The relative importance of extrinsic and intrinsic wine attributes:

Combining discrete choice and informed sensory consumer testing

S. Mueller[a], P. Osidacz[b] , L. Francis[b], L. Lockshin[a]

[a] Ehrenberg Bass Institute of Marketing Science, University of South Australia, Adelaide SA 5000, Australia.
Simone.Mueller@unisa.edu.au; Larry.Lockshin@unisa.edu.au

[b] The Australian Wine Research Institute, Glen Osmond SA 5064, Australia.
Patricia.Osidacz@awri.com.au; Leigh.Francis@awri.com.au

Abstract

In this study, an online choice task was combined with a separate informed sensory hedonic test to understand the interplay of wine sensory characteristics and extrinsic attributes such as packaging, price and brand awareness. This approach simulates the process of a consumer choosing a product from the shelf, tasting the product, and making a repurchase decision.

Twenty-one Australian Shiraz red wines were characterised by a trained sensory panel. Four hundred and twenty regular wine consumers chose a wine for a dinner with friends from simulated shelves of the wines represented by photographs in an online experiment. The same consumers evaluated liking and purchase intent in a central location sensory test, which included photos of each wine tasted.

Respondents' online choices are a measure of extrinsic wine attributes and were found to be highly related to a wine's AC Nielsen market share. Price was found to be a strong positive driver of informed liking, which did not relate to the sales volume, or to the choice in the online experiment. In contrast, the previous online choice was a strong predictor for purchase intent, confirming that extrinsic attributes substantially influence the re-purchase decision. For both liking and purchase intent a number of sensory characteristics were also positively (sweetness, fresh fruit aromas) and negatively (sherry-like and reductive aromas) related, confirming the influence of sensory characteristics on the repurchase decision.

Combining choice experiments and sensory tests which simulate consumers' purchase, tasting and repurchase decision process is the first step towards better pre-testing of new wines and predicting their market uptake.

Keywords: extrinsic vs. intrinsic cues, informed sensory testing, sensory characteristics, discrete choice experiment, repurchase.

Introduction

To which degree should a winery invest in its winemaking practices or in the packaging and promotion of its wines? Most previous wine research has either concentrated on intrinsic attributes (sensory characteristics) or extrinsic attributes such as price, region of origin, brand and packaging. Only a few studies have aimed to analyse the interplay of intrinsic and extrinsic product characteristics.

A first step in understanding the interplay of sensory and non-sensory cues is to measure *sensory expectations* generated from extrinsic cues, especially packaging. For instance Deliza *et al.* (2003) showed that labelling information, packaging colours and images influence consumers' sensory expectations for orange juice.

The psychological framework of *expectation disconfirmation* theory (Deliza and MacFie, 1996) goes one step further by relating sensory expectations to informed and/or blind sensory product tests. In the informed conditions consumers are either exposed to holistic product concepts or to single attributes. For wine, a number of studies have quantified a very strong combined effect of brand, price and/or origin on informed wine sensory liking and willingness to pay (Lange, 2000; Lange *et al.*, 2002; Yegge and Noble, 2000 and Priilaid, 2006; Szolnoki and Mueller, 2009). Other studies focused on the relative effect of only one attribute on informed wine evaluation (Marin et al, 2007 for closures; Siegrist and Cousin, 2009 for wine critic's rating scores; Combris *et al.*, 2009 and Wansink *et al.*, 2007 for region of origin; and Plassmann *et al.*, 2008 for price). In general, these studies agree that consumers' informed sensory liking of wine is strongly influenced by extrinsic cues.

Adding to the existing knowledge of the degree of extrinsic influence, a neural imaging approach taken by Plassman *et al.* (2008) allowed first insights into the *neurological processes* of extrinsic cues on sensory evaluation. The authors showed that when tasting wine, price directly affected respondents' activity in the medial orbitofrontal cortex, an area that is connected with the pleasantness experienced during the experiential tasks. Higher prices increased respondents' neural activity in the brain area related to experienced pleasantness but not in the primary taste areas. This provides first insights into the processing of extrinsic cues such as price, which modulate the hedonic experience of sensory cues such as flavours.

