p=0.219$, respectively).

Examining the ratings of pleasantness and WTP between rounds showed that the order and type of information affected the measures. When the evaluation was done based on visual cues only (TR1), there was no difference between rounds in any of the cultivars (**Table 3**).

When information followed the visual cues of R1 (TR2, R2), ratings of pleasantness and WTP for the sour cultivar 'Konsta' declined from 6.1 to 5.5 and they rose for the other cultivars, although only the difference in pleasantness of red and somewhat mealy 'Tobias' was statistically significant ($p=0.027$). Tasting the apples (TR2, R3) caused the pleasantness of 'Tobias' to decline from 7.4 to 6.7 ($p=0.054$). Comparing the sour 'Konsta' between R1(visual) and R3(taste) revealed a decline of 1.1 in pleasantness ($p=0.009$) and 0.47 euro/kg in WTP ($p=0.017$). For other cultivars, no significant difference was observed between R1 and R3 in TR2.

When tasting followed visual cues (TR3 R2), ratings of pleasantness and WTP rose for 'Amorosa' from 6.1 to 7.2 and from 2.19 to 2.59 euro/kg ($p<0.001$ and $p=0.006$, respectively), respectively, and for 'Konsta', ratings of pleasantness declined from 6.4 to 5.5 ($p=0.008$). When written information followed visual cues and tasting (TR3, R3), no change in pleasantness or WTP was observed in any of the cultivars, indicating that providing written information after tasting has low impact. With all cues present differences in pleasantness and WTP (TR2, R3 vs TR3, R3) were found to be small between TR2 and TR3, except pleasantness for 'Tobias' ($p=0.039$), because in TR2, pleasantness declined after tasting (from 7.36 to 6.73) to the same level where it was before written information (6.63).

3.4 Comparison of hedonic ratings and WTP

The aforementioned results suggest that the round and the type of information affected the pleasantness and WTP in different ways, depending on the cultivar and information (Research Question 1). When WTP was predicted by pleasantness using pooled cultivar data (linear regression analysis), β and R^2 varied only slightly by treatment and round in the models (Research Question 2) (**Table 5**). The results of the models' estimation show that when pleasantness goes up by one point, WTP increases by 0.31 to 0.45 euro/kg. Furthermore, the estimated models explained 38-55% of WTP. Thus, about half of WTP is caused by other reasons than pleasantness.

3.5 Effect of frequency of consumption on pleasantness and WTP

To study the effect of frequency of consumption on pleasantness and WTP, respondents were divided into groups based on their reported frequency of eating domestic apples and apples in general (Research Question 3). The heavy eaters of domestic apples were older

than light eaters (40.9 y. vs. 31.6 y., p=0.002), while for the eaters of apples in general, the age difference was smaller (39.6 y. vs. 34.5y., p=0.080). There was no major difference in education or income level between either of the eating frequency groups (p-values from 0.309 to 0.822).

Heavy eaters of domestic apples reported a higher WTP than light eaters of domestic apples ($p \leq 0.001$). The mean difference between these groups was highest for 'Lobo' (0.74 euro/kg) and smallest for 'Amorosa' (0.52 euro/kg). The ratings of pleasantness were also higher among the heavy eaters than light eaters of domestic apples, but the statistical difference was less significant (p varied from 0.015 to 0.175). For heavy and light eaters of apples in general, no major differences in pleasantness or WTP were observed.

Studying WTP in more detail by treatment and round showed that the heavy eaters of domestic apples were willing to pay from 0.26 to 1.13 euro/kg more than the light eaters, and the majority of the differences were significant (**Table 6**). Most of the differences in pleasantness were small and below the level of significance (data not shown). Again, no differences were observed between the heavy and light eaters of apples in general in either of the measures. The results indicate that heavy eaters of domestic apples are motivated to pay higher prices for domestic apples, even in situations where they find the pleasantness of these apples modest.

When linear regression models were specified to predict WTP by pleasantness based on treatment and eating frequency groups of domestic apples or apples in general, results did not show any reasonable trend, although some models differed between the heavy eaters of domestic apples compared to the heavy eaters of apples in general. With low number of respondents due to the treatments ($n \leq 20$ in some of the eating frequency groups), no definite conclusions are possible regarding the effect of pleasantness on WTP in the eating frequency groups.

