Assessment of consumer preferences: an experimental study on acceptance of non-orange carrots

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Abstract

The acceptance of new products, especially in fruits and vegetables, is always difficult to appreciate, due to product variation, level of information, consumer heterogeneity, and measurement methods. The principal objective of this study is to compare the results of different methods designed to measure consumer preferences for a new product. We compared hedonic scores with willingness to pay (WTP) and willingness to accept (WTA), for new types of carrots, under three conditions of information: first with only visual appreciation, second with information about the natural origin of the products, and third after tasting. The impact of information was studied on hedonic scores and monetary valuations. Moreover, buying and selling prices were compared. No significant difference between WTP

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and WTA was found. On average, WTP was better correlated to hedonic scores than WTA . More, we found that the monetary valuation measurement used (WTP or WTA) can influence hedonic scores. Our results suggest that a combination of hedonic scores and willingness to pay is accurate to evaluate the acceptance of new fresh food products.

Keywords: novel colours; hedonic scores; willingness to pay; willingness to accept; experimental auctions, fruits and vegetables, acceptance measurement methods, preference elicitation.

1. Introduction

Several methods are used in economics and marketing research in order to measure the value consumers give to food products or product characteristics. The measurement techniques can be separated in two general categories: monetary valuations and hedonic scores (HS). The first ones, also called reservation prices, estimate the price that consumers will be willing to pay (or to accept) for a given quantity of product (e.g. Alfnes & Rickertsen, 2003; Shogren, List & Hayes, 2000; Lusk, Feldkamp & Schroeder, 2004; Rozan, Stenger & Willinger, 2004). HS measures consumers' preferences for a product, regardless of prices or quantities: consumers rate the product on a given scale. Each measure has its own advantages. HS evaluates consumer's preferences independently from the budget constraint, but it may be inappropriate for explaining the actual buying behaviour. Reservation prices could offer a good estimation of buying behaviour but they are restricted by the budget constraint and omit a part of information about consumer's preferences (how they like the product). HS and willingness to pay (WTP) methods coexist in marketing or economic researches, although there are a few studies about the relationship between the two methods. Some previous studies found that, in aggregate level, product rankings are identical under monetary valuations and HS but at individual level, there are some differences (Noussair, Robin & Ruffieux, 2004). Other studies found a correlation coefficient about 0.6 between the results obtained by the two measures (Stefani, Romano, & Cavicchi, 2006). Also, Lange, Martin, Chabanet, Combris and Issanchou (2002), found that the two methods perform equally in revealing the effect of external information on the overall evaluations, but the distribution of evaluations can differ, according to the conditions of information.

Most of the studies on the relationship between HS and monetary valuation used the WTP as the method of monetary valuations. However, there is another method commonly used, the willingness to accept (WTA) or the minimum amount of money an individual is willing to accept to give up a product that this individual already has. Rational choice theory suggests that with small income effects and many available substitutes, the WTP and the WTA for the same commodity should be about equal (Hanemann, 1991). However, several studies have shown that it is not always true: WTA is usually substantially higher than WTP (see the surveys of Shogren, 2002, Horowitz & McConnell, 2002, or Sayman & Onculer, 2005). Both methods are already used to study the reservation prices for food products, for example for an increase in food quality or a reduction in food risk (Hayes, Shogren, Shin & Kliebenstein, 1995; Alfnes et.al.2003). Since the results could change according to the method used, it is important to know which one is more appropriate to evaluate the consumer's real preferences. In this study, we compared elicited reservation prices with two alternative methods, WTP and WTA, along with HS.

We compare also the effect of new information on WTP, WTA and HS. Several recent studies have estimated the effect of information about novel goods on consumers' preferences in experimental markets. Rousu, Huffman, Shogren and Tegene (2007), estimated the value of information on genetically modified food, using experimental auctions. Similarly, Rousu and Shogren (2006) found that both pro- and anti-irradiation information had value to consumers when presented separately, but that only anti-irradiation information had value to consumers when both were provided. On fish species, Marette, Roosen, Blanchemanche and Verger (2008) examined the value of information for the consumers using experimental methods. They found that health information had significant value to consumers. .While all of these

studies examined the effect of information about food products, none of them used WTP, WTA and HS together.

We study the relationship between HS and reservation price methods (WTP and WTA) in order to better appreciate consumers' preferences and the impact of information. In this purpose, we used an experimental study on carrots with colours that are novel for consumers. Our protocol was similar to previous studies, which compared the two methods, with somehow two differences. First, we consider *both* WTP and WTA measurements. Second, we use Becker, DeGroot and Marschak (1964, BDM) method which is shown to be incentive compatible to elicit real reservation prices.