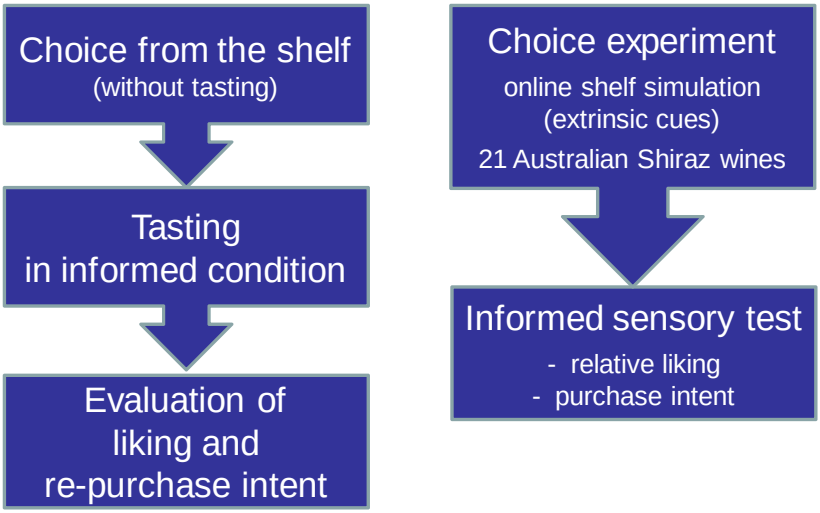
Previous research studying the interplay of intrinsic and extrinsic product characteristics mostly utilised measures of liking (Lange *et al.*, 1999; Siegrist and Cousin, 2009), purchase intent (Guinard *et al.*, 2001; Szolnoki and Mueller, 2009) and willingness to pay (Combris *et al.*, 2009; Lange *et al.*, 2002, Stefani *et al.*, 2006). Research in marketing and sensory consumer research could not confirm liking and purchase to be valid predictors for consumers' true purchase behaviour (Garber *et al.*, 2003). Instead, letting consumers choose from different alternatives in discrete choice experiments was found to result in valid market predictions (Grunert *et al.*, 2009; Louviere *et al.*, 2000; Lusk and Schroeder, 2004).

Those sensory consumer studies, which utilised choice experiments, so far only included one sensory cue together with a larger set of extrinsic attributes (Solheim and Lawless, 1996; Veale and Quester, 2009; Enneking *et al.*, 2007; Raz *et al.*, 2008). A reason for this can be sought in the complexity caused by the interaction of several sensory attributes, which challenge the limits of a choice experiment. Sensory respondent fatigue from evaluating several stimuli is especially strong for red wine, caused by its tannin and alcohol content.

We avoid the limits arising from sensory fatigue by limiting the DCE to extrinsic characteristics. Choosing from different alternatives and thereby trading off different

attributes reflects what consumers do when purchasing wine from the shelf, where they usually do not have to option to taste the wine. This scenario certainly represents the majority of wine purchases. After their purchase consumers almost always consume the wine in an informed condition (being aware of the brand, region, packaging and price of a wine). Then consumers evaluate the product based on the interplay of extrinsic and intrinsic cues and consider if they would repurchase the wine or not. We simulate this second step in a sensory test where respondents evaluate how much they like a wine and if they would purchase it or not, being informed about the wine they taste (see Figure 1).

Figure 1: Simulation of realistic wine purchase scenario (left) in experimental design of the study (right)



The contribution of this paper is threefold. We analyse the relative importance of intrinsic and extrinsic product cues to Australian wine consumers. Our approach allows to find specific sensory wine characteristics, which positively or negatively influence consumer liking and purchase intent of Shiraz wine. Finally, we validate all response measures (choice, liking and purchase intent) by relating them to actual AC Nielsen wine market shares.

Materials and Method

The methodological approach of this study simulates a purchase decision where a consumer first chooses a wine from the shelf without tasting it, and then evaluates how much s/he likes the wine and if s/he would repurchase it (see Figure 1). We aimed to replicate this process with a combination of a shelf simulation choice experiment and a subsequent informed consumer tasting.