4 Discussion

4.1 General overview

We had three main research questions to answer: 1) how do information and its timing affect hedonic ratings and WTP, 2) what is the relationship between WTP and hedonic ratings, and 3) how does frequency of consumption affect these measures. The overall mean

rating of pleasantness and WTP was 6.6 and WTP 2.36 euro/kg, respectively. When only visual cues were available, differences between cultivars were small. With accumulating information, both pleasantness and WTP differentiated cultivars in all settings (R2 and R3 in both TR2 and TR3) (Research Question 1). Similar observations were made by Zhang & Vickers (2014). Regression models showed that when pleasantness increased by one point (scale 1-9), WTP increased by 0.31 to 0.45 euro/kg (Research Question 2). Reported heavy consumption of domestic apples (more than once a week) increased WTP considerably, over 0.5 euro/kg, compared to the less frequent consumption (Research Question 3).

4.2 Comparison of hedonic ratings and WTP

Our results suggest that the round and the type of information affected the pleasantness and WTP, but the effect depended on the cultivar and information available (Research Question 1). Thus, we concur with Arvola et al. (1999) who showed that pleasantness of cheese measured by tasting dominated over attitudes as a choice criterion, especially with unfamiliar cheeses. Although apples differ from cheeses both by nature and typical ways of use, our results suggest that offering shoppers a possibility to taste a product is a strategy worth to consider in marketing.

The means of the ratings of pleasantness for each cultivar showed that sour 'Konsta' was regarded as the least pleasant and not-sour 'Tobias' as the most pleasant. As regard the WTP, similar results were found (i.e. participants' WTP was the lowest for sour 'Konsta' and the highest for not-sour 'Tobias'). While both evaluation methods revealed almost identical discrimination between the cultivars and rounds, there were also differences. For 'Tobias' in TR2(visual-information-tasting), pleasantness differed between the rounds more than WTP. Also, differences between cultivars were larger in R2(information) of TR2 with pleasantness than with WTP. Noussair et al. (2004), comparing hedonic ratings and WTP measured with Vickrey (orange drinks and chocolate bar) or BDM (cookies) auctions reported results similar to ours.

As documented in previous studies (Combris et al., 2009; Kähkönen et al., 1996; Lange et al., 2000), information has an effect on hedonic ratings and WTP, and the magnitude and direction of change depend on the samples tested. In the present study, ratings of pleasantness differentiated rounds (information stages) of two cultivars in TR2 and TR3,

but WTP only one cultivar in each treatment. Thus, pleasantness revealed differences more clearly.

Lange et al. (2002), studying five different Champagnes, found a better product discrimination with WTP than hedonic ratings. Value of the finding diminishes slightly because WTP and liking data were collected from different groups, although demographic background was balanced and ranking order of the Champagnes did not change. However, it may be that Champagne is a product for which price differences are more critical and more sensitive indicator of quality than liking. In Lange et al. (2002), this was the case especially for he unfrequent consumers of Champagne. Noussair et al. (2004) noted that social or internal pressure may cause participants to rate their WTP higher than the actual liking is. Apples are unlikely to create such pressure.

Information of the character of 'Konsta' has a clear meaning to Finns: when an apple is process apple, it is sour, crispy and firm. However, 'Konsta' was somewhat mealy and only medium crispy and thus, proved to be a disappointment as crispiness is a highly valued property of apples (Galmarini, Symoneaux, Chollet, & Zamora, 2013; Harker et al., 2003; Seppä et al., 2013a).

Likewise, information on 'Tobias' created expectations, this time positive, and pleasantness rose substantially, while the rise in WTP was less significant. Tasting declined the rate of pleasantness of 'Tobias' sharply, contrary to WTP, which declined more moderately. Possibly the texture of 'Tobias' was also a disappointment, but as the cultivar is novel, respondents were willing to purchase it in spite of its mealy quality.

