PERCEPTION AND ACCEPTANCE OF WHITE WINES BY CONSUMERS BELONGING TO DIFFERENT AGE GROUPS

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Abstract

Aims: This study investigated whether age has an impact on perception and liking of white wine.

Methods and results: Differences between two groups of 50plus consumers (each n = 50, 50-65 and 65-80 years) and a group of young subjects (n = 50, 25-40 years) regarding white wine perception and liking were investigated. Participants blindly rated the perceived sweetness, sourness, aroma intensity and overall liking of six different wines on an 11-point scale. Subjects also performed a taste and smell test. Finally, socio-demographic data and consumerism were collected. This study demonstrated that elderly people perceive sweetness, sourness and aroma intensity only slightly differently compared to younger subjects. The older groups gave slightly higher liking-marks, but results were not significantly different. Sensory attributes (sweet, sour, aroma) of the wines had most influence on liking.

Conclusion: This study delivers no proof that age and/or gender explains liking as insulated factor. Generally it seems that sour products were liked less, whereas regularly consumed and sweeter products were preferred.

Significance and impact of the study: As sensory properties of the wines, in combination with experience, contribute most to the overall liking of the product, it seems to be more successful economically for producers/outlets to provide wines rich in positively engaged attributes or possessing familiar flavour profiles to the consumers, irrespective of the socio-demographic group of the potential buyer.

Key words: white wine, 50plus, 11-point-category scale, smell, taste

Résumé

Objectifs: Cette étude a pour objectif d'évaluer l'influence de l'âge sur la perception et l'appréciation des vins blancs.

Méthodes et résultats: Les différences entre deux groupes de consommateurs âgés de 50 ans et plus (chaque n = 50, 50-65 et 65-80 ans) et un groupe de sujets jeunes (n = 50, 25-40 ans) concernant la perception et l'appréciation du vin blanc ont été examinées. Les participants ont évalué dans un test à l'aveugle la douceur, l'aigreur, l'intensité aromatique et l'appréciation générale de six vins différents sur une échelle de 11 points. Les sujets ont également effectué un test gustatif et olfactif. Enfin, des données sociodémographiques et de consommation ont été recueillies. Cette étude a démontré que la perception de la douceur, de l'aigreur et de l'intensité aromatique des personnes âgées est seulement peu différente de celle des sujets plus jeunes. Les groupes plus âgés ont donné des notes d'appréciation légèrement plus élevées, mais les résultats n'étaient pas significativement différents. Les attributs sensoriels (doux, aigre, arôme) des vins avaient la plus grande influence sur l'appréciation.

Conclusion: Cette étude ne fournit aucune preuve que l'âge et/ou le sexe sont des facteurs isolés pouvant déterminer l'appréciation. De façon générale, il semble que les produits acides sont moins appréciés et que les produits régulièrement consommés et les produits plus doux sont préférés.

Signification et impact de l'étude: Comme les résultats ne montrent pas de différences significatives en termes d'appréciation entre les différents groupes sociodémographiques, il semble qu'il est économiquement plus efficace pour les fabricants/points de vente de fournir des vins riches en attributs positifs ou possédant des profils aromatiques familiers au consommateurs, indépendamment du groupe sociodémographique de l'acheteur potentiel.

Mots clés: vin blanc, 50plus, échelle de 11 points, odeur, goût

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INTRODUCTION

Current global wine production is higher than wine consumption and the latter is expected to decrease further (OIV, 2010). The difference between over production and consumption is about to rise further if no corrective actions are taken. Such actions could be the reduction of vineyards, regulation of yields, targeting new consumer groups, or focusing on already existing consumers to boost sale quantities. Those consumer groups should be structurally attractive, high in number and possess buying power (Kotler and Bliemel, 2006 ; Michael, 2006). A potential group which fulfils all these demands are consumers in the 50plus age group[1]. An estimated 62 % of wines, 55 % of sparkling wines and 52 % of whiskey are already consumed by this age group in developed countries (Tréguer, 2002). To stress these estimations, an American study, which dealt with calorie intake of persons between 20 and 65plus years, showed that the elderly subgroup consumed more alcohol during the week, and only at weekends the youngest experimental group drank more (de Castro, 2002).

However, the sensibility of the chemical senses decreases with age and nearly everybody is affected by the age of 70 (Forde and Delahunty, 2004 ; Mojet *et al.*, 2001 ; Schiffman, 1992 ; Stroud, 2005), with smell being more affected than taste (Schiffman and Warwick, 1989). The decrease of sensibility depends very much on the person, which explains why test results of elderly vary greater in comparison to younger individuals (Koskinen *et al.*, 2003b ; Laureati *et al.*, 2008 ; Stevens and Dadarwala, 1993), with results of threshold tests decreasing the most (Hummel *et al.*, 2002). At the same time the general attractiveness of food does not seem to decrease with age (Mattes, 2002 ; Yoshinaka *et al.*, 2007). However, there seems to be a relation between sensitivity of taste and smell and preferred foodstuff (Duffy *et al.*, 1995), with alcohol being least affected (Mathey *et al.*, 2001 ; Mattes, 2002).