Wines and their sensory properties

We selected 86 Australian Shiraz wines in the price range of $8-$26 from the New South Wales AC Nielsen Top 100 Shiraz sales data. Vintages from 2001-2006 represented the age of the wines as available in wine retail outlets in November 2007. We analysed the chemical composition and described the sensory properties of these wines by bench tasting with sensory experts. Out of these 86, we selected 21 wines that differed a wide range of sensory properties and had a variety of price points, sales volumes, label types and both more and less well-known brands and regions. The sensory characteristics (appearance, aroma and in-mouth attributes) of those 21 wines were characterised by a trained sensory descriptive panel (13 assessors) in triplicate. A basic chemical composition of the 21 wines and a detailed description of all 28 sensory attributes evaluated can be found in Mueller, Osidacz *et al.*

(2009). Figure 2 shows the first two components of the descriptive analysis, which demonstrate the wide sensory space covered by these wines.

Consumer sample

To qualify respondents had to be regular wine drinkers of legal drinking age (18 years) who had purchased a bottle of red wine in NSW in the last month for consumption at home or someone else's home. The sample of 420 respondents was provided in May 2008 by a sensory research company in North Sydney and is representative of Australian regular red wine consumers.

Choice task

Instead of asking consumers for their liking, we used an online choice task, which was previously shown to be more valid in predicting what consumers do in real market settings. Photographs of the 21 wines were included in a shelf simulation showing five bottles at a time and their real market price (see an example screen in Figure 3).

We asked consumers to choose the wine they would most likely (best) and least likely (worst) buy to have at home with friends or family tonight, which is one of the most common wine drinking occasions in Australia (Hall and Lockshin, 2000). Every respondent completed 16 choice sets of the online experiment at home. Because consumers could not taste the wines, their choices in the shelf simulation experiment reflect overall extrinsic product attributes. It should be emphasised that we did not control the extrinsic attributes by an experimental design to unbundle the separate effects of individual extrinsic cues. Instead, wines and their choices represent the combined effects of extrinsic cues. For the results of an experiment disentangling brand, region of origin, price, packaging and other attributes for Australian wine consumers, see Lockshin *et al.* (2009).

Informed consumer hedonic tasting

A few days after respondents completed the choice experiment they participated in a central location test in North Sydney. In an informed taste test every consumer evaluated five out of the 21 wines, resulting in 100 responses per wine. The allocation of the wines was controlled by an incomplete balanced block design. Respondents received a glass of wine (30 ml) together with an A4 photograph of the wine bottle and its price, identical to the online choice experiment. Respondents indicated their hedonic liking for each wine on a 9-point structured scale (dislike extremely to like extremely) relative to a standard wine representing intermediate intensity in most of its sensory properties. Finally respondents were asked to indicate their purchase intent for each wine (binary: yes or no).

Analysis

The analysis related the following different information and response measures of the 21 wines:

1) Market information: market price and market sales (AC Nielsen, 2007)
2) Sensory characteristics: intensity ratings by sensory panel from descriptive analysis
3) Choices (best and worst) in online shelf simulation
4) Relative hedonic liking in informed condition
5) Purchase intent in informed condition.

From the choice experiment we counted the number of times a wine was chosen as most and least liked across all respondents. From the most and least choices of each wine a ratio scale was derived by the square root of the ratio of most over least (Lee et all, 2008; Mueller, Francis and Lockshin 2009). The term *online choice* is in the following used synonymously for the mathematical expression Sqrt (most/least).

Each wine's actual market share was calculated from its volume sold relative to the total volume sold in NSW in 2007 over all 21 wines. Online choice, liking and purchase intent of a particular wine were related to its market share and market price with Pearson's correlation.

We related all data sets (price, sensory characteristics, choices, liking and purchase intent) with partial least square regression (PLS) with full cross validation and a jack-knifing procedure to test for significant attributes, using Unscrambler (Version 9.5, CAMO Software, Oslo, Norway). Two models, one explaining relative hedonic liking and the other purchase intention as the dependent variables, were estimated. We used price, sensory characteristics and online choices as the independent variables in both models. PLS regression is especially suitable for relating a large number of correlated independent variables (sensory attributes) to dependent variables, when only a small number of observations (21 wines) are available.

