

1 What are domestic apples worth? Hedonic responses and sensory information as 2 drivers of willingness to pay

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6 Abstract

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

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

27 **1 Introduction**

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

40 Consumers' willingness to spend money on a commodity can be studied with a range of
41 hypothetical (e.g. contingent valuation, hypothetical choice experiment) and non-
42 hypothetical value elicitation methods (VEMs). Non-hypothetical VEMs, such as
43 experimental auctions, have gained rising popularity in the last two decades as a tool for the
44 valuation of private and public goods mainly because of their ability to mimic real market
45 situations by using real products and allowing for exchange of real money. This is probably
46 why non-hypothetical VEM tends to provide more accurate willingness to pay (WTP)
47 values than their hypothetical counterparts (Lusk & Shogren, 2007). Various combinations
48 and designs have been used, the common feature being that real products need to be
49 present, which may be accompanied with tasting of some or all of the samples by some or
50 all respondents (e.g. Combris, Bazoche, Giraud-Héraud, & Issanchou, 2009; Lange, Martin,
51 Chabanet, Combris, & Issanchou, 2002; McCluskey, Mittelhammer, Marin, & Wright,
52 2007; Yue & Tong, 2011).

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

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

61 Experimental auctions have been applied in specialty products such as Champagne (Lange
62 et al., 2002), region-of-origin labelled spelt (Stefani et al., 2006), GM-foods (Jaeger et al.,
63 2004), and everyday commodities like apples (Costanigro, Kroll, Thilmany, & Bunning,
64 2014; Lund, Jaeger, Amos, Brookfield, & Harker, 2006; Zhang & Vickers, 2014), steaks
65 (Lusk et al., 2001), orange drink, cookies and chocolate (Noussair et al., 2004), and wine
66 (Combris et al., 2009; Grebitus et al., 2013). Lusk et al (2001) examined the effect of
67 sensory information for steak tenderness on consumer WTP in a grocery store setting.
68 When relying on tasting alone, an average premium was less than in condition in which
69 samples were tasted and written information about tenderness was provided.

70 Hedonic ratings have been combined with WTP, either in within- or between-subjects
71 settings. For example, Lange et al. (2002) had two respondent groups, one of which
72 reported hedonic ratings of the samples, while the other rated WTP. In their study, Yue &
73 Tong (2011) considered 14 apple cultivars, and respondents stated their WTP and liking of
74 attributes (such as juiciness) for 6-7 samples, but not their overall liking. Lund et al. (2006)
75 measuring liking after tasting, found that tasting had small effect on the mean WTP, but the
76 distribution of the bids was different before and after tasting the samples. Ginon et al.
77 (2014) observed a slightly better discrimination between cheese and bread samples with
78 WTP mechanism than with ratings of liking.

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

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

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

94 The shoppers are typically able to examine only the extrinsic properties of the product i.e.
95 visual information, such as colour and size, while repeated purchases ultimately depend on
96 whether the inner sensory properties (flavour, texture) of the fruit were well-liked (Harker,
97 Gunson, & Jaeger, 2003; Jaeger et al., 2011; Jaeger & MacFie, 2001; McCluskey et al.,
98 2007). The timing of information may markedly affect expectations and actual perceptions
99 of a product (Kähkönen, Tuorila, & Rita, 1996; Lange, Issanchou, & Combris, 2000; Zhang
100 & Vickers, 2014). Kähkönen et al. (1996) showed that nutritional information offered
101 before exposures increased pleasantness ratings. However, use of sensory descriptions as a
102 type of information is rare. To our knowledge, only Lusk et al. (2001) has used this kind of
103 information in WTP research. In addition, previous consumption practices and involvement
104 in the product play a role in pleasantness, purchase intention and WTP (Hollebeek, Jaeger,
105 Brodie, & Balemi, 2007; Kähkönen & Tuorila, 1999; Lange et al., 2002). Lange et al.
106 (2002) observed that brand information increased WTP in respondents who consumed
107 Champagne unfrequently, while frequent consumers of Champagne relied more on their
108 individual hedonic expectations.

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

114 Therefore, the present study compares the effect of information provided at different phases
115 (appearance of the product, written descriptive sensory information, tasting) on hedonic
116 ratings and WTP, using a familiar local product frequently used as a snack (i.e. apple) with
117 distinct sensory properties. The research questions were formulated as follows: 1) do the
118 information of the product attributes and the timing of the information affect hedonic
119 ratings and WTP, 2) what is the functional relationship between pleasantness and WTP, i.e.
120 $F(\text{plea}) = a + b * \text{plea}$, and 3) how does previous domestic and general apple consumption
121 affect hedonic ratings and WTP.