At this point a possible impact of learning effects should be considered as well, for example “mere exposure”. This phenomenon describes the fact that a particular liking for often consumed products can be developed (Derndorfer, 2012). Research, already done in this area with a variety of products, tries to find connections between consumption behaviours of certain products over a period of time. Mennella *et al.* (2001) found out that babies whose mothers consumed carrot juice during pregnancy or in the first two months of lactation preferred cereals mixed with carrot juice to cereals mixed with water as first solid food. Results of another study, where women consumed products with anise flavours (or not) were pretty similar. Newborn babies whose mothers consumed anise reacted positively to the smell of anise oil immediately after birth and on day four, whereas their counterparts, whose mothers did not consume anise, did not (Schaal *et al.*, 2000). Others investigated if repeated exposure to sweetened/soured orangeade and yoghurt respectively has influence on overall liking of children. Children exposed to the sweet lemonade preferred it in the end (and to a lesser extend the yoghurt as well), but this was not the case with the group being exposed to the soured food systems or the control group (Liem and de Graaf, 2004). This phenomenon could also be shown with rather unpleasant foodstuff like chillies. Those are traditionally not consumed during pregnancy and lactation in Mexico, but when children are one to three years old they are encouraged to spice their staple diet with some salsa. As a result, the tolerance for this type of spiciness seems to develop over time (Mennella *et al.*, 2005). Other research shows that learning effects could also be proofed in adults. People with a dislike for durian and rhubarb developed a neutral attitude towards the fruits or even started to like them after less than ten exposures (Blake, 2004). Lately, this approach with regard to alcohol drinking behaviour (and wine in particular) over the life span of consumers was presented as a pilot study in South Australia. The main aim was to get insight on how experience might drive current behaviour and getting to understand the long-term development of preferences. It was found that at the beginning of their “alcohol-consumption-period” people drank nearly the same amount of spirits, beer and wine. In later phases, however, the spirit and beer consumption decreased, whereas wine consumption rose. Besides, white wine consumption shifted towards red wine consumption during consumer lives and the importance of “taste” as a reason for consumption rose strongly over time (Melo *et al.*, 2010a ; Melo *et al.*, 2010b).

For a very long time, only the change of sensitivity, not hedonic preferences of elder consumers, was of interest (Mathey *et al.*, 2001). This disinterest has to be critically seen, as even very old persons put high demand on their food. For example, inhabitants of an Italian nursing home marked down a soup in their hedonic ratings and justified that with the argument that soup is a dinner and not a starter for lunch (Laureati *et al.*, 2006).

[1] 50plus means people who are older than 50 years

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A number of studies examined the perception of sensory attributes as well as hedonic responses by younger and older people of aroma-enhanced foods. These were soups (Kremer *et al.*, 2005), vanilla dessert (Kremer *et al.*, 2007b), tomato juice and dessert cream (Kremer *et al.*, 2007a), sweet and savoury waffles (Kremer *et al.*, 2007c), starters and juice (Laureati *et al.*, 2008), flavour powder enhanced meals (Mathey *et al.*, 2001), orange juice (Forde and Delahunty, 2004), yoghurt (Koskinen *et al.*, 2003b), fermented oat cream (Koskinen *et al.*, 2003a), tomato soup, Quorn and yoghurt (Griep *et al.*, 1997) as well as clear vegetable soup and chocolate dessert (Forde and Delahunty, 2002). The acquired data do not come to a consensus regarding perceived aroma intensities and hedonic acceptances by elderly target groups. There were not even clear tendencies within a product category. This could also explain the failure of an examination to create physic-physical and physic-hedonic functions of the perception and acceptance of foodstuff by younger and older consumers (de Graaf *et al.*, 1996). Most of the tested products in the cited studies were modified, commercially available products. It is possible that because of flavour alterations within a strict scientific test design some of the resulting products were too exotic, novel and not really palatable to receive high liking marks. This possibility was also considered by some authors of the presented studies (Koskinen *et al.*, 2003b; Kremer *et al.*, 2007b).

This study investigates whether commercially available Austrian white wines are similarly perceived by young consumers and consumers of the 50plus generation. We also examined if wines with naturally higher concentrations of aroma and taste compounds (sugar, acid) are more likely to receive high hedonic responses from the elderly groups. We hypothesised that age as a single factor might not be sufficient to explain likings. Therefore, a taste test and a smell test were included. As consumption behaviour, formal education and smoking behaviour could also have an impact on liking, these parameters were considered in our study.