Zhang & Vickers (2014) observed that for cultivar 'Braeburn' (a cultivar familiar to the participants), bids decreased significantly after tasting in information first -condition, while in taste first -condition, not much change in the bids was observed after the second step, giving information. The lot of 'Braeburn' in that study was exceptionally soft, and thus respondents were disappointed with it, a case similar to "Tobias" in our study. With its low sourness, 'Tobias' is rather atypical for a domestic cultivar. However, the cultivar may have been slightly over-ripe and its sweetness was lower than previous years, on which the written sensory information was based (Seppä et al., 2012; 2013b). Thus, great care must be taken when formatting written descriptions. They should be realistic and cover typical

quality variations. Quality characteristics should also be taken into account in marketing claims.

4.3 Effect of frequency of consumption on pleasantness and WTP

Results of linear regression analysis showed that about half of WTP could be explained with pleasantness (Research Question 2), while the other half of WTP is caused by other, partly unknown factors. One of these variables was shown to be previous use frequency of domesic apples, but not that of apples in general (Research Question 3). Thus, WTP increased with reported high consumption of domestic apples. In accordance with the findings by Hollebeek et al. (2007), our results suggest that frequent consumers of a food product are more willing to pay higher price for it because they know what they are paying for.

Naturally, respondents also tend to like the products they frequently consume (Kähkönen & Tuorila, 1999). However, the present results suggest that frequent consumption leads to increases in WTP, but not necessarily in increased ratings of liking. It may be even possible that for frequent eaters of domestic apples, pleasantness is less important than the possibility of buying domestic apples, which are not always easily available in big cities. Consequently, frequent consumers of a product are familiar not only with the product itself, but also more able to read and interpret written descriptions of it. This is supported with the findings from comments analysis by Galmarini et al. (2013): respondents who ate apples daily mentioned more descriptive words and cultivar names than those who ate apples less frequently, i.e. vocabulary concerning apples was more familiar.

Yue & Tong (2011) found that frequent apple buyers were slightly younger, had larger household size and had higher income level than infrequent buyers. However, only the age category mean was reported, and consequently, real mean age was not revealed. In our study, the heavy eaters were older than light eaters in both categories, although the difference was clearer with domestic apples, and no differences in income level were observed between the frequency of consumption groups. In this research, the respondents were asked to report their own consumption only, while Yue & Tong (2011) inquired about apple buying, in which case people with families naturally report buying more apples.

4.4 Methodological considerations

Lund et al. (2006), investigating the effect of apple freshness using WTP, were surprised to learn how little participants knew about normal storage times of apples, an observation confirmed by Harker et al. (2003). Participants in Lund et al. (2006) were not aware of the seasonality of apples either. On the contrary, Finns should be well aware of the seasonal nature of garden produce, including apples, because of the clear seasonality in the weather. Thus, we believe that the separate questions concerning eating frequency of domestic apples and apples in general were soundly based. Proof for this is that the frequencies of consumption differentiated the participants, some were heavy eaters of one type of apples but not the other, and vice versa, while there was also a group of heavy eaters of both apple types.

In studies where the effect of written or label information on WTP has been investigated, the information has usually comprised of health-related information (Ginon, Lohéac, Martin, Combris, & Issanchou, 2009; Kähkönen & Tuorila 1999) or claims concerning origin (Combris et al., 2009; Costanigro et al., 2014; Grebitus et a., 2013; Hollebeek et al., 2007; Stefani et al., 2006; Zhang & Vickers, 2014), quality (Ginon et al., 2014; Lange et al., 2002; Lund et al., 2006) or production method (Zhang & Vickers (2014). To our knowledge, the research by Lusk et al. (2001) on steak tenderness is the only one before our study where descriptions of the sensory properties of a product have been used as a source of information. In this sense our work is unique, while, on the other hand, this type of product information will not elicit polarised or extreme responses, as is more likely in the case of health or production method information.

The original plan was to allow purchases of one kg or even more, but we were forced to limit it to 0.5 kg, because one cultivar came from several orchards and not from one as would be the optimal case. As we wanted the apples from each cultivar to originate from only one orchard, we had to set a limit to the quantity we could sell to guarantee sufficient amount of apples throughout the sessions. We believe that this did not affect the auction procedure, because in Finland, it is very common to buy apples by the number, especially if buying for a snack. As domestic apples are relative small, a package of 0.5 kg to 0.6 kg contained 4-7 apples. Yet, the shoppers are informed of the price of kg, when buying fruits or vegetables, so the situation resembled a normal shopping occasion.