2. Materials and methods

Both HS and monetary valuations were elicited within an experimental design. We studied consumer's preferences for novel colours of carrots under three conditions of information.

2.1. Participants

The participants were recruited by announcement at various local colleges. It was mentioned in the announcement that they would participate in a choice experiment about carrots and that the necessary condition to participate was to like carrots. The characteristics of the participants are described in Table1. Most of the 64 participants were students. Our sample did not represent the whole consumer population, but our main aim was first the assessment of methods used. It is essential because a theoretical proposition should hold for any subsample of the population (Lusk and Coble, 2005). Furthermore, most of WTP/WTA

disparity studies are based on students, as it is the case for 78% of papers published between 1983 and 2005 (Roth, 2005).

<Insert Table 1 here>

2.2. Monetary valuations

We used BDM mechanism to elicit reservation prices. This method is widely used in experimental economics (e.g. Shogren, 2002). This is an intuitive method whereby a random price will be drawn in a given interval, and then compared to the elicited WTP. If the random price is higher than the WTP subject cannot buy the product; otherwise, the subject can buy the product, but pays only the random price. The same procedure can be used to elicit the WTA (replace "higher" by "lower" and, conversely, "buy" by "sell"). It can be shown that the dominant strategy for each participant is to reveal his or her true reservation prices. The advantage of BDM is that the number of participants in a group does not affect the probability of winning, if we compare with the auction mechanisms.

We divided our participants into two groups, one for WTP and one for WTA. Hence, the comparison of WTP and WTA is based on a between subject analysis, while the relationship between HS and monetary valuations are studied through a within subject analysis.

2.3. Effect of information

Consumer's appreciation was asked under three conditions of information: first with only visual aspects of the product, second after introduction of information about products, and third after tasting.

2.4. Products

We chose to conduct this study on fresh carrots, in which very novel colours are available. We could therefore compare measurement methods on novel and significantly different products. Five different types of carrots were used: orange, white, yellow, pink and purple. Hence, we had the opportunity to compare a familiar product (orange carrots) with the same kind of product with novel aspects (other colours), but also the effect of information on consumers' behaviour for both familiar and unfamiliar (novel) types of food. Beyond the methods, the results could help to identify the colour as a potential segmentation factor since the market is nowadays mainly limited to orange types. All carrots were grown in the same conditions at INHP (Angers, France). Carrots were harvested washed and prepared in one-kilogram lots the day before the experiment. The grown varieties were all traditional ones from France or other part of the world (pink and purple). The precise geographical origin of varieties was not provided to participants.

2.5. Sessions

The 4 sessions of the experiment were conducted the same day, in the laboratory for sensory analysis in ESA, Angers. Each subject participated to one session either in buying price (WTP, session 1 and 3) or in selling price (WTA, session 2 and 4) group. Each session lasted approximately 1 hour.

2.6. Experimental protocol

<Insert Table 2 here>

A summary of the experimental protocol is shown in table 2. At the beginning of each session, we explained the rules of the experiment during 10-15 minutes. It was explained to participants that they should answer to HS and monetary valuation for each carrot lot and that they would receive 10 € for their participation. The BDM method was also described: the reason why it was in their best interest to reveal their true reservation prices was shown with three possible strategies (example for WTP group):

1- To give a price higher than WTP ($\overline{p}$). In this case, if the random price (p^*) is higher than $\overline{p}$, or lower than the WTP, the effect is neutral. But if p^* is between WTP and $\overline{p}$, there will be a negative effect ($p^* - WTP$) for the participant, who will have to buy the product at the random price (higher than her real WTP).

2- To give a price lower than WTP ($\underline{p}$). If p^* is either lower than $\underline{p}$ or higher than the WTP, there is no effect. But if p^* is between $\underline{p}$ and the WTP, the participant cannot buy the product at p^* although it is lower than WTP (loss of $WTP - p^*$).

3- To give the WTP. That is the best strategy since there is no negative effect.

Then, participants moved to the experiment lab that was partitioned in order to avoid communication between them. A set of five different carrots (orange, white, yellow, pink and purple) was displayed in front of each participant. All responses were collected on an individual computer. First, they answered to some general questions about their socio-

economic characteristics and their carrot consumption. Then, they were asked to evaluate each type of carrot (HS), on a hedonic scale from 0 (very bad) to 10 (very good), based only on the visual aspects of the carrots. Subjects of WTP group were asked to indicate their WTP for each carrot, and participants to WTA group had to assume to possess a one kilogram bag of each carrot type, and were asked to indicate the minimum price they would be willing to accept to give it up. Note that the participants knew that only one randomly chosen situation would be effective and they could carry home no more than one bag. In each treatment, the questions were presented in a random order, between participants and also for one participant across treatments.