Results

Online choice

One aim was to see how valid the online choices were compared to the actual sales of real wines in the market. After deleting one outlier[1] we found that the wines online choice (combination measure of their best and worst choices, see above) was strongly related to their actual market shares according to AC Nielsen data. A significant and strong correlation of 0.564 ($p=0.013$) indicates that consumers choice based on extrinsic attributes, is a good approximation for what consumers purchase in reality (see Figure 4).

When relating online choices to price, an inverse quadratic relationship provides the best fit to the data ($R^2=0.26$, see Figure 5). Wines of medium price levels around $15 are more often chosen than less or more expensive wines. The same inverse U-shaped relationship between number of bottles sold across price points is representative for the overall Australian wine market (AC Nielsen, 2008). This indicates that our small sample of 21 wines forms a similar sales by price relationship as the actual wine market.

Hedonic liking

The first PLS model relates hedonic liking of the wines to their sensory properties, their online choice and price. The left side of Table 1 lists the PLS loadings for hedonic liking in descending order. The price of a wine was the strongest predictor for how much consumers like each wine, confirming previous findings by Plassman (2008), also see Figure 6. Next to price a number of sensory intrinsic attributes were found to be significant drivers of liking. Fresh fruit, dark fruit and oak/wood have a positive influence on consumer liking. Wines that were characterised by the sensory panel with relatively high sherry, medicinal and band-aid aromas were not well liked by consumers. The wine consumers chose in the choice task and the market share of a wine were not related to their liking.

[1] Wine S-06 has an extraordinary high market share of 23% of the total sales that is under-predicted by online choice. It is likely that the high sweetness level (see Figure 2) and its lowest price of all wines make this wine more attractive to consumers mainly drinking cask wine, who did not qualify for the study.

The relationship between these drivers is visualised in the first and second PLS principal components diagram (Figure 7). Price is located closest to the liking vector, indicating its strong relationship. Other positive drivers like fresh fruit and sweetness are located on the upper right quadrant. Negative sensory drivers can be found in both left quadrants.

Purchase intent

Purchase intent was strongly positively related to how often consumers had chosen a wine in the online experiment. While this is the strongest predictor, it was not found to be significant by the jack-knifing procedure, indicating that this effect was not consistent for all wines. Thus some wines' purchase intent values were more strongly influenced by the sensory attributes than others. Fresh fruit and fruity aftertaste were again positive drivers, whereas medicinal aromas related to the older wines decreased the likelihood of purchase (right side of Table 1).

The first and second PLS principal component in Figure 8 can be interpreted by a horizontal sensory axis (fresh fruit and fruity aftertaste as positive drivers versus medicinal aromas as negative drivers). Those attributes that are related to the key drivers are located in close proximity, such as dark fruit, chocolate, purple for the positive direction and sherry, brown and band-aid for the negative direction. The y-axis is strongly related to online-choice that reflects the extrinsic product attributes. The liking vector is spanned by both positive extrinsic and intrinsic attributes: online choice and fruity sensory aromas. Price was not a significant driver of purchase intent compared to online-choice. Purchase intent is only very weakly related to market share (Pearson's $r = 0.088$, $P = 0.713$)

Conclusion

The experimental approach used provides insight into the complex interactions of sensory and non-sensory influences on consumer responses. Consumers' wine choices in an online shelf simulation were well correlated with AC Nielsen market shares. This indicates that choice experiments without tastings have external validity and can closely predict how consumers choose in the real market.

Price and some sensory attributes were found to influence informed sensory liking. That price is a very strong quality and pleasurable experience heuristic confirms previous findings. The fact that liking is not related to online choice indicates that each is measuring a different construct and that one should be careful when drawing conclusions from sensory liking to actual choice in the market. Previous choice and several sensory attributes were key drivers of (re)purchase intent.

Our results suggest that extrinsic product attributes play a very strong, if not the strongest role, for consumer wine choice. Nevertheless wine makers have to make sure that negative sensory characteristics in older vintages and reductive aromas do not decrease the likelihood of a wine being re-purchased. On the other hand, fresh fruit and sweetness are sensory characteristics, which positively impact re-purchase.