The number of zero bids was 2% (27 cases). The zero price option was not specifically stressed in our study but it was mentioned during the training. The low number of zero bits

519 is probably because apple prices are generally low, compared to products of higher
520 monetary value such as steaks or Champagne. Apples are an ordinary food product in
521 Finland, as they are the second most common fruit after bananas (Finnish Customs, 2013).
522 In addition, domestic apples of good quality are not always easily available in the city,
523 which may have increased interest. Consequently, the respondents found apples a useful
524 item to buy.

525 Previous research (Seppä et al., 2013a) suggested that apple eaters can be clustered into
526 three distinct groups: those who prefer sour & firm, medium sour & medium sweet or sweet
527 & slightly soft apples, which is in accordance with the findings by other researchers (e.g.
528 Carbonell, Izquierdo, Carbonell, & Costell, 2008; Tomala, Baryłko-Pikielna, Jankowski,
529 Jeziorek, & Wasiak-Zys, 2009). Here, dividing respondents into preference segments was
530 not worthwhile, because, due to the treatments, the number of respondents would have been
531 too small for clustering. Further research should aim at having either a higher number of
532 respondents than here, or using a simpler procedure to obtain a detailed analysis of
533 pleasantness and WTP and their relationship in different consumer groups. Without
534 considering clusters, we may end up having products that are acceptable, but not delightful.

535 **5 Conclusions and future prospects**

536 To maximise consumer satisfaction and future purchases it is important to know consumer
537 preferences and willingness to pay for different products. As for the apple cultivars,
538 traditionally new crosses have been selected for cultivation based on a few opinions
539 (usually those of the breeders), which does not guarantee that the sensory quality of these
540 apples will be widely popular. The results emphasise that tasting experience is important
541 before the purchase decision. Good labelling enables consumers to purchase again their
542 favourite cultivar. Farmers should be encouraged to use alternative forms of market
543 channels such as farmer's market or the other forms of farmer-to-consumer direct
544 marketing, where farmers are able to discuss with their customers and provide them
545 additional information and allow them to taste the products.

546 Finding that the frequent consumers of domestic apples are willing to pay for apples over
547 half euro per kg more than other respondents, suggests that promotion of domestic apple
548 consumption eventually promotes also the prices paid for them. Information of good quality
549 and proper timing is a prominent way of assisting consumption. Mean WTP 2.36 (SD ±

550 0.91 euro/kg) obtained from this study shows that consumers are willing to pay a price
551 premium for domestic apples. Some apples of non-domestic origin are sold around the year
552 at a low price of 1 euro/kg or less.

553 Our results showed that almost the same discrimination is achieved with pleasantness and
554 WTP. Differences between cultivars were rather small when rated pleasantness and WTP
555 were based only on the appearance of the auctioned apple cultivars. Substantial differences
556 emerged, when other aspects were added, especially written information and tasting
557 combined. Currently, in a normal shopping situation, consumers receive very little
558 information about the cultivars available (either domestic or imported). Finally, an
559 interesting topic for future research is to replicate our study measuring consumers' hedonic
560 ratings and WTP for both domestic and imported apples.