Participants, at the end of the first treatment, had to read the following information on a card:

> *"All these carrots of various colours are old French varieties or varieties cultivated in other regions of the world. They are classic varieties, obtained without help of biotechnologies.*
> *The different colour is due to the natural presence of various pigments, (carotenoid, anthocyans), which are positive for human health, thanks to their effect on the prevention of cardiovascular diseases or cancers (antioxidant effect*)."

After reading this information, they answered to the same questions as the first treatment.

On the third treatment, subjects received one raw slice of each carrot in order to taste them[1]. The same questions as in the first and second treatment were repeated.

[1] The carrots where not cooked in order to keep the taste, and we have chosen the slice presentation because it was simpler for the tasting test and showed clearly the various colours.

At the end of the experiment, each participant found his/her answers on a sheet printed. Then he/she drew a random number between 1 and 15 to determine which pricing situation will be effective. Then a price between 0.1 and 3 € was randomly drawn and the buying or selling became effective. Before leaving the lab, each participant received:

- 10 € minus the paid price (if any, if they bought the product) for WTP group.
- 10 € plus the price of the sold product (if any; otherwise they kept the product) for WTA group

3. Results

3.1. General results

Mean HS, mean WTPs and mean WTAs were calculated for 15 situations (3 treatment x 5 types of carrot). Figures 1 and 2 show the Mean HS for both groups. Globally, the orange carrots were the most appreciated, and the purple ones were the least appreciated. The introduction of information (treatment 2) seemed to influence positively the HS in the case of purple carrots, while this information did not change the HS for orange, white, yellow and pink carrots.

<Insert Figures 1 and 2 here>

During the third treatment, participants tasted successively the five carrots. Results showed that for orange and white carrots, tasting did not affect the scores significantly. For yellow

carrots, there was a significant decreasing effect only in WTP group. The scores for pink and purple carrots decreased significantly after tasting in both groups. Subjects perceived the expected carrot taste for orange and white carrots, while they were disappointed by yellow (in WTP group only), pink and purple carrots.

Figures 3 and 4 give the results of monetary valuations. Concerning WTPs (Figure 3) the information had no significant effect. The taste of orange carrots influenced positively the evaluations, while for yellow, pink and purple carrots, tasting decreased the evaluations. WTA, however, was more stable across treatments (figure 4). Very small variation was observed for WTA, both between types of carrots and conditions of information.

<Insert Figures 3 and 4 here>

3.2. Effect of tested factors

Factors affecting HS and prices were analysed through the analysis of variance. The results showed a significant effect of treatment, colour and group on HS (table 3). This confirms results from the fist observations which showed that all colours were not similarly scored. Also, there was a significant effect of treatment and group.

The effects of interactions treatment × colour, treatment × group and colour × group were also significant. It means that the effect of treatment was different across colours and groups and there was a different effect of colour depending on group. As our observations showed, the effect of treatment was not the same for familiar and unfamiliar carrots : the information or

tasting had a high impact for unfamiliar carrots, while making little difference for familiar carrot.

<Insert Tables 3 and 4 here>

However, only the effect of colour was significant on prices, while treatment and group had no significant impact (table 4). Scores were more sensitive to the level of information than prices. Conversely, Lange et. al. (2002) found a greater impact of information conditions on reservation prices than scores. One reason for that divergence can be the product used: their study was based on Champagne, a socially consumed product for which label and market price have a great importance. The reservation prices are more easily influenced by the knowledge about label and estimation of market prices. On the contrary, in the case of carrots, as for many fruits and vegetables, personal liking is the most important factor of choice.

3.3. Correlation between prices and hedonic scores

The overall correlation coefficient for all carrot types, treatments and groups was r=0,421. This coefficient is lower than 0,578 found by Stefani et. al. (2006). However, these coefficients are not directly comparable because they studied three products instead of five, and used individually centered data. These features might explain the higher correlation found in their study.

Correlation coefficients between prices and HS for five carrot types were also calculated separately in WTP and WTA groups. Results are shown in table 5. We can analyse these results according to the familiarity of products. Three product categories are distinguished: familiar (orange), intermediate (white, yellow and pink) and unfamiliar (purple) carrots.