MATERIALS AND METHODS

1. Subjects

A total of 50 "young" subjects (25-40 years, 25 male, 25 female, mean age 30.56), 50 "young old" (50-65 years, 25 male, 25 female, mean age 54.82) and 50 "old" (65-80 years, 25 male, 25 female, mean age 72.20) participated in the examination. Participants in the youngest group had to be a minimum age of 25 years to conduct the experiment. This minimum age allowed subjects to have consumed wines for several years legally and develop experience with the product (mere exposure effect) (Kern and Müller, 2010). The age gap between the "young" and "young-old" group was chosen to have a clear age difference between the groups. The other age ranges were chosen, as 65 years is the legal retirement age in Austria, and 80 years-approx. average life expectancy in Austria. The chosen age groups were justified by other research works with similar age cohorts (de Castro, 2002; Kremer *et al.*, 2007a). All participants lived independently and were members of different social clubs, via which they were recruited. All subjects knew about the purpose of the examination. They were informed which types of tests they would have to perform and gave their consent orally prior to the tastings. All subjects were strongly encouraged to spit the wine. They were also told that they could stop immediately in case they did not feel comfortable with any of the tests. Subjects were not paid for their participation.

2. Test location

The tastings took place in quiet, smell neutral rooms lit by daylight in public places, mainly in the respective community centres, club houses, etc.

3. Samples

The wine samples were chosen so as to fulfil certain criteria with regard to perceived sweetness, sourness and taste intensities (tables 1, 2). The wines should represent average products and were, therefore, available at local supermarkets. All wines were quality wines with regard to the Austrian legislation, which includes a sensory test by experts to guarantee faultlessness. To ensure that products meet the demands of the research, all wines were tasted and attributes as well as varietal authenticity were evaluated and confirmed by 11 professionals in the wine business (table 1). The bottles were stored in a fridge at 12°C for a minimum of 48 hours before each tasting session and were transported in cool boxes, if necessary, to tasting venues. Wine serving temperature was controlled and was +/- 1.0 °C compared to the storage temperature. The samples were coded with three digit codes to avoid any influence on the perception because of grape variety, origin, supposed quality and cognitive prototypes built on experience (D'Alessandro and Pecotich, 2013; Hughson and Boakes, 2002). 50ml of each wine was served in standard transparent tasting glasses. Samples were presented sequentially monadic in a randomised order (Carpenter *et al.*, 2000).

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4. Procedure

A pre-test was performed simulating the whole experiment with five persons above the age of 75. No problems occurred therefore no modification seemed necessary. The results were not used.

The test itself started with a screening question concerning the consumption frequency of beverages. Only subjects who stated to consume white wine at least "several times per month" and qualified as basic wine drinker (Famularo *et al.*, 2010) were allowed to participate in the experiment. Only subjects without formal wine education were included in the test.

The participants then had to complete a smell test and a taste test. They received four Sniffin' Sticks of which two were filled with n-butanol ("target") in different concentrations and two were empty ("blank"). The participants had to identify the targets (Hummel *et al.*, 1997; Kobal *et al.*, 2000). The lower target had a concentration of 0.03125 %, which should be detected by a normosmic person below 50 years. The higher target had a concentration of 0.25 %, which should be detected by 80 % to 90 % of a population above 55 years (Kobal *et al.*, 2000). The substance of n-butanol does normally not occur in wine, but this test is widely used in sensory research to classify subjects into groups regarding their smell abilities. The Sniffin' Sticks were smelled in random order and resmelling was not permitted. Subjects were told not to search for an identifiable quality, but for a chemical smell and were asked to move the test sticks beneath both nostrils as one nostril is usually more sensitive than the other (Dubois and Rouby, 2002; Hummel *et al.*, 1997; Issanchou *et al.*, 2002; Kobal *et al.*, 2000). After the smell test, a taste test was carried out with sucrose and citric acid dissolved in water. The two taste qualities sweet and sour were chosen, because they occur in white wine and have the biggest relevance in this experiment, as sweetness and sourness of each wine had to be rated. Bitterness was not included as this quality does normally not occur in white wine. Each participant received a glass of water and was told that this was the same water, which was used as a solvent in the taste solutions before the actual test. This water sample should be used as a reference of plain water for the subjects, as water quality differs quite remarkably between locations. Afterwards, subjects received the same order of stimuli, to avoid irritation when the higher intensities were picked incidentally at first. Participants had to identify if they sipped plain water or a solution, but did not have to identify qualities. The order was as follows: 3.5 g/l sucrose, plain water, 0.3 g/l citric acid, 10 g/l sucrose and 0.9 g/l citric acid. Re-tasting was not permitted. The lower concentration corresponded with the identification threshold, the higher was the approx. threefold. The chosen concentrations were identical to similar experiments (Kremer *et al.*, 2005; Sanders *et al.*, 2002). A total of 4+5 = 9 points could be reached in the test of abilities of chemical senses.

