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Polarized projective mapping as a rapid sensory analysis method applied to South African Chenin Blanc wines

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ABSTRACT

To test the applicability of Polarized Projective Mapping (PPM) to dry South African Chenin Blanc wines, one Projective Mapping (PM) and four PPM experiments were performed using expert judges. PM was used to create an initial product map for comparison with PPM results and to assist in the selection of the three poles. For the purposes of method validation 17 wines were analysed in this set of experiments. As the use of poles as stable references between evaluations allowed, the PPM results from all four PPM experiments were combined in a single statistical analysis. This gave a single figure which compared samples from all evaluations in a "Global MFA". In this experiment repetitions, blind duplicates, explained variance, confidence ellipses, and grouping trends were used to establish the consistency of the results. All of these parameters indicated good reliability of the results. PPM consistently separated wooded and unwooded wines with acceptable percentage of explained variance and correct groupings of blind duplicates. The overall groupings were also consistent with those found in PM.

1. Introduction

When selecting a sensory methodology, the primary considerations are whether the method is appropriate for the type and number of samples, as well as the cost and time involved. Researchers must take into account the value and detail of information gained versus the costs of gaining such knowledge. Time-effective "rapid methods" have been developed and popularized within sensory research to address the issues of lengthy, costly training sessions involved in descriptive analysis (DA). Though projective mapping/Napping® (PM) was originally proposed in 1994 (Risvik, Mcewan, Colwill, Rogersa, & Lyonb, 1994), and a decade later suggested as a companion method to DA (Pagès, 2003, 2005), several studies have compared the accuracy and usefulness of information gained in PM to results from DA and have found rapid methods to have the potential to stand alone, especially when differences between products are large or do not need to be quantitatively described (Cartier et al., 2006; Hopfer & Heymann, 2013; Perrin et al., 2008; Varela & Ares, 2014). However, one important limitation of both PM and DA is the number of samples that can be tested in a single session. This limitation of sample size is not a problem for studies which test the differences between a control sample and a few treatments, or compare samples within a small or well-defined category of products. Larger sample sets are required, though, in the case of categorizing the sensory space of a complex and diverse category, such as a certain wine style or grape cultivar. This type of categorization using the current sensory methods is very challenging and expensive.

Variants of the rapid methods are being developed and validated in order to improve the quality of information gained and address certain disadvantages of the above-mentioned methods. One such variant of the PM method is polarized projective mapping (PPM), which provides a solution to the issue of limited sample size. PPM is a form of PM which integrates the concept of reference samples, termed "poles", from polarized sensory positioning (PSP) (Ares et al., 2013). In PPM, the poles have a fixed, pre-determined location on the panellist's map. Panellists are presented with "free-moving" products to arrange around the poles to create a two-dimensional product map. This use of poles, which serve as consistent references, allows direct comparison of data from multiple sessions where new "free-moving" samples can be introduced. This effectively increases the maximum sample size, thus giving PPM the ability to analyse large sample sets.

This method is an exciting addition to the field of sensory science, but to the moment has only been applied to orange-flavoured powdered drinks, which are relatively simple products with large differences between them (Ares et al., 2013; De Saldamando, Antúnez, Giménez, Varela, & Ares, 2015; De Saldamando, Antúnez, Torres-moreno, Giménez, & Ares, 2015) and to meat products (Horita et al., 2017).

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Complex products with small differences between them, such as wine, have not been analysed by this method. Additionally, only one study has looked at the possibility of combining data from separate sessions as theorized, by comparing results when sample sets were evaluated as a whole, and the aggregated data when sample sets were split and evaluated separately (De Saldamando, Antúnez, Torres-Moreno et al., 2015). All the studies to date made use of consumers/"*naïve consumers*", which is a factor that can hinder the evaluation of the panel in terms of performance over time, especially when the results from multiple sessions are to be combined.

To test the applicability of PPM to dry South African Chenin Blanc wines, one PM and four PPM experiments were performed. The objective of this experiment was to validate the use of PPM in wine in two ways: 1) When using the same product set, whether MFA groupings resulting from PPM are similar to those found in PM, and 2) Following the natural progression of the method, if the product configuration and explained variance remain similar when new samples are evaluated against the same poles.

2. Materials and methods

2.1. Samples

Seventeen commercially available South African dry 100% Chenin Blanc wines from the Western Cape were selected for this study. The product set was selected to cover a range of price-points and vinification styles, and span the entire sensory space of South African dry Chenin Blanc wines. The choice was made based on the knowledge of the product and industry experts' opinion, and was considered representative for the South African Chenin Blanc commercial wines according to the experts. The sample set included 10 one-year-old, 6 two-year old, and 1 three-year old wines. Of the 17 wines, ten received oak contact, three were made from bush vines, and nine were made from vines aged 35 years or older.