Focusing on the two extreme cases, and WTP group (first column of table 5), we observe a weaker correlation between monetary valuation and HS in the case of orange carrots compared to purple ones. As purple carrots are very unusual in the market, those participants who appreciated the purple carrots were also willing to pay more to have it. They knew that they probably could not find them outside for less expensive. That is not true for orange carrots. The participants who appreciated orange carrots did not necessarily give a high reservation price because they are common products. In this case, the reservation prices are limited to an upper bound that is the market price. No one would pay for a bag of common orange carrot more than its market price. In the contrary the scores are not limited. This fact can explain a weaker correlation between HS and prices for familiar and ordinary products.

Considering also WTA group (second column of table 5), the coefficient correlation for orange carrots remains weak in both WTP and WTA, while for of purple carrots the correlation is stronger in WTP group than WTA. This can be a result of different psychological perception between buyers and sellers. We develop this analysis in the following section.

<Insert Table 5 here>

3.4. Comparison of WTP and WTA

Mean WTP and WTA for each carrot and treatment are shown in Figures 3 and 4. We also calculated the overall means of 15 conditions (3 treatments x 5 colours), and then performed a *t-test* for a significant difference between the two measures. We could not reject the hypothesis of non difference between WTP and WTA in overall level (*p-value=0,29*). Even if

the analysis of variance revealed a significant effect of group on scores, there is no such effect on prices (Tables 3 and 4) at overall level.

But if we compare WTP and WTA in each situation (treatment x colour) we will observe that WTA exceeds WTP significantly only in third treatment and only for less usual carrots (yellow, pink and purple). There could be a psychological explanation for this observation: Figures 1 to 4 show that the WTP decreases when HS decrease, but not the WTA which stays stable. There are two different reactions to the treatments: 1) In the case of WTA, participants did not change their initial prices since they did not consider consuming the carrots themselves. Even if the taste was bad (for example 3rd treatment for purple carrots), the reasoning could be: "I do not like this but it will be possible to sell it on the market". Participants did not behave as if they will consume the carrots, although it was the goal of the experiment. 2) In the case of WTP, the subjects consider the consumption of the carrots, and the prices follow the HS. These two reactions could explain in part the WTA-WTP gap, where own consumption is not considered.

3.5. Influence of reservation prices evaluation on HS

For now, we have just analysed the HS independently of WTP or WTA, as if the subjects have reacted in isolation of the other decision. However, the WTP or WTA might have slightly influenced the HS. The HS in the first treatment were almost the same in the two groups (figures 1 and 2), probably because these 5 decisions (HS for five carrots) were the first ones in both groups. While the monetary valuation questions had not been asked yet, all conditions were the same in both groups. After the second and third treatments, the tendency of the evolution was the same in both groups but we observed that the HS tended to decrease

more in the WTP group. On the third treatment, the HS are significantly greater for the WTA group, especially for the 3 last colour types. The differences between HS in WTA and WTP groups are shown in figure 5.

<Insert Figure 5 here>

The HS appeared slightly influenced by the buying or selling price. Since the WTP decreased for the yellow, pink and purple carrots (figure 3), the HS of the WTP group decreased more than in the WTA group. To test these results, we performed à Wilcoxon signed-rank test to compare the difference in score between groups for each carrot and each treatment. We observed that in the third treatment the scores for yellow, pink and purple carrots on WTA group are significantly higher than the scores in WTP group (respectively $z = 2.305$, $z = 2.309$ and $z = 2.548$). Except for three carrots (yellow, pink and purple) in the third treatment, in other cases there was no significant difference between HS in WTP and WTA group.

This last result raises questions about the independence between HS and WTA or WTP. Various studies have already combined both measurement techniques, but the impact of WTA or WTP on HS (or the reverse effect) could be studied more deeply: the independence between both procedures, implicitly assumed in the experiment using it together, is not evident. We saw this effect because *both* WTA and WTP were studied and compared to HS.
Our study showed that HS may not be independent from the method of monetary valuation, an interesting finding which has not been investigated in previous studies:.

4. Conclusion and discussion

We tested the effect of information and tasting on HS, WTP and WTA for five different coloured carrots.

We found that the WTP method for the unfamiliar (purple) carrots was the most correlated with hedonic scores. Hence we can conclude that, for the monetary valuation of new products, WTP is a more relevant method than WTA. For common products, neither WTP nor WTA is strongly correlated to HS. For this kind of products we cannot rely only on monetary valuation. Because the market prices are common knowledge, monetary valuations are highly influenced by them (Boothe, Schwartz, & Chapman, 2007, found a similar result on the influence of market prices on monetary valuations).

The method used would therefore depend on the novelty level or scarcity of products. Since the objective of most marketing researches is to predict buying behaviour for new product rather than existing ones, a combination of WTP and HS is the most accurate method to study consumer preferences.