Future research should also relate consumers' blind liking to choice and informed sensory evaluation. If respondents can taste all wines in several successive test sessions, differences between consumers in their reaction to sensory and non-sensory cues can be uncovered.

Combining online choice and informed tasting, especially following blind sensory hedonic tests, could be an approach to avoid situations where new products that may be highly liked in consumer hedonic tests fail in the market.

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Appendix

Figure 2: Biplot of principal components 1 and 2 for mean scores of sensory descriptive analysis data. Vectors for the sensory attributes and points for the 21 wines (coded by A-T and vintage) are shown .

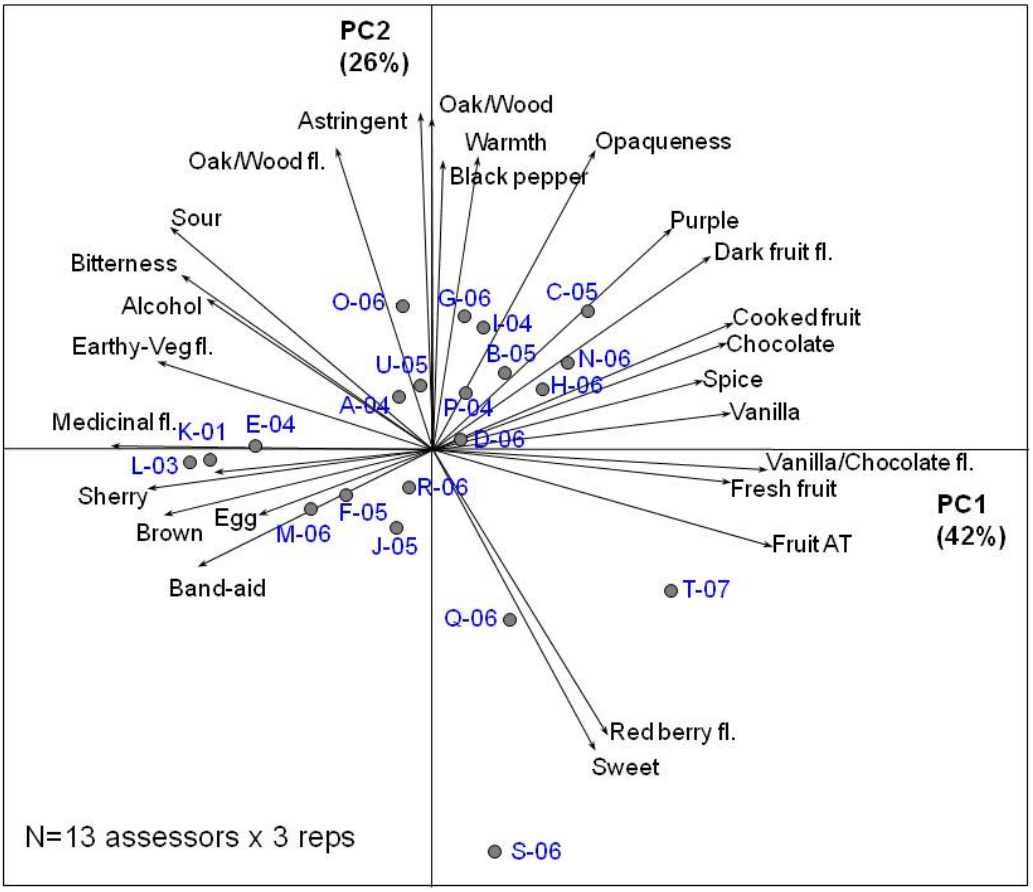

Figure 3: Screenshot of the online DCE shelf simulation

Figure 4: Relationship between online choice and market share (n = 20 wines)