122 **2 Materials and methods**

123 **2.1 Samples**

124 Four domestic apple cultivars ('Amorosa', 'Konsta', 'Lobo', 'Tobias') were selected for the
125 study based on their distinct sensory characteristics representing major sensory variations
126 of cultivars in production and their availability during the study. 'Lobo' is the most widely
127 cultivated domestic cultivar and 'Amorosa' is rapidly gaining popularity. 'Konsta' and
128 'Tobias' are novel cultivars. Each cultivar was harvested from one orchard in South-
129 Western Finland. The apples were kept in the cold storage (+3°C, relative humidity 80–
130 92%) of the research orchard of MTT (Agrifood Research Finland) until evaluations. Just
131 before the first session, the apples were transferred to the cold storage (+4°C) at the
132 University of Helsinki, where the evaluations were carried out.

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

142 An unexpected difficulty was that the written sensory information, based on descriptive
143 analysis of apples from the years 2009-2010, did not fully correspond to the actual sensory
144 properties of the cultivars of the present study (apples of the year 2011). The slight
145 differences were observed in sweetness and textural properties, due to the rainy weather of
146 the growing season. For example, 'Konsta' was less crispy and 'Tobias' less sweet than
147 previous years. General apple information (process/dessert apple, colour of jam) was from
148 Tahvonen (2007).

149 **2.2 Participants**

150 The respondents (n=118, 95F, 23M, mean age 37 years, range 19–79) were recruited by
151 posters, e-mail posting lists and personal on-site contacts at the campus and neighbouring

152 workplaces and residential areas. They randomly signed up for 13 separate sessions, each
153 participant to one session according to his or her schedule. The sessions were carried out
154 either in the morning, mid-day or late afternoon. The late afternoon times were chosen so
155 that those with full-time jobs were able to take part in the study. At the end of a session,
156 each participant completed a questionnaire including demographic information and apple
157 eating habits (**Table 2**).

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

163 **2.3 Procedure**

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

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

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

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

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

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

197 **2.3.1 Treatments**

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

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

214 **2.3.2 BDM auction**

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

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

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

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

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

253 At the end of the session, one of the three rounds was randomly selected to be the binding
254 round. Next, one of the auctioned products in the binding round was randomly chosen to
255 determine the binding product. Finally, the price was randomly drawn from a price
256 distribution ranging from 1.00 to 6.00 euro/kg with an increment of 20 cents. All three
257 draws were done by randomly selected participants. The respondent purchased apples, if
258 her/his bid was greater than the randomly drawn price in the binding round. For practical
259 reasons, apples were packed beforehand into transparent plastic bags, weighting between
260 500-600 g, and containing 5-6 apples. Participants were able to choose the bag they wanted
261 if they won the bid, and paid the randomly drawn price.

262 **2.4 Data analysis**

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

272 Two age groups were formed for the purpose of the analyses: 34 years or younger ($n=66$,
273 56%) and older than 34 years ($n=52$, 44%). Two new variables were generated for apple
274 eating frequency, “heavy eaters” (more than once a week) and “light eaters” (once a week
275 or less), for domestic apples and apples in general. In the following text, the term “apple

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

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

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

287 **3 Results**

288 **3.1 Participants**

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

300 All respondents were regular apple consumers, and 87% ate apples frequently (“2-4 times a
301 month” to “daily”). Domestic apples and apples in general were eaten daily by 37% and
302 25% of the respondents, respectively. Among all respondents, 56% ($n=66$) were heavy
303 eaters of apples in general, while 64% ($n=76$) were heavy eaters of domestic apples. The
304 frequency of consumption did not differ between the treatments for domestic apples or
305 apples in general (p -values from 0.281 to 0.651 and from 0.182 to 0.706, respectively).