In the other hand, we found that the individual answers to WTP or WTA can influence HS. This issue can be explained by different psychological positions to which individuals are exposed, and needs to be more deeply investigated. Given theses results, we suggest combinations of WTP and HS methods in separate groups, so that the participants are exposed to either pricing (WTP) or HS question. In this case we can eliminate the effect of pricing on HS.

We also found that the positive information had an increasing effect on HS, only in the case of purple carrots. This result in not surprising because purple carrots have a more unusual colour and the first reaction can be explained by a fear of an unnatural (genetic) manipulation,

while the other types of carrots may be perceived as closer to the classical orange carrot. Therefore, when subjects were insured of the natural production, the HS increased. A similar result was found in the case of new colour types of kiwifruits by Jaeger and Harker (2005). They already concluded that for many consumers the emergence of novel foods raises questions about whether or not they have been produced using genetic modification. Hence the role of information is crucial in the acceptance of novel food products.

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Tables

Table1- Socio-economic characteristics of the WTP and WTA groups

Variable	WTP group		WTA group	
Gender	27 females	7 males	16 females	14 males
	Mean	Std	Mean	Std
Age	20,8	1,5	20,9	2
Monthly income	376,8	108,6	372,7	174,9
Monthly food expenditure	122,5	46,7	105,7	36,4
Carrot consumption[1]	3,26	0,71	3,1	0,66
Carrot Purchase [1]	2,71	0,76	2,33	0,84

1. for never. 2 for rarely. 3 for every month. 4 for every week. 5 for every day

Table 2- Summary of the experimental design

Stages	Description
Beginning	Explanation of the procedure with examples.
Treatment 1- Visual valuation	HS for 5 carrots- WTP (for WTP group) or WTA (for WTA group) for each of 5 carrots-
Treatments 2 + information	Reading information card about coloured carrots- HS. WTP (for WTP group) or WTA (for WTA group) for each of 5 carrots
Treatment 3 + tasting	Tasting each carrot- - HS. WTP (for WTP group) or WTA (for WTA group)) for each of 5 carrots
At the end	Drawing of a random number to choose one effective situation. BDM procedure for pricing questions.

Table 3– Effects of factors on for HS (or analysis of variance for HS).

Source	Degrees of freedom	F-Ratio	p-Value
Main Effects:			
Treatment	2	31.83	0.00
Colour	4	121.07	0.00
Group	1	48.71	0.00
Interactions:			
Treatment × Colour	8	8.06	0.00
Treatment × group	2	7.04	0.00
Colour × group	4	7.41	0.00
Treatment × Colour × Group	8	0.88	0.55

Table 4 – Results of the analysis of variance for prices

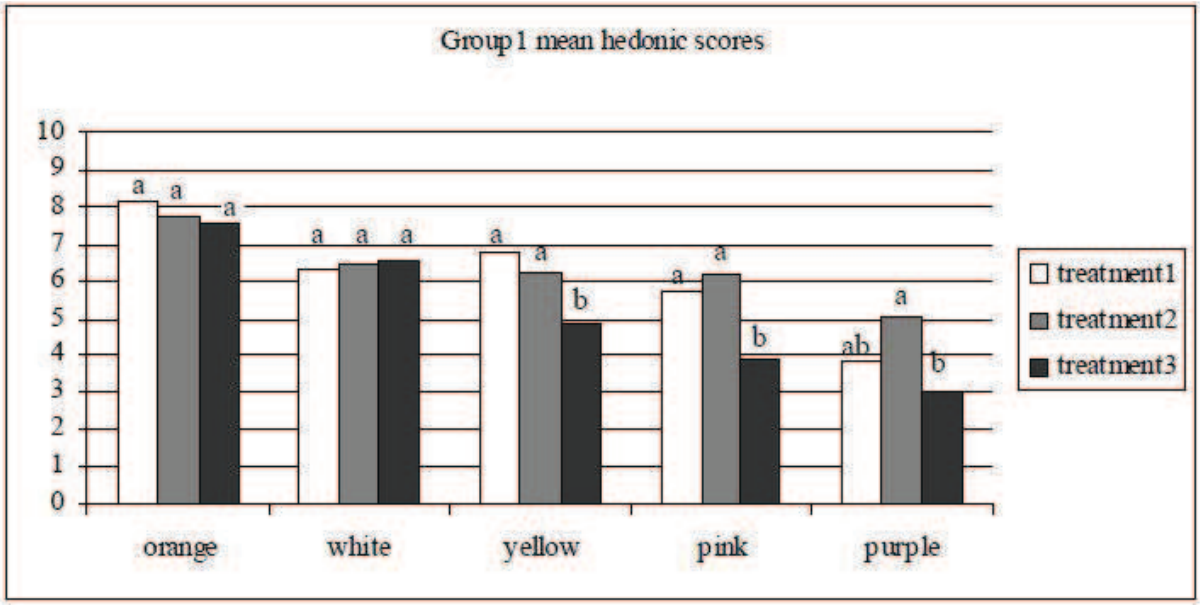
Source	Degrees of freedom	F-Ratio	p-Value
Main Effects:			
Treatment	2	0.05	0.95
Colour	4	3.63	0.02
Group (WTP/ WTA)	1	2.75	0.11
Interactions:			
Treatment × Colour	8	0.64	0.74
Treatment ×group	2	0.98	0.39
Colour × group	4	1.46	0.24
Treatment × Colour ×Group	8	0.26	0.97