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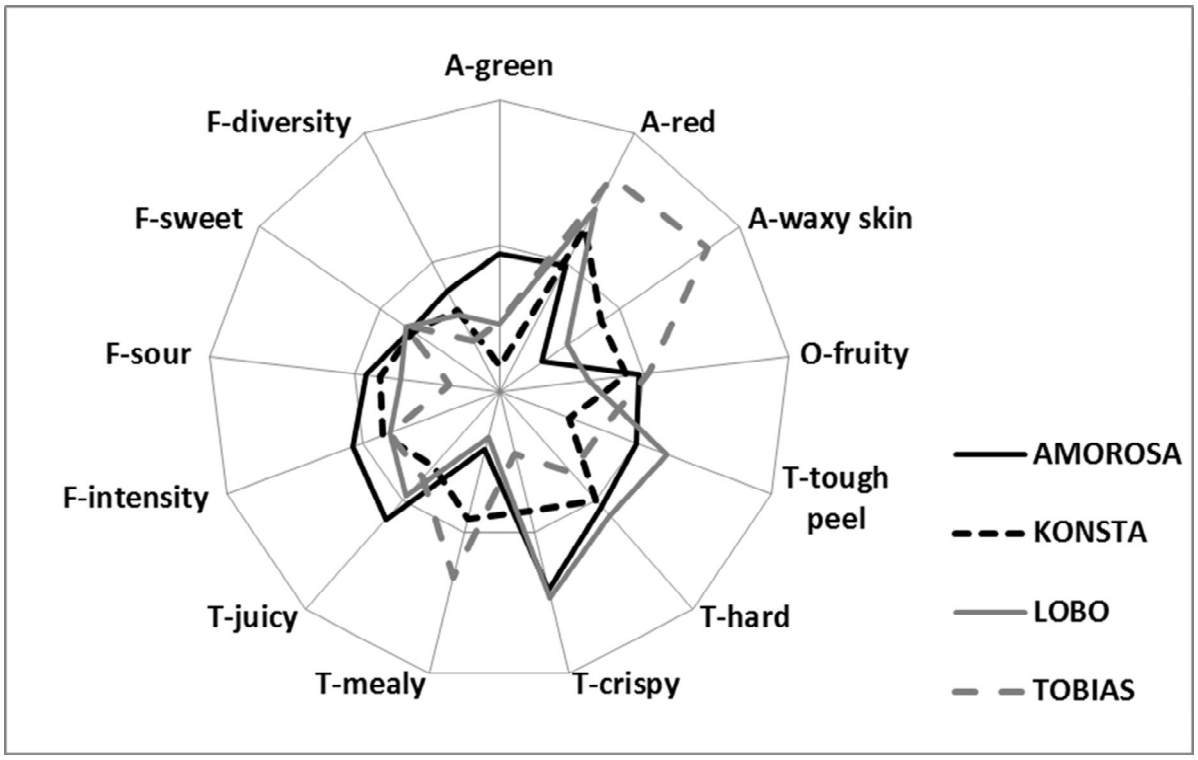
FIGURES



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673 Figure 1. The profiles of the four cultivars, based on descriptive analysis (n=13). The
674 profile is based on 2x2x13 ratings of each attribute. A= appearance, O = odour, T = texture
675 and F = flavour attributes.

676

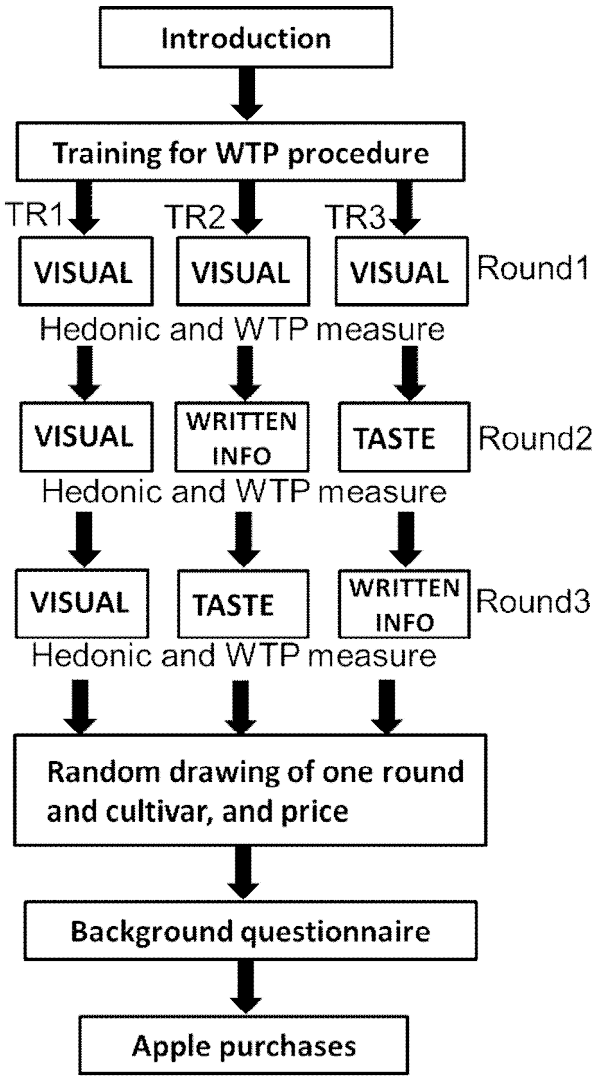

Figure 2. Flowchart of the auction sessions, which were carried out using three different types of treatments (TR1, TR2, TR3). Each participant was randomly assigned to one type of treatment. Introduction was tailored for each treatment type. Round1 (visual cues) was similar in all treatments. In each round, both pleasantness and WTP were rated, n(TR1)=25, n(TR2)=44, n(TR3)=45.