306 **3.2 Hedonic ratings and WTP**

307 The average hedonic rating and WTP over all cultivars, rounds and treatments were 6.6 (SD
308 ± 1.7), and 2.36 euro/kg (SD ± 0.91), respectively. Eight respondents reported zero WTP
309 (0.00 euro/kg) for one or more cultivars in one or more sessions, but none gave zero to all
310 offers. In total, there were only 27 zero bids among 1416 bids. The means of pleasantness
311 and WTP were quite similar for ‘Amorosa’, ‘Lobo’, ‘Tobias’, whereas they were lower for
312 ‘Konsta’. Taking into account only the results from TR1 (all rounds) and R1 in TR2 and
313 TR3, where the assessment was based on appearance only, differences between the
314 cultivars were found to be small (**Table 3**). Mean pleasantness ranged from 6.1 (‘Konsta’
315 and ‘Amorosa’) to 7.0 (‘Amorosa’) and mean WTP ranged from 2.18 (‘Konsta’) to 2.47
316 euro/kg (‘Amorosa’, ‘Lobo’, ‘Tobias’).

317 **3.3 Effect of information on hedonic ratings and WTP**

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

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

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

337 When information followed the visual cues of R1 (TR2, R2), ratings of pleasantness and
338 WTP for the sour cultivar ‘Konsta’ declined from 6.1 to 5.5 and they rose for the other
339 cultivars, although only the difference in pleasantness of red and somewhat mealy
340 ‘Tobias’ was statistically significant ($p=0.027$). Tasting the apples (TR2, R3) caused the
341 pleasantness of ‘Tobias’ to decline from 7.4 to 6.7 ($p=0.054$). Comparing the sour ‘Konsta’
342 between R1(visual) and R3(taste) revealed a decline of 1.1 in pleasantness ($p=0.009$) and
343 0.47 euro/kg in WTP ($p=0.017$). For other cultivars, no significant difference was observed
344 between R1 and R3 in TR2.

345 When tasting followed visual cues (TR3 R2), ratings of pleasantness and WTP rose for
346 ‘Amorosa’ from 6.1 to 7.2 and from 2.19 to 2.59 euro/kg ($p<0.001$ and $p=0.006$,
347 respectively), respectively, and for ‘Konsta’, ratings of pleasantness declined from 6.4 to
348 5.5 ($p=0.008$). When written information followed visual cues and tasting (TR3, R3), no
349 change in pleasantness or WTP was observed in any of the cultivars, indicating that
350 providing written information after tasting has low impact. With all cues present differences
351 in pleasantness and WTP (TR2, R3 vs TR3, R3) were found to be small between TR2 and
352 TR3, except pleasantness for ‘Tobias’ ($p=0.039$), because in TR2, pleasantness declined
353 after tasting (from 7.36 to 6.73) to the same level where it was before written information
354 (6.63).

355 **3.4 Comparison of hedonic ratings and WTP**

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

364 **3.5 Effect of frequency of consumption on pleasantness and WTP**

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

368 than light eaters (40.9 y. vs. 31.6 y., $p=0.002$), while for the eaters of apples in general, the
369 age difference was smaller (39.6 y. vs. 34.5y., $p=0.080$). There was no major difference in
370 education or income level between either of the eating frequency groups (p -values from
371 0.309 to 0.822).

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

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

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

393 **4 Discussion**

394 **4.1 General overview**

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

398 rating of pleasantness and WTP was 6.6 and WTP 2.36 euro/kg, respectively. When only
399 visual cues were available, differences between cultivars were small. With accumulating
400 information, both pleasantness and WTP differentiated cultivars in all settings (R2 and R3
401 in both TR2 and TR3) (Research Question 1). Similar observations were made by Zhang &
402 Vickers (2014). Regression models showed that when pleasantness increased by one point
403 (scale 1-9), WTP increased by 0.31 to 0.45 euro/kg (Research Question 2). Reported use
404 frequency of domestic apples increased WTP considerably, over 0.5 euro/kg (Research
405 Question 3).

406 **4.2 Comparison of hedonic ratings and WTP**

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

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

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

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

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

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

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

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

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

460 **4.3 Effect of frequency of consumption on pleasantness and WTP**

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

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

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

487 **4.4 Methodological considerations**

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

498 In studies where the effect of written or label information on WTP has been investigated,
499 the information has usually comprised of health-related information (Ginon, Lohéac,
500 Martin, Combris, & Issanchou, 2009; Kähkönen et al., 1999) or claims concerning origin
501 (Combris et al., 2009; Costanigro et al., 2014; Grebitus et a., 2013; Hollebeek et al., 2007;
502 Stefani et al., 2006; Zhang & Vickers, 2014), quality (Ginon et al., 2014; Lange et al.,
503 2002; Lund et al., 2006) or production method (Zhang & Vickers (2014)). To our
504 knowledge, the research by Lusk et al. (2001) on steak tenderness is the only one before our
505 study where descriptions of the sensory properties of a product have been used as a source
506 of information. In this sense our work is unique, while, on the other hand, this type of
507 product information will not elicit polarised or extreme responses, as is more likely in the
508 case of health or production method information.