Then participants smelled and tasted the anonymised wines in an individually randomised order to avoid position effects. Between samples subjects could neutralise their palate with white bread and/or water. Each participant could taste at her/his own pace, but no one needed more than 15 minutes. Tasting time was either morning or afternoon to avoid hunger or saturation as both could result in higher acceptance marks (Yeomans, 2006). The scale was chosen in order for the subjects to show their attribute impressions correctly and for user-friendliness (Barylko-Pikielna *et al.*, 2004). As the experiment

Table 1. General requirements of the products (defined by experimental leaders where necessary for the experiment), varietal choice, defined min/max scores on an 11-point-category scale and received points by expert rating (bold print) and residues

Requierement	Varietal	Sweetness	Sourness	Aroma intensity
Acidic/Sour	Riesling	≤5 (**3.0**: ±0.44)^{a}	≥ 6.5 (**7.4**; ±1.29)^{b}	≤6 (**4.1**: ±0.73)^{a}
Mostly consumed	Grüner Veltliner	≤6 (**3.9**; ±0.89)^{a}	≥6 (**6.3**; ±1.04)^{ab}	≤ 6 (**4.5**; ±1.05)^{ab}
Aromatic	Sauvignon blanc	nT (**4.2**; ±0.94)^{a}	nT (**5.8**; ±1.23)^{ab}	≥ 6 (**3.3**; ±1.07)°^{a}
Aromatic	Muskateller	nT (**5.0**: ±1.23)^{a}	nT (**4.3**: ±1.01)^{a}	≥ 6 (**7.6**: ±0.88)^{ac}
Sweetish	„off-dry" blend	≥6 (**6.8**: ±1.03)^{b}	nT (**4.7**: ±0.98)^{a}	nT (**6.2**: ±1.15)^{bc}
Aromatic	Traminer	nT (**5.0**: ±1.04)^{a}	nT (**4.7**: ±1.04)^{a}	≥ 6 (**6.2**: ±1.28)^{c}
p-value		.000***	.004**	.000***

°wine did not reach predefined points, but was described with typical terms and recognised as Sauvignon blanc. Besides, experts stated intensive aroma and therefore the wine was used in the experiment

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included hedonic ratings for the factor liking as well as three attribute intensity ratings for sweetness, sourness and aroma per wine, scales were chosen to be similar in appearance, especially as they were displayed beneath each other in the questionnaire. Both scales contained the same number of categories and both displayed the verbal end anchors of the LAM-scale in German translation (Lawless *et al.*, 2010). An 11-point scale was chosen as it enables more precise results compared to a scale with fewer gradations, as subjects might try to avoid the extreme positions (Schutz and Cardello, 2001). Besides, an 11-point-category scale seems to be well able to distinguish between the most and the least liked product (Villanueva *et al.*, 2005). The points in between the end anchors were brought into hierarchy with figures for user-friendliness and these seem to have no influence on the final results (Schutz and Cardello, 2001). Overall liking was rated before the attributes as question order may have an impact on results (Earthy *et al.*, 1997). Finally, age, gender, highest education level and smoking habits were recorded as well as which white wine they normally drank and which ones they never consumed.

5. Data analyses

The questionnaires were designed using EvaSys and scanned after completion. Data analysis was carried out using IBM SPSS v. 17.0 and R v 17 (Core Team 2012). Data were assessed for normality using QQ plots. No relevant deviations from normality were detected. Therefore, all analyses were based on parametric tests. First single factor group analyses were performed and evaluated with Student's TTest (two groups) and One Way ANOVA with Bonferroni post-hoc (more than two groups). Cross tables were made and analysed with a Chi square test to recognise eventual socio-demographic differences among groups.

To analyse the influence of the possible explanatory variables age, gender, abilities of chemical senses, sweet, sour and aroma perception on liking, a three-step approach was chosen: first, shapes of relationships between liking and sweet, sour and aroma perception were analysed graphically for each combination of wine, age group and gender by scatterplots with smooth curves (LOESS smoothing) fitted by local regression (not shown). Then based on insights from those graphical analysis, multiple linear regression models were estimated separately for each wine including linear and quadratic effects of sweet, sour and aroma perception as well as interactions with age and gender. Finally, data from all wines were analysed in a combined linear mixed model with random intercept in order to account for repeated measurements of each person.

A 5 % significance level was applied to all tests.

RESULTS

1. Age

In mean value comparison and univariate analyses with ANOVAs, there were only small differences in attribute ratings between the three age groups (table 3). The oldest group gave slightly higher hedonic ratings compared to the younger subgroups, although these differences were not significant. The only exceptions in this pattern were a wine produced from Sauvignon blanc grapes (357) and from Traminer (645).

Age as insulated factor was not a statistically significant factor for any wine either in the linear mixed model with person as random effect (table 4) or in the linear regression models for liking for each wine (data not shown). Besides, in those models there were hardly any statistically significant interactions between AgexAttributes on liking for each wine.