TABLES

Table 1. Written information provided about the cultivars, based on Seppä et al. (20012; 2013b) and Tahvonen (2007). In the ballot sheet, only the three-digit numbers and no cultivar names were shown to the participants.

Amorosa	**Konsta**	**Lobo**	**Tobias**
Dessert apple	Process apple Also suitable for eating as such	Dessert apple	Dessert apple Creates nice colour when preparing jams
Medium sour	Sour	Slightly sour	Slightly sour
Slightly sweet		Medium sweet	Sweet
Crispy	Medium crispy	Medium crispy	Medium crispy
Juicy	Slightly juicy	Juicy	Medium juicy

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Table 2. Profile of the participants (n=118).

Age group, years	**n**
19-24	35 (29.7%)
25-34	31 (26.2%)
35-54	28 (23.8%)
55-79	24 (20.3%)
Education	
Basic level	39 (33.0%)
Bachelor's degree	35 (29.7%)
Upper university degree	44 (37.3%)
Work status	
Working	63 (53.4%)
Student a)	49 (41.5%)
Maternity leave, pension	6 (5.1%)
Income of the family	
20.000 euros or less	38 (32.2%)
20.001-60.000 euros	53 (44.9%)
60.001 euros or above	21 (17.8%)
NA b)	6 (5.1%)
Eating frequency, apples in general	
about once a month	15 (12.7)
2-4 times a month	36 (30.5%)
couple of times in a week	36 (30.5%)
daily	30 (25.4%)
NA	1 (0.8%)
Eating frequency, domestic apples during season	
about once a month	16 (13.6%)
2-4 times a month	26 (22.0%)
couple of times in a week	32 (27.1%)
daily	44 (37.3%)

a) approximately half of the students worked part-time.

693 b) NA data not available.

694

Table 3. Rated pleasantness of and willingness to pay (WTP) for each cultivar with standard error (SE) in different rounds (R) of each treatment (TR).

	Pleasantness (SE) [a b)]						Willingness to pay (WTP)					
TR1 [c)]	R1 visual		R2 visual		R3 visual		R1 visual		R2 visual		R3 visual	
AMOROSA	6.96 (0.27)		6.72 (0.28)		6.76 (0.28)		2.47 (0.17)		2.47 (0.14)		2.45 (0.13)	
KONSTA	6.48 (0.33)		6.42 (0.36)		6.58 (0.33)		2.28 (0.20)		2.40 (0.20)		2.46 (0.18)	
LOBO	6.52 (0.38)		6.64 (0.38)		6.72 (0.36)		2.30 (0.18)		2.47 (0.17)		2.43 (0.18)	
TOBIAS	6.56 (0.32)		6.82 (0.26)		6.60 (0.29)		2.36 (0.16)		2.46 (0.14)		2.44 (0.15)	
TR2 [d)]	R1 visual		R2 info		R3 taste		R1 visual		R2 info		R3 taste	
AMOROSA	6.51 (0.23)		6.86 (0.25)	B	6.95 (0.23)	B	2.26 (0.14)		2.49 (0.14)	B	2.50 (0.15)	B
KONSTA	6.14 (0.27) b		5.48 (0.27) ab	A	5.07 (0.31) a	A	2.18 (0.14) b		1.92 (0.12) ab	A	1.70 (0.14) a	A
LOBO	6.51 (0.26)		6.95 (0.22)	B	7.07 (0.19)	B	2.29 (0.16)		2.49 (0.16)	B	2.57 (0.16)	B
TOBIAS	6.63 (0.24) a		7.36 (0.21) b	BC	6.73 (0.24) ab	B	2.35 (0.16)		2.67 (0.16)	B	2.38 (0.18)	B
TR3 [e)]	R1 visual		R2 taste		R3 info		R1 visual		R2 taste		R3 info	
AMOROSA	6.10 (0.22) a	A	7.24 (0.21) b	C	7.14 (0.20) b	C	2.19 (0.11) a	A	2.59 (0.10) b	C	2.54 (0.10) b	C
KONSTA	6.43 (0.24) b	AB	5.53 (0.23) a	A	5.57 (0.24) a	A	2.26 (0.12)	AB	1.96 (0.12)	A	1.95 (0.12)	A
LOBO	6.76 (0.20)	B	6.63 (0.21)	B	6.59 (0.22)	BC	2.46 (0.11)	B	2.35 (0.11)	B	2.36 (0.11)	BC
TOBIAS	6.82 (0.23)	B	7.33 (0.19)	C	7.37 (0.19)	C	2.47 (0.11)	B	2.67 (0.11)	C	2.66 (0.12)	C