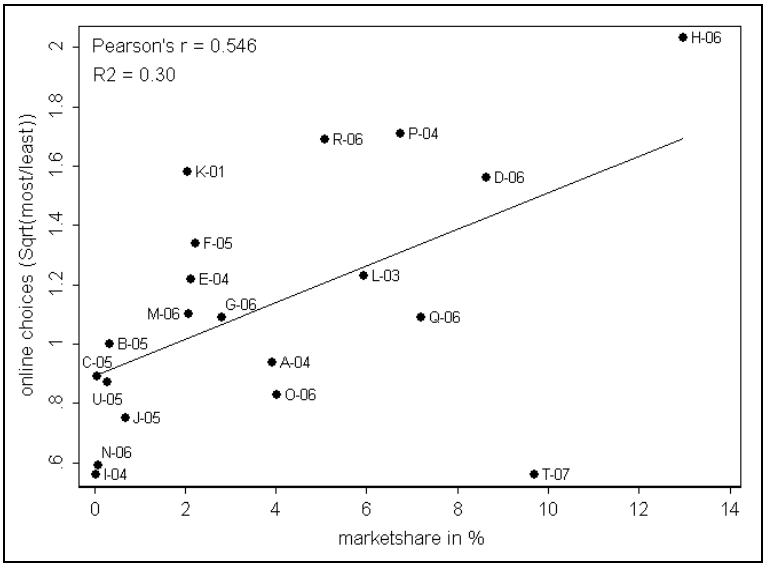

Figure 5: Relationship between online choice and price (n = 21 wines)

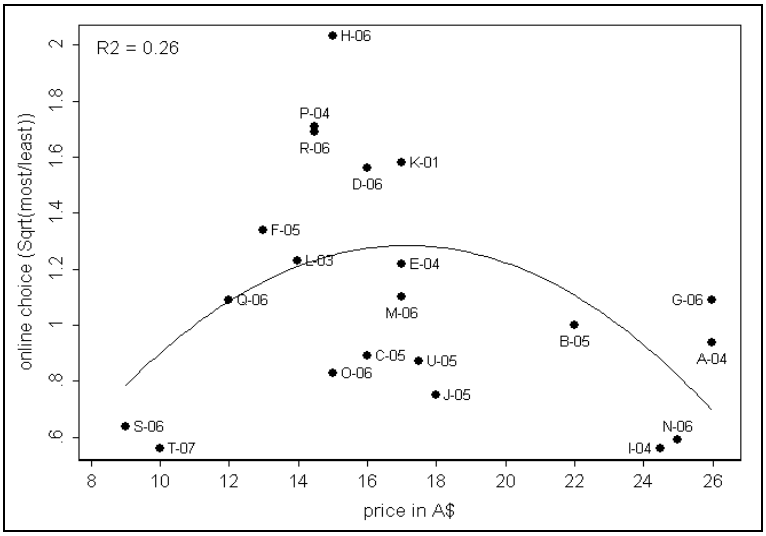

Figure 6: Relationship between hedonic liking and price (n = 21 wines)

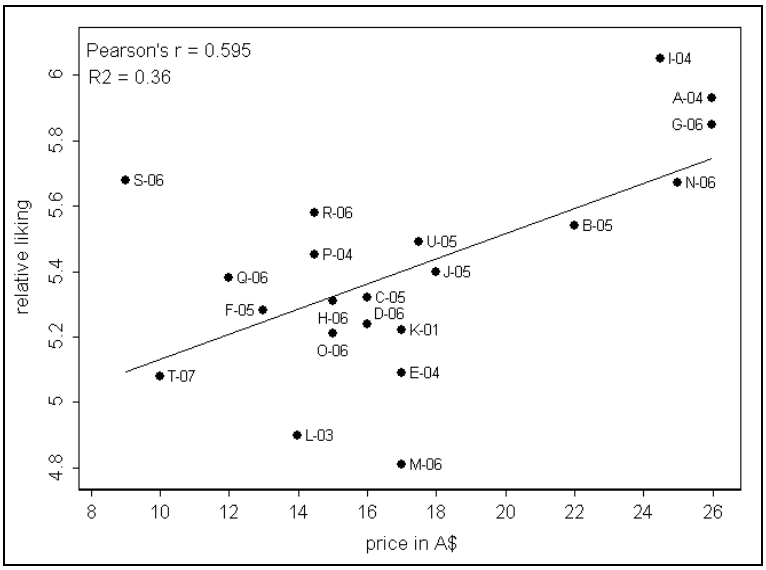

Figure 7: PLS model of relative liking shown as a biplot of components 1 and 2, using sensory attributes, online choice, price and market share, with wines identified as circle symbols.