Table 2. Analytical details about the wines: varietal, vintage, origin, residual sugar, acid, alcohol and random 3-digit codes for the experiment

Varietal	Vintage	Origin	Residual sugar in g/l	Acid in g/l	Alcohol in % vol.	Random Code
Riesling	2009	Wachau	2.1	7.1	11.6	126
Grüner- Veltliner	2009	Neusiedlersee-Hügelland	3.3	6.2	11.8	238
Sauvignon blanc	2009	Weinviertel	3.6	6.1	12.9	357
Muskateller	2009	Neusiedlersee	1.3	4.8	11.8	461
Spätrot-Rotgipfler	2009	Thermenregion	10.8	5.7	12.5	519
Traminer	2007	Wien	2.7	5.8	13.4	645

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2. Gender

In mean value comparison and univariate analyses with ANOVAs (table 5) there was a trend that men perceived sweetness of the wines stronger than women, though it was only statistically significant with wine 645 (Traminer). Acidity and aroma were perceived in a similar way by both males and females and products were equally liked by the two genders. Only wine 238 (Grüner Veltliner) received significantly higher marks from male subjects in a univariate comparison.

Gender as single factor was not a statistically significant factor for liking either in the linear mixed model with person as random effect (table 4) or in the linear regression models for liking for each wine (data not shown). In those models also GenderxAttributes as combined factor on liking showed only significant results with wine 126 (Riesling): perceived sweetness had a positive effect on liking for women, but not for men. Besides, as single factor sourness was negatively correlated with liking in all wine models for females, but men perceived it negatively only if the wine reached high acidity levels in the liking models for each wine. This finding was also significant in the linear regression model with person as random effect.

3. Results of the taste and smell test

Women reached slightly more points in the cumulative taste and smell test than men (6.28 vs. 5.96 out of 9 points) and so did the medium age group (6.2/youngest, 6.3/medium old, 5.8/old group out of 9 points; $p<0.07$).

4. Chemical senses

Scatterplots with smooth curves fitted by local regression (not shown) could not unveil differences in the abilities of the chemical senses on liking. When only observing the excellently performing group (8 and 9 points/n = 16) versus the very weak group (3 and 4 points/n = 15) in a univariate group comparison with ANOVA, a trend could be unveiled that the latter perceive sourness more strongly, in two cases significantly. Perceived sweetness and aroma intensity showed no correlation with sensory abilities. However, all wines received lower liking marks from the group with very weak chemical senses (table 6).

5. Smell and taste properties of wines as a factor for liking

Table 7 shows that perceived sensory properties can explain liking best, as most of the values in the

Table 3. Means of the three age groups for all wines and all attributes (liking, sweet, sour, aroma) and significance of single attribute group comparison (One Way ANOVA with Bonferroni Post-hoc), n = 150

	Like	p-value	Sweet	p-value	Sour	p-value	Aroma	p-value
Young 126	4.60	0.44	3.56	0.55	6.90	0.52	5.72	0.14
Medium 126	3.96		3.10		7.14		4.68	
Old 126	4.60		3.20		7.52		5.24	
Young 238	5.76	1.00	4.22	0.79	6.86	0.20	6.12	0.47
Medium 238	5.74		4.22		7.18		6.46	
Old 238	5.78		4.50		6.32		6.74	
Young 357	5.36	0.96	4.04	0.57	7.16	0.34	6.20	0.12
Medium 357	5.34		3.66		6.42		5.58	
Old 357	5.20		4.10		6.60		5.20	
Young 461	5.48	0.97	4.92	0.82	4.90	0.21	6.58	0.51
Medium 461	5.38		4.84		5.78		6.94	
Old 461	5.52		4.60		5.36		7.26	
Young 519	5.76	0.51	5.56	0.11	6.08^{b}	.019*	7.14	0.59
Medium 519	5.48		6.10		4.98^{ab}		6.64	
Old 519	6.16		6.64		4.74^{a}		6.92	
Young 645	5.38	0.53	4.32	0.48	6.00	0.20	6.88	0.26
Medium 645	5.44		4.40		5.78		5.98	
Old 645	4.82		4.88		5.12		6.44	

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regression for liking are statistically significant. It should be stressed that sweetness and aroma are positively correlated with liking, whereas sourness had a negative impact on nearly all wines. In the linear mixed model with person as random effect (table 4) the perceived attributes as such explain liking the most again. Sweetness, sourness, aroma intensity and quadratic terms of sourness showed statistically significant results.

6. Further results

Smokers perceived most wines as slightly more aroma intense than non-smokers, but only the rating of 645 (Traminer) was significantly different.

There was a clear trend that subjects with an academic degree gave higher liking marks, but no differences in perception could be found on the basis of education.

There were hardly any differences in attribute perception between experts and novices. The only three significant results concerned aroma intensity (table 8).

7. Consumer behaviour

The open question "Which white wines do you normally drink?" was answered by 130 persons (87 % of the total population cohort), distributed equally across all age groups and both genders. A total of 208 responses were generated. A vast majority of answers contained varieties of which Grüner Veltliner with 68 responses and Riesling with 32 were the most responded.

The open question "Which white wines do you never drink?" was answered by 80 persons (53 % of the total population). These results show that more subjects could tell what they drink compared to what they do not drink. In all age cohorts, more males than females responded, and also elderly people were more likely to respond. It has to be noted that most responses (38) referred to taste qualities, with "sweet" (25) being the dominant response.