a) small letters a, b (in rows) denote difference in pleasantness or WTP of each cultivar between the rounds of each treatment, at significance level $p<0.05$, based on LSD.

b) capital letters A, B, C (in columns) denote difference in pleasantness or WTP between cultivars in each round in TR1, TR2 or TR3, at significance level $p<0.05$, based on LSD.

c) n=25

d) n=44, except for pleasantness in TR2, round 1 n=43

695 e) n=49

696

Table 4. Results of repeated analysis of variance performed on pleasantness and willingness to pay (WTP), with the factors cultivar (4) and round (3) in treatments (TR) 1, 2 and 3.

	Pleasantness			WTP		
	df; df_{error}	F	p	df; df_{error}	F	p
TR1 (n=25)						
cultivar	3; 72	0.21	0.890	3; 72	0.12	0.951
round	2; 48	0.24	0.784	2; 48	3.41	0.041
cvar x roun	6; 144	1.15	0.338	6; 144	0.67	0.678
TR2 (n=44) [a)]						
cultivar	3; 126	12.06	<0.001	3; 129	8.06	<0.001
round	2; 84	1.72	0.186	2; 86	4.11	0.020
cvar x roun	6; 252	4.95	<0.001	6; 258	4.46	<0.001
TR3 (n=49)						
cultivar	3; 144	11.43	<0.001	3; 144	11.15	<0.001
round	2; 96	2.28	0.108	2; 96	0.93	0.398
cvar x roun	6; 288	11.44	<0.001	6; 288	9.65	<0.001

697 a) missing ratings of pleasantness by one respondent in round 1.

698

Table 5. Regression models for willingness to pay as a function of pleasantness ratings (B) with standard error (SE). Pooled cultivar data, according to treatment (TR) and round (R).

Treatment (TR)		Round (R)	**Constant (SE)**	**B (SE)**	**R^2**
TR2	(n=44)	visual cues (R1)	-0.39 (0.23)	0.41 (0.04) ***	0.45
		information (R2)	-0.23 (0.23)	0.39 (0.03) ***	0.45
		tasting (R3)	-0.60 (0.21) **	0.45 (0.03) ***	0.55
TR3	(n=49)	visual cues (R1)	0.35 (0.19)	0.31 (0.03) ***	0.38
		tasting (R2)	0.10 (0.18)	0.34 (0.03) ***	0.48
		information (R3)	0.05 (0.18)	0.35 (0.03) ***	0.47

a) level of significance: *** p<0.001; ** P<0.01

Table 6. Mean difference in the amount of money in euros that heavy and light eaters of domestic apples were willing to pay in treatments 2 and 3.

Round	Treatment 2 (n=45) [a]			Treatment 3 (n=49) [b]		
	VISUAL	INFO	TASTE	VISUAL	TASTE	INFO
	Price difference (euro/kg) (heavy users - light users)			Price difference (euro/kg) (heavy users - light users)		
AMOROSA	0.26	0.61 *	0.73 * [c]	0.70 **	0.50 *	0.44 *
KONSTA	0.74 **	0.38	0.69 *	0.27	0.55 *	0.71 **
LOBO	1.13 ***	1.11 ***	0.95 **	0.45 (*)	0.40 (*)	0.39
TOBIAS	0.96 **	0.92 **	0.76 *	0.54 *	0.33	0.57 *

a) In TR2, n(heavy)=26, n(light)=18

b) In TR3, n(heavy)=34, n(light)=15

c) level of significance: *** p<0.001; ** P<0.01; * p<0.05, (*) p<0.1