Table 5- correlation coefficients between HS and prices measurements. All of the correlation coefficients are significant at 0,05 level

	WTP	WTA
Orange	0,2996	0,2189
White	0,3640	0,3749
Yellow	0,3205	0,3287
Pink	0,4237	0,4107
Purple	0,6115	0,37

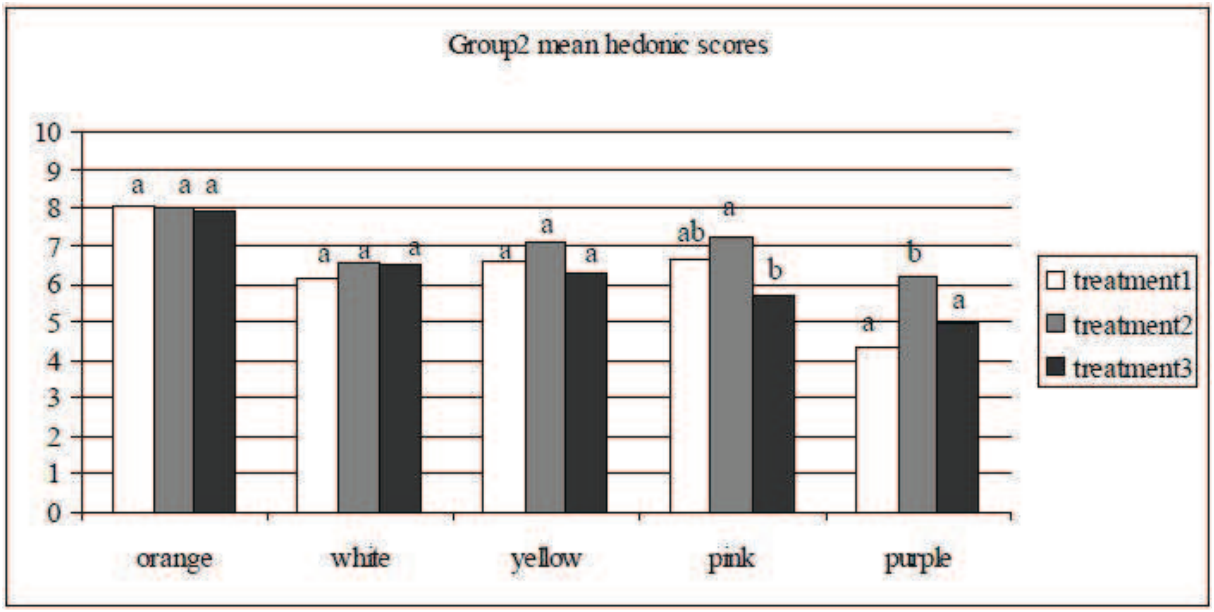
Figures

Figure 1- Mean hedonic scores for five carrots and three treatments, in WTP group