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

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

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

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

536 **5 Conclusions and future prospects**

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

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

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

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

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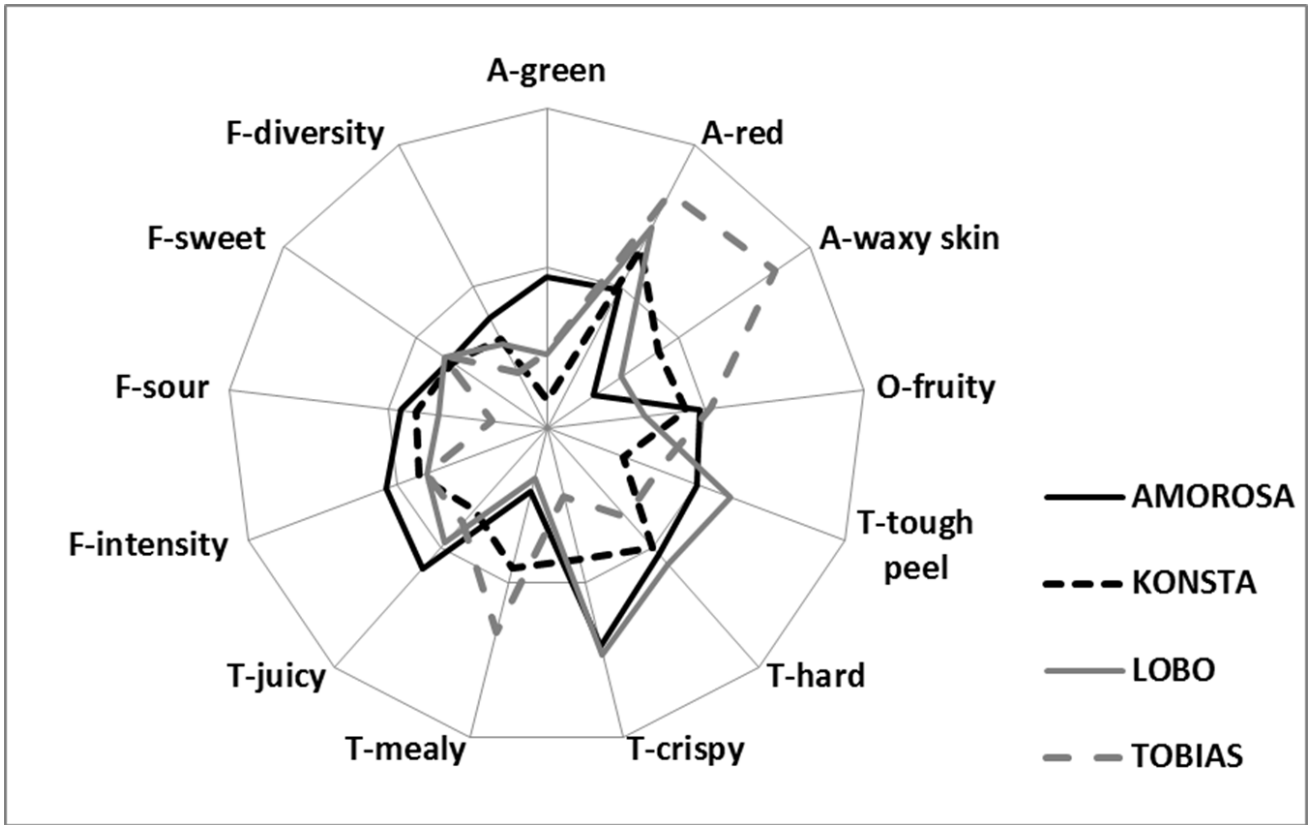
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668 experimental auction matters. *Food Quality and Preference*, 36, 12-19.