Table 4. Linear mixed model with person as random effect including all wines and likings as dependent variable (Wine 126 is used as reference), n = 150

	Value	Std. Error	DF	t-value	p-value
Age	0.013	0.011	147	1.113	0.267
Gender	-0.041	0.103	147	-0.396	0.693
Sour	-0.083	0.035	728	-2.329	0.020*
Sweet	0.326	0.044	728	7.397	0.000***
Aroma	0.335	0.077	728	4.371	0.000***
$Sour^2$	-0.027	0.013	728	-2.053	0.040*
$Sweet^2$	-0.062	0.014	728	-4.56	0.000***
Wine 238	0.486	0.285	728	1.704	0.088
Wine 357	0.52	0.288	728	1.81	0.07
Wine 461	-0.246	0.295	728	-0.836	0.403
Wine 519	-0.271	0.304	728	-0.892	0.373
Wine 645	-0.201	0.289	728	-0.695	0.487
Wine238:Age	-0.028	0.015	728	-1.828	0.068
Wine357:Age	0.001	0.015	728	0.051	0.967
Wine461:Age	-0.017	0.015	728	-1.133	0.258
Wine519:Age	-0.009	0.015	728	-0.575	0.566
Wine645:Age	-0.018	0.015	728	-1.191	0.234
Wine238:Aroma	-0.09	0.11	728	-0.821	0.412
Wine357:Aroma	0.197	0.111	728	1.778	0.076
Wine461:Aroma	0.105	0.102	728	1.028	0.304
Wine519:Aroma	0.238	0.112	728	2.133	0.033*
Wine645:Aroma	-0.001	0.105	728	-0.013	0.99

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Regarding drinking frequency comparisons, there were statistically significant group differences between age cohorts, as the elderly group stated to drink white wine ($p<0.043$) and red wine ($p<0.010$) more often than the younger group (table 9). At the same time group comparisons based on the frequency of wine consumption showed no differences either in attribute perception or in liking.

DISCUSSION

It was not possible to find a connection between response behaviour and gender, age and education. This finding disproves the prejudice that elderly and/or "poorly" educated people have a lower scale utilisation, because of a lack of semantic ability (Barylko-Pikielna *et al*., 2002, cit. after Barylko-Pikielna *et al.*, 2004). It should be noted that no product received a rating higher than 5.8 marks with regard to liking, although the high quality was noticed by participants during the sessions.

This study does not support findings that women rate food generally better than men (Mojet *et al.*, 2005). However, our work confirms the results of other studies that elderly people give higher liking scores when tasting foods (Meiselman, 2006; Mojet *et al.*, 2005). The only exceptions in this pattern were wines from aromatic grape varieties: the Sauvignon blanc (357) and Traminer (645). With regard to the Sauvignon blanc it is possible that elderly people are not familiar with this variety, as it only gained importance in Austria in the last decade. Unfortunately there is no such explanation with the Traminer, especially as the wine producer told us that only elderly people buy this particular wine. Neither

Table 5. Means of the female and male group for all wines and all attributes (liking, sweet, sour, aroma) and significance of single attribute group comparison (Student's TTest), n = 150.

	Like	p-value	Sweet	p-value	Sour	p-value	Aroma	p-value
Male 126	4.52	0.572	3.31	0.911	6.91	0.21	5.15	0.757
Female 126	4.25		3.27		7.47		5.28	
Male 238	6.27	0.021*	4.41	0.598	6.63	0.422	6.69	0.215
Female 238	5.25		4.21		6.95		6.19	
Male 357	5.25	0.847	4.15	0.247	6.72	0.975	5.73	0.713
Female 357	5.35		3.72		6.73		5.59	
Male 461	5.39	0.768	5.15	0.098	5.56	0.298	6.76	0.484
Female 461	5.53		4.43		5.13		7.09	
Male 519	5.65	0.539	6.15	0.826	5.32	0.799	6.68	0.268
Female 519	5.95		6.05		5.21		7.12	
Male 645	5.11	0.665	4.96	0.035*	5.73	0.63	6.36	0.734
Female 645	5.32		4.11		5.53		6.51	

Table 6. Means of all attributes and liking of all wines of the excellently and weakly performing group in the test evaluating the abilities of chemical senses, n = 31.

	Like	p-value	Sweet	p-value	Sour	p-value	Aroma	p-value
Weak 126	4.33	0.827	3.20	0.286	7.53	0.856	4.73	0.662
Excellent 126	4.56		3.63		7.81		5.19	
Weak 238	5.53	0.72	4.07	968	6.33	0.749	6.73	0.163
Excellent 238	5.81		4.06		6.00		5.50	
Weak 357	5.70	0.328	3.47	0.518	7.80	0.009**	6.00	0.338
Excellent 357	6.63		4.13		5.69		6.69	
Weak 461	4.73	0.17	5.67	0.632	5.26	0.328	7.07	0.841
Excellent 461	6.19		5.00		4.56		6.88	
Weak 519	4.53	0.392	5.00	0.181	6.33	0.030*	5.80	0.144
Excellent 519	5.75		6.13		4.31		7.06	
Weak 645	4.13	0.449	4.73	0.689	5.27	0.888	6.13	0.391
Excellent 645	5.00		4.13		5.19		6.81	

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gender nor age as a single factor could provide explanations for acceptance in whatever statistical model.