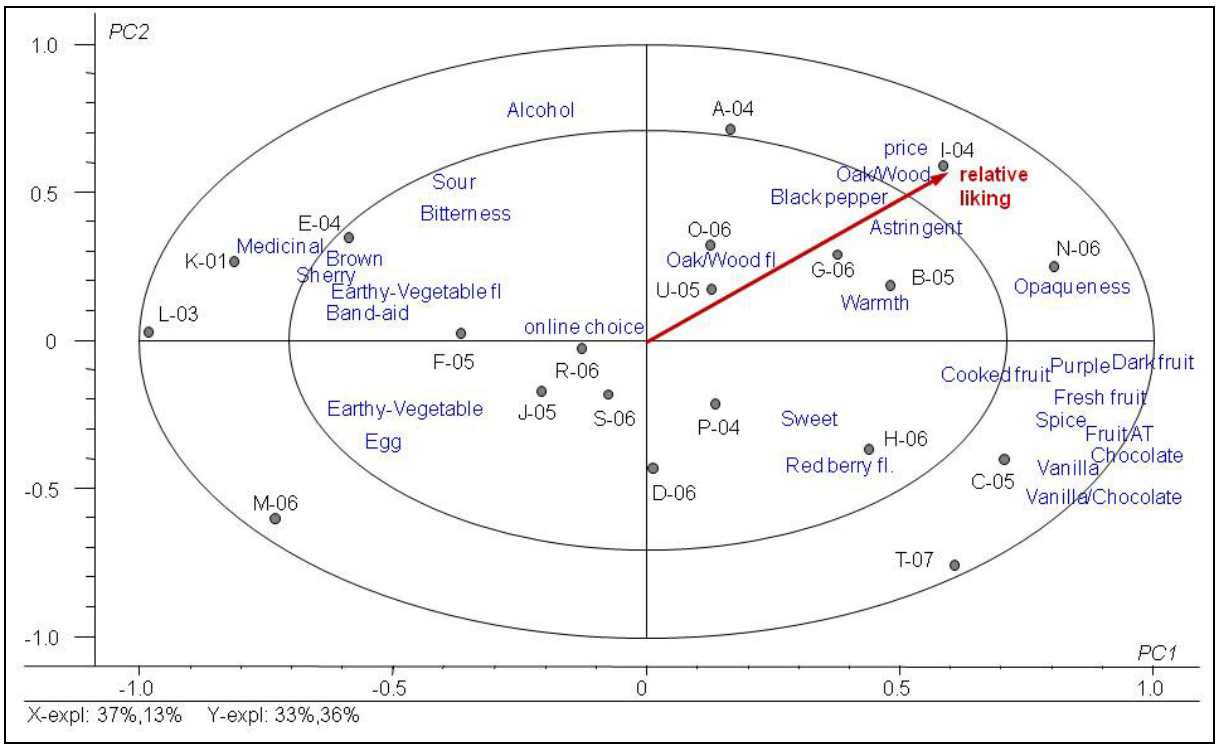

Figure 8: PLS model of purchase intent shown as a biplot of components 1 and 2, for mean liking scores using sensory attributes, online choice, price and market share, with wines identified as circle symbols.