669

670 FIGURES

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

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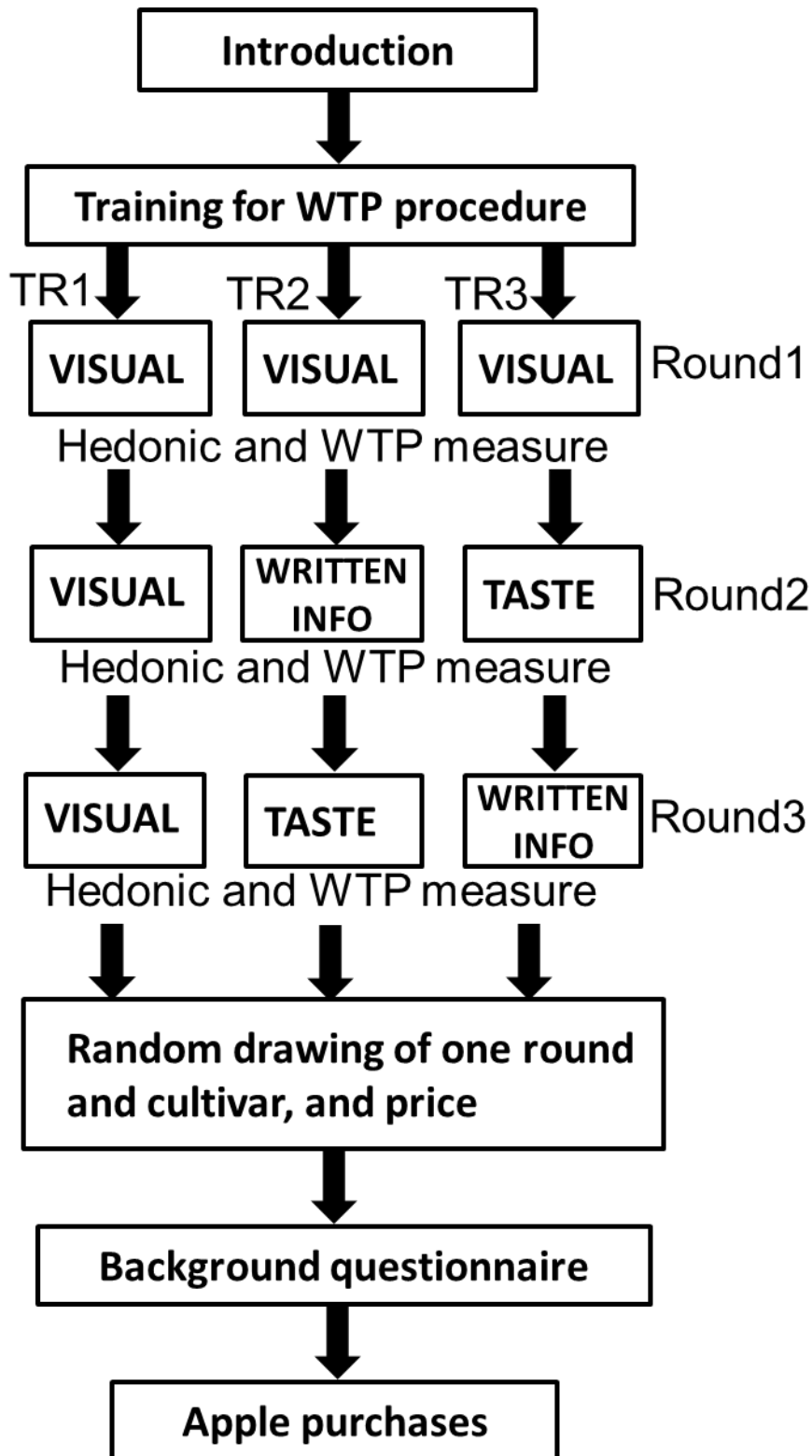


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678 Figure 2. Flowchart of the auction sessions, which were carried out using three different
679 types of treatments (TR1, TR2, TR3). Each participant was randomly assigned to one type
680 of treatment. Introduction was tailored for each treatment type. Round1 (visual cues) was
681 similar in all treatments. In each round, both pleasantness and WTP were rated, $n(\text{TR1})=25$,
682 $n(\text{TR2})=44$, $n(\text{TR3})=45$.
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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 Slightly sweet	Sour	Slightly sour Medium sweet	Slightly sour Sweet
Crispy	Medium crispy	Medium crispy	Medium crispy
Juicy	Slightly juicy	Juicy	Medium juicy

688

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.

b) NA data not available.

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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)		
	R1 visual	R2 visual	R3 visual	R1 visual	R2 visual	R3 visual
TR1 ^{c)}						
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 $n=43$

e) $n=49$

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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 round	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 round	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 round	6; 288	11.44	<0.001	6; 288	9.65	<0.001

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

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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

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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

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