2.2. Sensory evaluation

As previously reported in the literature (Ares et al., 2013), PM was used to create an initial product map for comparison with PPM results. This product map was also used for selection of the three poles for PPM. Four PPM experiments were performed with varying sets of wines. In other words, the PM and PPM1 session had the same samples, PM to allow the choice of poles and PPM1 to evaluate if the configuration will be the same as in PM or will change due to the presence of the poles. The following PPM sessions were added to see how the configuration/distribution of the samples will change depending on whether the assessors were previously exposed or not to the samples. Thus, some of the sessions contained mixed samples of "known" wines (*i.e.* used in PM and PPM1 experiment) and "unknown" wines (additional samples to those used in the two first sessions). In one of the PPM sessions the assessors evaluated only "unknown" wines. This was relevant because the idea behind PPM is to be able to add in subsequent sessions new samples to the set originally evaluated, thus increasing the number of products assessed. This is indeed one of the limitations of a rapid method such as PM – the results from separate sessions can be compared but not combined, and the number of samples evaluated at once is limited by panel fatigue. Additionally, the creation of the "global MFA" would to demonstrate this point, by combining all the results from all the PPM sessions and comparing them to individual sessions.

2.2.1. Experimental design

Five separate sensory evaluation tasks were performed with a one-week break between each evaluation to mitigate the effect of product familiarity. Initially, a projective mapping with ultra flash profiling (UFP) was performed. The results of this PM were used to select three wines which spanned the sensory space to serve as poles for PPM. These poles were included in four separate PPM (with UFP) experiments with varying product sets. All samples which the judges could freely place on the sheet of paper were designated as "free moving" samples. The same set of wines were evaluated in PM and PPM1, a different set was evaluated in PPM 2, and mixtures of the two sets were evaluated in PPM3 and PPM4 (Table 1).

Table 1
Experimental design detailing which wines were evaluated in each experiment.

Wine	PM	PPM1	PPM2	PPM3	PPM4
PETIT	✓	†*	†*	†*	†*
MH	✓	†	†	†	†
RB	✓	†	†	†	†
KZFR	✓*	✓			✓
KZCS	✓*	✓			✓
KZVS	✓	✓			✓
CG	✓	✓		✓	
SPIER	✓	✓			✓*
BOO	✓	✓*		✓	
BBS	✓	✓		✓	
56H			✓*		✓
MB			✓	✓	
DG			✓	✓	
HB			✓		✓
SIM			✓	✓	
SR			✓	✓*	
RH			✓		✓

✓ = included, † = included as pole, * = blind duplicate.

2.2.2. Procedure

In all experiments, evaluations took place in off-white individual sensory booths in a well-ventilated, odourless 20 ± 2 °C air-conditioned room (ISO 8589:2007). Samples were served in black glasses (ISO 3591:1977) labelled with random 3-digit codes unique to each judge and repeat. Wines were stored at 20 ± 2 °C for no more than three weeks prior to testing. Samples at ambient temperature were poured 30 min before testing in 20 ± 2 mL aliquots, and immediately covered with plastic Petri dish lids. Absence of TCA and *Brettanomyces*-related spoilage in the samples was confirmed sensorially by the researchers. Products were presented in a different randomized order for each panellist according to a Williams Latin Square design (Macfie, Bratchell, Greenhoff, & Vallis, 1989). Two replications of aroma evaluation were performed with a 10 min break between flights.

2.2.3. Panellists

Fifteen panellists participated in each experiment as suggested by other research done using reference-based and PM methods (Lelièvre-Desmas, Valentin, & Chollet, 2017; Louw et al., 2015; Thuillier, Valentin, Marchal, & Dacremont, 2015). All judges were students or staff members from the Department of Viticulture and Oenology at Stellenbosch University. This "in house" panel has received training in general aroma evaluation and has extensive previous experience in sensory evaluation of South African Chenin Blanc wines as the judges participate regularly in the experiments running in the environment. Due to the nature of the methods used in this work, the judges did not receive specific training on the set of wines evaluated. While it was not possible to use the same judges for each test, care was taken to keep the panel as consistent as possible by recruiting judges with similar levels of experience and training. Eight judges participated in all five evaluations, and a total of thirteen judges were present in at least four out of five experiments. The entire group of 21 panellists consisted of 6 males and 15 females, aged 22–41.

2.2.4. Projective mapping

A PM experiment was conducted where a single sensory modality, namely aroma, was evaluated. This PM experiment was performed to create a consensus map by multiple factor analysis (MFA) which was