Development of a wine style guided by consumer research

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Abstract

In an era of global market competition, wine companies realise the need to understand better consumer preferences and respond to their needs effectively. At the 11th Australian Wine Industry Technical Conference Terry Lee presented a paper (Lesschaeve et al. 2002) on the use of preference mapping to define successfully the sensory preferences of wine consumers. The current study proposes a strategy to target and develop a wine style based on preference mapping outcomes.

Twelve white wines were selected to represent a specific category available in Ontario liquor stores. One hundred and fifteen Canadian consumers from the Greater Toronto Area were recruited according to specific demographic criteria, as well as their white wine purchase and consumption habits. Consumers participated in tasting sessions held on three consecutive days. During each session, they tasted four of the 12 selected wines according to a specific experimental design and indicated their overall liking. Eight of the twelve wines were then evaluated in triplicate by an extensively trained panel for a comprehensive range of sensory attributes. Sensory preferences were mapped using internal preference mapping techniques aimed at explaining the preference of consumers in terms of sensory attributes of the wine. An opportunity for developing a new white wine style was highlighted. The profile of this new style was defined by its coordinates on the preference map. Then, the expected intensities of its sensory attributes were obtained by reverse engineering the coordinates into attribute scores (Moskowitz 1994). Strategies are proposed to communicate effectively the sensory profile of the new desired wine style to winemakers.

Introduction

Wine companies have recognised the need to understand better consumer preferences to sustain and develop their business in a competitive global market. This creates an opportunity to design wine styles that respond better to consumers' expectations. Traditionally, qualitative consumer surveys were used to investigate likes and dislikes of consumers for a certain style of wines. However, quantitative tests are now part of research tools which wine businesses can use to define and target better consumer preferences (Lesschaeve et al. 2002).

The current study proposes a strategy to target and develop a wine style based on results obtained from preference mapping, using straightforward statistical analyses available in most statistical packages. The data presented were collected during a commercial study conducted by the authors for a company that wishes to remain anonymous.

Material and methods

Approach

Our customers were losing market share in a specific and highly competitive wine category. They wanted to understand if the sensory quality of their wines was an explanatory factor. The strategy proposed to our customers was to conduct a category appraisal of their wines relative to the competition within the specific wine category. The first step was to implement a hedonic test with consumers who were frequent users of this wine category. The second step was to characterise the sensory properties of each wine representative of the category. If an opportunity for improving our customers' wine style was identified, we would make the necessary recommendations to proceed and guide the winemakers to reach the sensory profile of the targeted wine style.

Wine selection

Twelve white wines were selected to represent a specific wine category available in Ontario liquor stores, i.e. blends of white wines sold at $6.00 to $8.00 a bottle. The main characteristics of these wines are reported on Table 1.

Preference tests

One hundred and fifteen Canadian consumers (25 males; 90 females; age range: 19-65 years) from the Greater Toronto Area (GTA) were recruited according to specific demographic criteria as well as to their white wine purchase and consumption habits. Consumers participated in tasting sessions of about an hour each on three consecutive days. During each session, they tasted four of the 12 wines according to a specific experimental design and indicated their overall liking on an unstructured line scale corresponding to a 100-point scale (0: I do not like it at all; 100: I like it very much).

Wine descriptive analysis (DA)

Twelve panellists from the Compusense wine descriptive panel participated in the sensory analysis. They were provided with 10 hours of training to adjust their wine lexicon to this particular set of wines and to calibrate their intensity measurement framework to the sensory variability of the wine sample set. The final sensory ballot included 37 aroma attributes (perceived before or after stirring the sample glass) and 32 attributes for flavour. Eight of the 12 wines (see Table 1) were evaluated in triplicate. The reduced number of wines in the analysis set was decided by our client for proprietary purposes. Attributes differentiating the wines significantly ($p<0.05$) are reported in Table 2.