In fact, it seems that the perceived sensory attributes of the wines are more important for liking. Therefore, it should be focused on the liking scores without splitting subjects into subgroups. Riesling (126) received the lowest liking scores, whereas wine 519 (Rotgipfler-Zierfandler), which tasted sweet and also was classified as off-dry on the label, was highly accepted. The reason might be that the Riesling had a particular high acidity and low sugar levels with regard to analytics and a corresponding sour taste and was therefore disliked, whereas the Rotgipfler-Zierfandler, being semi-dry by analytics, tasted somewhat sweetish and was therefore appreciated (Booth *et al.*, 1989). This assumption is also supported by the results of the linear regression model with person as random effect where sweetness was always positively connected with liking, whereas acidity was not. Interestingly, a relatively large group of subjects claimed to never drink sweet wines. It is very likely that Austrian consumers only classify wines produced from grapes infected with noble rot and having more than 45g/l residual sugar as sweet, especially as semi-dry and semi-sweet wines are hardly produced in Austria. This leads to the assumption that a hint of sweetness is perceived positively, whereas high amounts of sugar seem to have a negative impact on liking, or at least people claim so. Further research might address the optimum sugar concentration in wine, as already done in one research project (Blackman *et al.*, 2010). This work showed that the fewer subjects are experienced in wine drinking, the higher is the preferred sugar concentration and experts enjoy hardly any sugar addition. At this point we wish to emphasise that none of our experts realised that wine 519 (Rotgipfler-Zierfandler) had some 11 grams of residual sugar and bared "semi-dry" on the label. The high liking score of wine 238, which was made from the varietal "Grüner Veltliner", the most planted and consumed white wine variety in Austria, might be the result of mere exposure, as people feel familiar with its sensory properties (Lawless *et al.*, 2010). Vice versa connections between high appreciation and frequent consumption have already been reported by several authors (Lawless *et al.*, 2010; Villanueva and Da Silva, 2009) and support our findings as men gave Grüner Veltliner (238) a higher liking score and

Table 7. Attributes as factors to explain liking of wines based on the multifactor linear regression models per wine (compressed data). n = 150.

Sweet/Liking	Estimate	Std. Error	t-value	Pr(>|t|)
126	0.329	0.146	2.255	0.026 *
238	3.03^{e-01}	1.09^{e-01}	2.784	0.006 **
357	0.286	0.119	2.416	0.017 *
461	0.263	0.102	2.565	0.011 *
519	0.104	0.094	1.098	0.274
645	0.305	0.109	2.81	0.006 **
Sour/Liking				
126	-0.299	0.088	-3.396	0.000 ***
238	-2.76^{e-02}	9.72^{e-02}	-0.284	0.777
357	-0.222	0.091	-2.425	0.017 *
461	-0.01	0.094	-0.104	0.917
519	-0.067	0.095	-0.699	0.486
645	0.096	0.095	1.005	0.317
Aroma/Liking				
126	0.335	0.073	4.612	9.11^{e-06} ***
238	2.45^{e-01}	8.92^{e-02}	2.749	0.007 **
357	0.546	0.087	6.314	3.59^{e-09} ***
461	0.43	0.088	4.904	2.63^{e-06} ***
519	0.611	0.091	6.72	4.58^{e-10} ***
645	0.362	0.089	4.044	8.74^{e-05} ***

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Table 8. Comparison of means of all attributes (sweet, sour, aroma) between experts and novices, n = 150 novices/11 experts

Attribute	Experts	Novices	p-value
Sweet 126	3.0	3.3	0.339
Sour 126	7.4	7.2	0.834
Aroma 126	4.1	5.0	0.023*
Sweet 238	3.9	4.3	0.57
Sour 238	6.3	6.8	0.493
Aroma 238	4.5	6.4	0.006**
Sweet 357	4.2	3.9	0.72
Sour 357	5.8	6.7	0.266
Aroma 357	3.3	5.7	0.002**
Sweet 461	5.0	4.8	0.796
Sour 461	4.3	5.3	0.165
Aroma 461	7.6	6.9	0.199
Sweet 519	6.8	6.0	0.367
Sour 519	4.7	5.3	0.492
Aroma 519	6.2	6.9	0.34
Sweet 645	5.0	4.5	0.543
Sour 645	4.7	6.0	0.246
Aroma 645	6.2	6.0	0.765

Table 9. Number of participants giving the respective answer on the question how often they consume red and white wine. n = 150