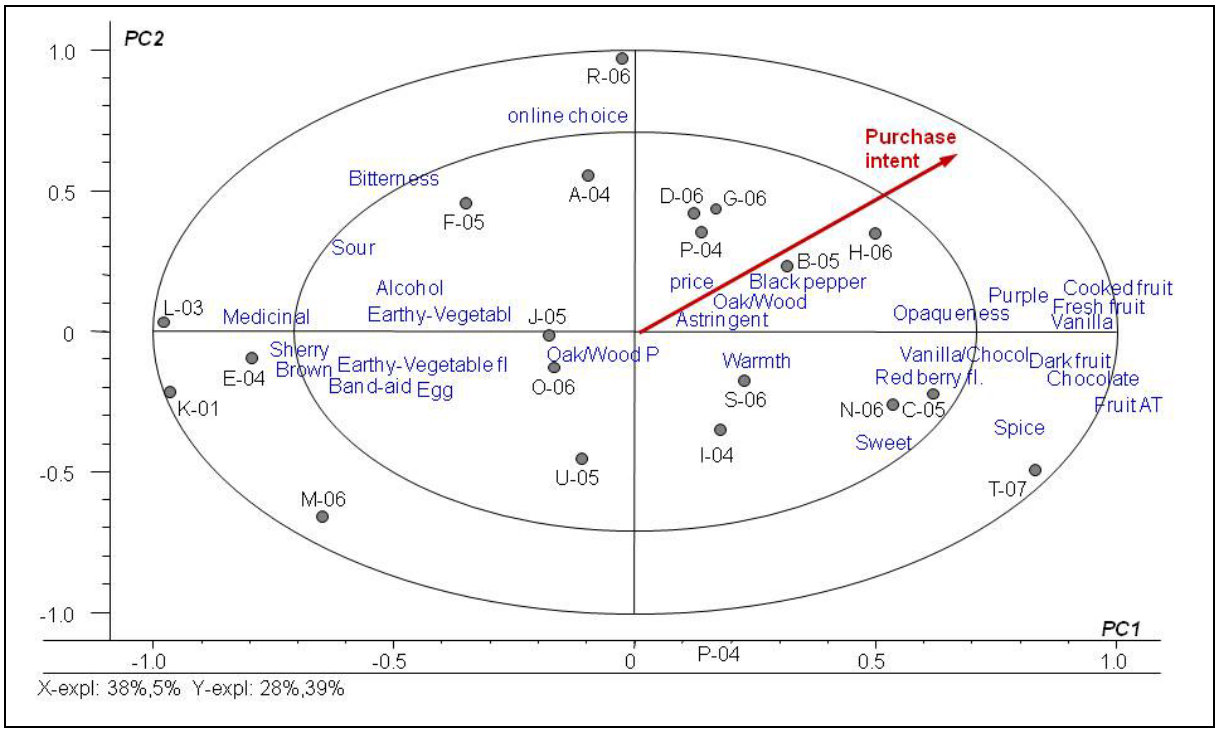

Table 1: Partial least squares regression coefficients of the hedonic liking and purchase intent data for the 20 wines modelled using the sensory attributes, online choice and price (sorted in descending order)

Hedonic Liking			**Purchase Intent**		
Variable	Coefficient	Sign.	Variable	Coefficient	Sign.
Price	0.55	*	Online choice	0.47	
Sweet	0.26	*	Bitterness	0.26	
Fresh fruit	0.22	*	Fresh fruit	0.16	*
Oak/Wood	0.11		Price	0.16	
Alcohol	0.09		Sweet	0.10	
Fruit AT	0.09		Oak/Wood	0.09	
Band-aid	0.09		Earthy-Vegetable	0.06	
Bitterness	0.08		Cooked fruit	0.05	
Opaqueness	0.08		Fruit AT	0.05	*
Dark fruit	0.07		Alcohol	0.03	
Sour	0.05		Purple	0.02	
Purple	0.04		Chocolate	0.02	
Online choice	0.04		Dark fruit	0.02	
Red berries	0.01		Warmth	0.01	
Black pepper	0.01		Red berries	0.01	
Cooked fruit	-0.02		Sour	0.00	
Oak/Wood fl.	-0.04		Vanilla/Chocolate fl.	0.00	
Brown	-0.04		Black pepper	-0.02	
Astringent	-0.07		Opaqueness	-0.02	
Spice	-0.09		Vanilla	-0.02	
Earthy-Vegetable fl.	-0.14		Band-aid	-0.04	
Chocolate	-0.15		Brown	-0.07	
Warmth	-0.17		Spice	-0.07	
Sherry	-0.17	*	Oak/Wood fl.	-0.10	
Medicinal	-0.17		Sherry	-0.16	
Vanilla	-0.17		Astringent	-0.18	
Egg	-0.18		Earthy-Vegetable fl.	-0.18	
Earthy-Vegetable	-0.18		Egg	-0.19	
Vanilla/Chocolate fl.	-0.19		Medicinal	-0.23	*

* significant driver according to Martens' uncertainty test jack-knifing procedure.