Table 1. Main characteristics of the wines evaluated in the study

Wine number	Origin	Included in Wine DA
1	France	
2	Ontario	X
3	France	
4	France	X
5	Ontario	X
6	British-Columbia	
7	Ontario	X
8	British-Columbia	X
9	Ontario	X
10	Italy	
11	Ontario	X
12	Ontario	X

Data collection

Sensory descriptive tests were conducted in a sensory room including 20 booths equipped according to American Society for Testing and Materials (ASTM) standard requirements. Red lights were used to minimise visual cues. Thirty millilitres of each wine sample was poured in an INAO (Institut National d'Appellation d'Origine) glass identified with a 3-digit blinding code. Samples were presented to panellists according to an order balanced for the first position and carry-over effects (MacFie and Bratchell 1989). Data were recorded in individual booths using the computerised data collection software Compusense five Release 4.6. (Compusense Inc., Guelph, Canada).

Table 2. Sensory attributes differentiating the eight wines significantly ($p<0.05$)

Code	Sensory attribute
b20	Vanilla aroma before stirring the glass
a5	Peach aroma after stirring the glass
a9	Pear aroma after stirring the glass
a20	Vanilla aroma after stirring the glass
a21	Alcohol aroma after stirring the glass
a39	Musty aroma after stirring the glass
a40	Oak aroma after stirring the glass
t1	Bitter taste
t3	Acid taste
t4	Sweet taste
m1	Mouth burn (mouth-feel)
m4	Smooth (mouth-feel)
f1	Apple aroma (retronasal)
f3	Banana aroma (retronasal)
f5	Peach aroma (retronasal)
f7	Tropical fruit aroma (retronasal)
f8	Melon aroma (retronasal)
f9	Pear aroma (retronasal)
f15	Elderflower aroma (retronasal)
f20	Vanilla aroma (retronasal)
f30	Butter aroma (retronasal)
f33	Earthy aroma (retronasal)
f39	Musty aroma (retronasal)

Consumer preference tests were conducted in the same room; however, natural daylight was used. Sample service used a similar presentation design to the consumers.

Data analysis

Analyses of Variance (ANOVA) was used to determine the significance of differences in liking scores between wine samples (two-way ANOVA) and to determine the sensory attributes perceived different by the trained panel between the wines (two-way ANOVA, mixed model).

MDPREF technique (McEwan 1996) was used to map the actual wine preferences from the GTA consumers. The sensory profile of a new wine style was defined from its location on the multidimensional preference map obtained from MDPREF. The coordinates of the desired wine were determined on each of the first four preference dimensions. Then, the expected intensities of its sensory attributes were obtained by reverse engineering the coordinates into attribute scores using a non-linear regression model (Moskowitz 1994). XLStat Pro v.7.1 (Addinsoft, France) was used to analyse the data.

Results

The discussion will focus on the eight wines that were tasted by both the sensory panel and the GTA consumer panel.

Preference patterns

Figure 1 displays the boxplot representation of the distribution of the 115 liking scores by wine sample. One can observe that the scores are widely spread from 0 to 100, whatever the sample. This indicates the variability of appreciation among consumers. The average scores for all products are close to 50, meaning that consumers neither like the wine nor do they dislike it. Although the average liking scores were significantly different among the wines (two-way ANOVA, $p<0.05$), mean scores do not segregate the products well except for the most liked and least liked samples (see Figure 1).

Looking at the individual preference directions on the first two preference components (Figure 2a), it becomes clear that the 115 consumers had different liking patterns. To illustrate this, let us consider wines 9 and 12: they were liked by the same consumers who rejected wines 7 and 8. Figure 2b displays the preference