	Red wine			White wine		
	25-40	50-65	65-80	25-40	50-65	65-80
Daily	0	2	5	3	6	8
Several times/week	3	8	11	10	17	16
Several times/month	18	23	19	37	27	26
Seldom	20	12	9	0_a	0_a	0_a
Never	9	5	6	0_a	0_a	0_a

claim to consume it more regularly than women (42 vs. 26 subjects). As this was the only difference between males and females and genders did not even differ in wine consumption habits, we cannot agree with a study finding differences between genders (Bruwer *et al.*, 2011). Results of this study were only based on questionnaires though and no tasting took place. Unfortunately, most studies presented in the introduction of this paper did not analyse differences between genders at all (Forde and Delahunty, 2002; Kalviainen *et al.*, 2003; Koskinen *et al.*, 2003a; Laureati *et al.*, 2008) and some do not give details about the cohort constitution (Kremer *et al.*, 2005, 2007c; Mathey *et al.*, 2001), which does not allow a direct comparison of results.

This work could not show a clear connection between abilities of the chemical senses and liking. Nevertheless, it should be outlined that the group with weaker sensory abilities liked the wines less, even though not significantly, than their counterparts with excellent sensory abilities. It seems that those very small differences in attribute perception have so much impact that they finally result in lower hedonic

rating. A comparison with most other works in this scientific field is rather difficult, as most of those studies work with modified samples, whereas our study was conducted with unaltered products.

With regard to the results of attribute perception between novices (based on ratings of all 150 subjects) and experts (based on the data collected before the actual experiment to confirm wine typicity), the ratings differ only in the attribute perception of aroma by a factor of three to a significant extent. It appears that experts have built up cognitive prototypes during their professional lives (Ballester *et al.*, 2008 ; D'Alessandro and Pecotich, 2013 ; Hughson and Boakes, 2002) and compare those, intentional or unconsciously, with the sample to evaluate.

Finally the choice of scale, which is crucial in any quantitative experiment, should be discussed. As hardly any tester needed additional instructions to the written ones, the scale seems to be easy to handle. The scale could also unveil a connection between normally consumed product and hedonic responses. The use of anchor points was near to a normal distribution (figure 1) and the "neutral" centre (6 points) was seldom used compared to values 3 and 4. Therefore, it can be stated that in this examination also an 11-point-category scale showed no tendencies of centre answers and a good reliability can be assumed. The total, expressed as percentage of values at both extreme ends compared to the other values, accounts for 25.85 % of the answers and is therefore in the same range as other examinations in the food sector (Hein *et al.*, 2008 ; Lawless *et al.*, 2010).

CONCLUSION

As the results do not show any major differences in liking between socio-demographic groups, especially not between age groups, it cannot conclusively be recommended to offer elderly consumers wines with more intensive taste and smell. Additionally, it should be avoided to stereotype women to prefer sweet and/or aroma intensive wines – as could be often observed in outlets and tastings –, as there is absolutely no proof for this in this study. As this study was unable to show a clear connection between groups and likings, it might be of interest to study wine drinking behaviour over life span and to try to predict product preferences of people in the future. This would enable producers to estimate demands in advance and prepare for these.

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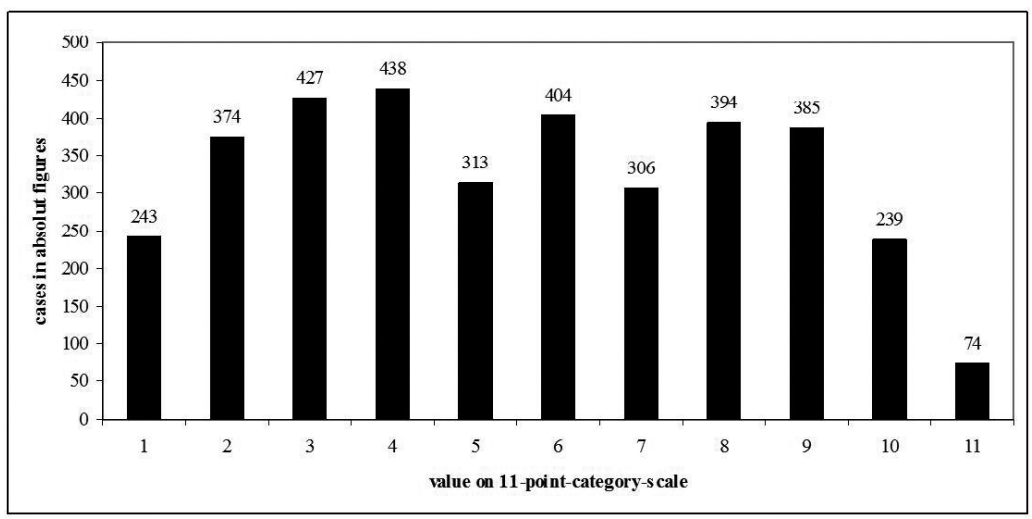


Figure 1. Overview of how often subjects used each anchor point in the experiment (n = 150).

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