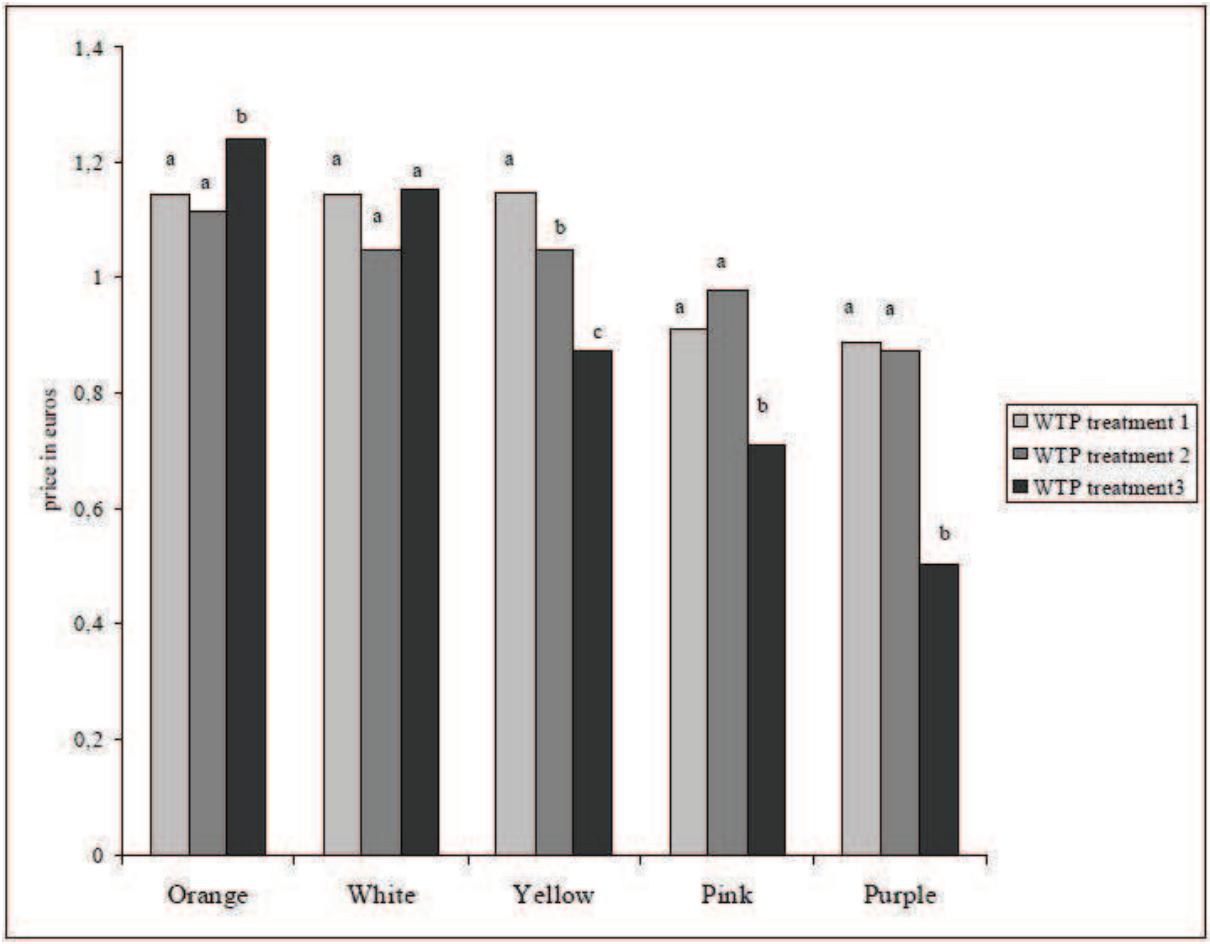
For a given colour, means with a different letter are significantly different (ab means that the set is not significantly different from a or b but a is different from b).
Treatment 1- only visual aspect; treatment 2-information; treatment 3- tasting

Figure 2- Mean hedonic scores for five carrots and three treatments, in WTA group



For a given colour, means with a different letter are significantly different
Treatment 1- only visual aspect; treatment 2-information; treatment 3- tasting

Figure 3- mean WTP for each of five carrots and three treatments.



For a given colour. means with a different letter are significantly different.
Treatment 1- only visual aspect; treatment 2-information; treatment 3- tasting

Figure 4- mean WTA for each of five carrots and three treatments.