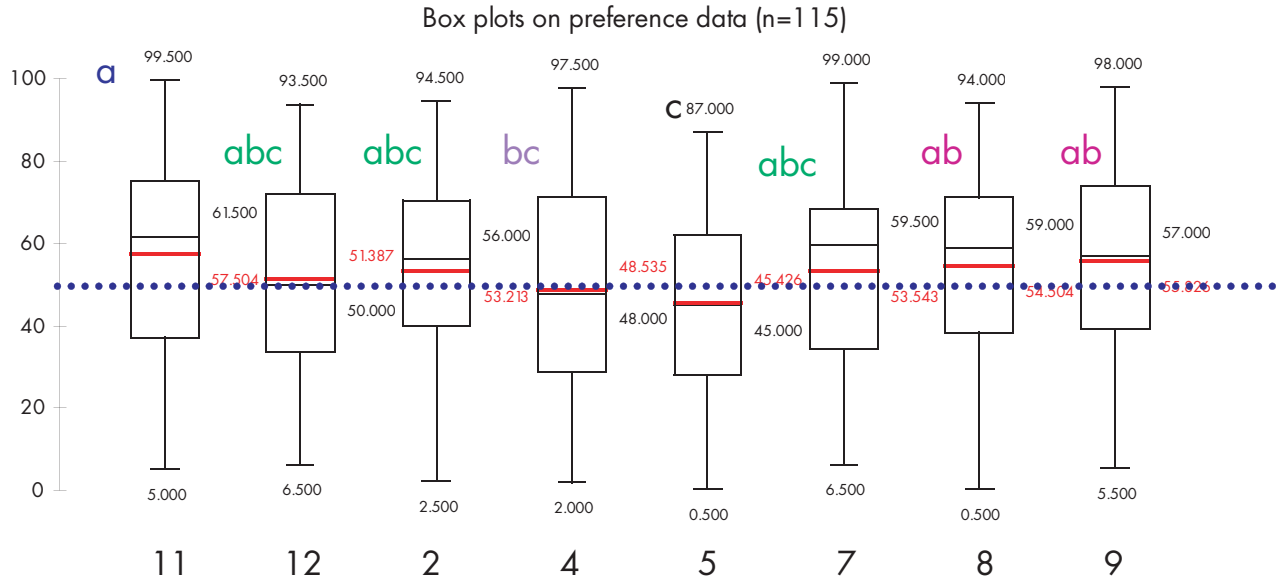

Figure 1. Boxplot representation of the distribution of consumer liking scores by wine sample. Each box contains 50% of the 115 scores, the red horizontal line indicates the mean score and the black horizontal line the median score. The vertical whiskers of each box indicate the spread of scores between the first and the second quartile (lower whisker) and the spread between the third and the fourth quartile (upper whisker). Boxes heading the same letter were found not significantly different (HSD mean comparison, $p<0.05$)

map for the third and fourth dimensions. This result suggests the existence of consumer segments, which are completely based on taste preference.

The PCA was conducted on the liking scores per wine sample per consumer using the covariance matrix. Each vector points toward the preference direction of a given consumer (coded from 1 to 120). The closer a wine is to the vector extremity, the more it is preferred by this given consumer

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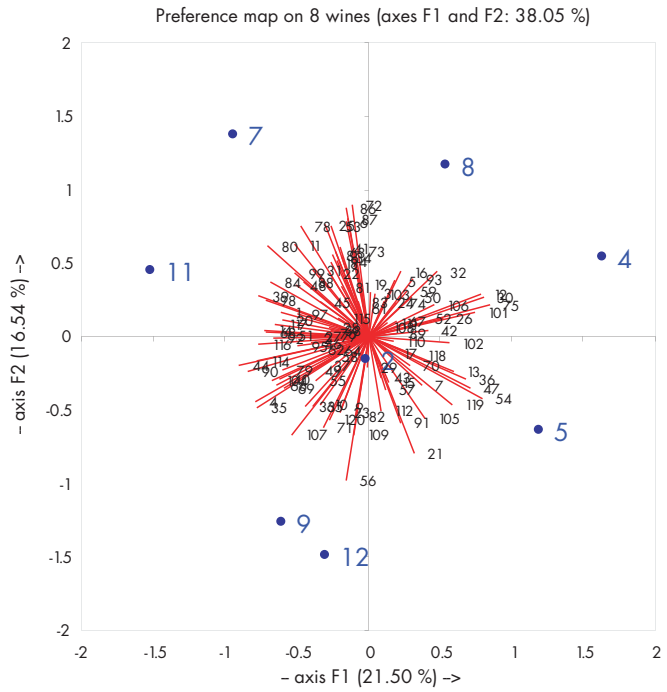

Figure 2a. Preference map (dimensions 1&2)

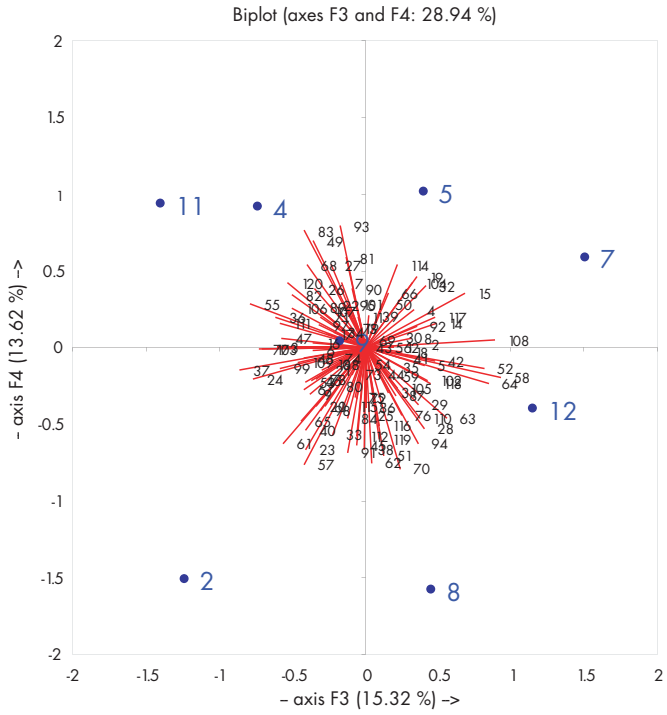

Figure 2b. Preference map (dimensions 3&4)

Consumer segmentation based on preference

Consumer liking scores were submitted to an ascending hierarchical cluster analysis using the Euclidean distance and the Ward aggregation method. Four clusters were found and described as below:

- Cluster 1, 21 consumers, 18% of the sample set
- Cluster 2, 21 consumers, 18% of the sample set
- Cluster 3, 38 consumers, 33% of the sample set
- Cluster 4, 35 consumers, 31% of the sample set

Consumer clusters were also characterised for their demographics and wine consumption characteristics (data not shown).

Sensory description of the wines

To explain the different liking patterns, sensory attribute mean scores were correlated to the preference dimensions. Results are summarised on Table 3.

Table 3. Attributes driving consumer cluster preferences

Cluster	Consumers tend to like	Consumers tend to dislike
1	Mouth burn, mouth-feel, banana aromas	Earthy and musty aromas, oak aroma
2	Acid, bitter, earthy, vanilla and oak aromas	Smooth, sweet, melon, banana
3	Smooth, sweet, melon, banana	Acid, bitter, earthy, vanilla and oak aromas
4	Alcohol, apple, tropical fruits, and pear aromas	n.d.

n.d.: non determined

Prediction of the sensory profiles of a new wine style

Wines 5, 8, and 9 belonged to our client portfolio. Looking at the results, wines 8 and 9 were well positioned and leaders in their respective consumer segments. However, wine 5 did not perform well whatever the consumer segment. Therefore, it was recommended to position wine 5 to be more suitable to a consumer group taste. Our customers identified consumer cluster 1 as the target. The rationale for this decision is not discussed in this paper. However, the selection of a specific sensory segment is the key to finding the optimum product.

The coordinates of the new wine style position were drawn from the preference maps. To derive the expected profile of the new style, we conducted a non-linear regression for each sensory attribute on the preference dimensions chosen as predictors. The following model was used and took into account the non-linear relationship between liking and sensory attribute intensity.

Sensory attribute intensity =
constant +
a*(DIM 1) +
b*(DIM 1)^2 +
c*(DIM 2) +
d*(DIM 2)^2 +
e*(DIM 3) +
f*(DIM 3)^2 +
g*(DIM 4) +
h*(DIM 4)^2,
with DIM 1-4 referring to the preference dimension numbers and a-h representing the regression coefficients.

The regression method selected the three preference dimensions maximising the R-square of each regression model. The equations were solved using the new wine style coordinates on the original preference map. The expected profile is reported Figure 3.