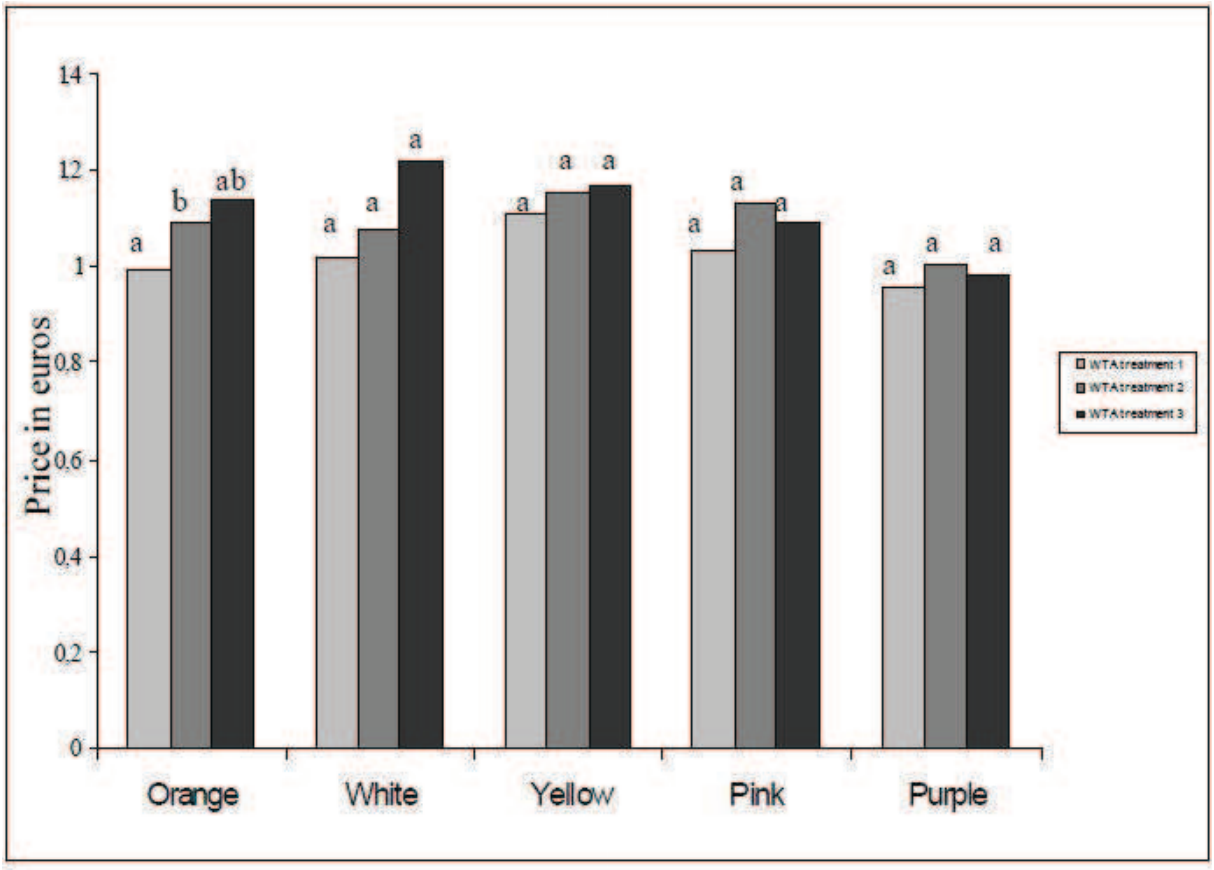
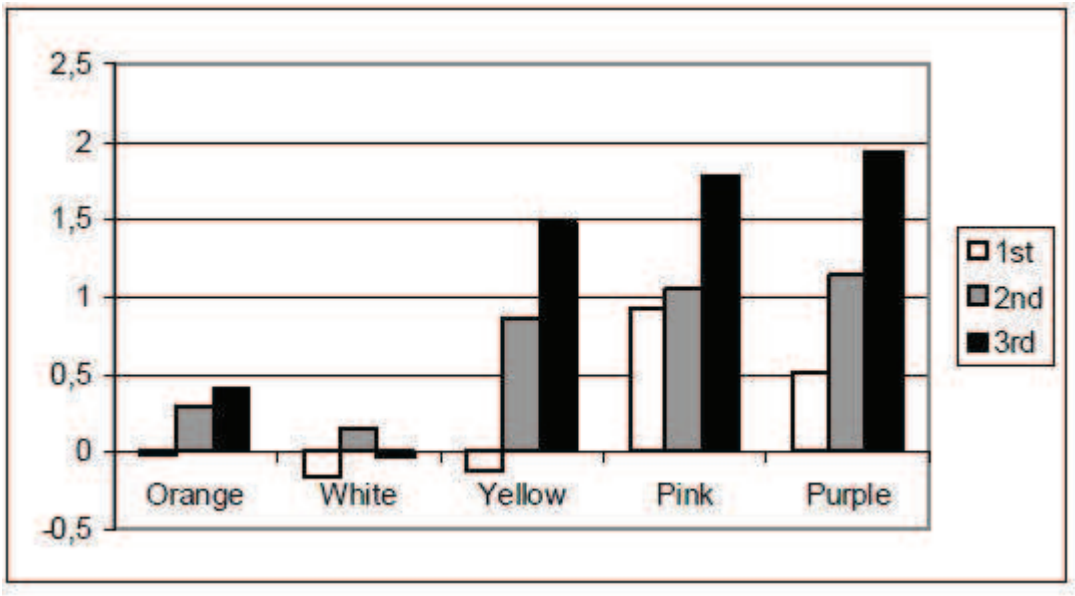


Figure 5- Difference between hedonic scores in the WTA and WTP groups



Treatment 1- only visual aspect; treatment 2-information; treatment 3- tasting