Discussion

Looking at Figure 3, one might ask how to craft such a wine. Indeed, wine is not a formulated beverage like cola and, therefore, we cannot simply reverse-engineer the sensory attributes into ingredient formulations as suggested by Moskowitz (1994). The sensory strategy we recommended was the following:

1. **Organise a tasting for the winemakers to compare wine 5 and its competitors in consumer cluster 1, i.e. wine 2 and 12.** Tasting is an integral part of winemaking and is the winemakers' privileged tool to assess wine quality. Therefore, the best way to describe the targeted profile is to present examples of wines to winemakers so that they can create a mental image of the new wine style.
2. **Demonstrate the sensory differences perceived by the sensory descriptive panel.** During the tasting, winemakers are encouraged to focus on the attributes they perceived different among the three wines. The tasting moderator attempts to translate the winemakers' language into the sensory attributes used by the sensory panel. By smelling or tasting the standard(s) defining each key attribute, the winemakers can understand better the sensory differences outlined by the sensory panel and transfer them into their technical framework. If possible, we would recommend designing mock-up wines by adding standards into a neutral base wine to illustrate each sensory attribute or a combination of sensory attributes.
3. **Stimulate the winemaker's creativity to produce the targeted wine profile.** The goal of the moderator is to expose the winemakers to a broad array of stimuli describing the target style. In this case, the stimuli are actual wines, mock-up wines or chemical standards. From his or her past winemaking experience, the winemaker can envision the best strategies to use and craft the target wine style. Good communication is critical at this stage to ensure that the sensory profile defined by the sensory panel is well interpreted and appreciated by the winemakers. Several tasting sessions might be required to ensure winemakers have a good understanding of the direction that they choose to take.
4. **Developing prototypes.** Using their tools and strategies, winemakers are invited to develop prototypes targeting the new sensory profile of wine 5. Prototypes could be produced in small-scale batches from grapes in season, or from frozen juice or available blend legs in the winery.
5. **Validating the best strategy**. The prototypes are then evaluated by the sensory panel using the same descriptive analysis methodology as for the commercial wines. The sensory data can then be superimposed on the original sensory map and one can visualise how close prototypes are to the target wine. However, the closest prototype might not be the most economical one to produce. The selected prototype should, therefore, be a trade-off between its closeness to the target profile and its production feasibility.

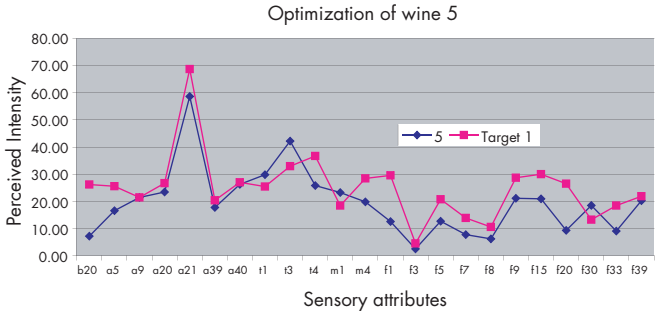

Figure 3. Sensory profiles of wine 5 and the new style expected (Target 1). Each point represents the mean score of the actual sensory attribute (in blue) or the predicted score in pink

Our mandate did not enable us to go through all the steps of our recommended strategy and, therefore, we cannot fully report on its success.

Conclusion

This study was aimed at demonstrating how to take the full benefit of the information provided by consumer tests and descriptive sensory data to create a wine style according to consumer preference. Other techniques exist to define the optimum sensory levels at which liking score maximises (Moskowitz et al. 1985; Kälviäinen, et al. 2000; Schlich et al. 2003) or to define a predictive model of preference based on sensory data (Martens and Martens, 1986; McEwan, 1996). These predictive techniques require often more than eight products to provide valid predictions, which might not always be realistic in a commercial situation. They moreover require sophisticated statistical packages.

The technique we used is more directional than statistically predictive. Indeed, the main goal is to provide the winemakers with sensory directions that they can choose to go in, rather than to predict an optimal theoretical formula for the target wine. The statistics are easy to implement and most common statistical software can be utilised to arrive at these conclusions. This practical approach is economical and enhances the role of the winemaker in establishing a wine style for consumers through the provision of invaluable complementary information.

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