Are wine categories convex? A preliminary study on white and red wine categories.

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1. INTRODUCTION

Categorizing perceptions is one of the most basic ways to organize our knowledge and this process has been widely studied mostly with visual stimuli. By contrast the classification of *wine* sensory perceptions into categories reflecting wine sensory concepts is an almost unexplored field. Among the few studies on this topic, Solomon (1997) shown that as expertise increases, the organization of chemosensory knowledge changes. Specifically, whereas experts tend to sort wines by grape variety, novices rely on basic properties such as sweetness or fruitiness. This result suggests that experts have built shared semantic memory representations of the different wine styles through frequent formal wine tasting in which they often have information about the wines they taste. However, this kind of expertise effect depends on the categories being studied. For example Ballester et al. (2009) showed that wine professional, novices, and trained panelists were able to successfully categorize wines as white and red wines based on olfactory information. Ballester et al. (2009) concluded that, in everyday life, wine drinkers build odor semantic representation of the color of wine, regardless of their expertise level. Yet, the underlying mechanisms used to build those representations and make category membership decisions remain to be explored. One possible mechanism is that when people taste wine (in a natural context) , they derive a white and a red prototype wine which they then store in semantic memory. Then, when asked to categorize new wines participants would compare these wines to the stored prototypes and would identity the current wine to its closest prototype. So if this prototype is the red wine prototype, then the current wine will be categorized as a red wine. Another mechanism would imply the comparison of the sample to the closest wine exemplar stored in memory. According to this mechanism, tasters would categorize the sample in the same category as this wine. When asked to categorize new wines, tasters would try to recall (consciously or unconsciously) the wine they tasted in the past that best matches the one being currently tasted. If the recalled wine happened to be red, then the taster will categorize

the current wine as a red. So far, there is no evidence in favor of one particular mechanism or the other, and further research is needed in this direction.

We decide to explore if this categorization was mediated by the abstraction of red and white wine prototypes. To address this question we designed a new experimental paradigm based on the seminal work by Posner and Keel (1968) that showed that participants readily categorized a prototype dot figure used to create a series of distorted patterns of dots even though the participants had never seen this prototype before being tested. In Posner and Keel's work, the exemplars were derived from prototypes using distortion rules. This classical distortion technique being somewhat hazardous with wines (chemical compounds are more difficult to manipulate than random dots) we adopted a different approach. We decided to adapt Rosch *et al* (1976) procedure who showed that the average shape of a number of chairs is still recognizable as a chair. Such categories—in which (linear) combinations of elements belong to the categories—are said to be convex, and these categories seem particularly relevant to model efficient human categorization. So, we built red and white wine "prototypes" as weighted sums of a number of red or white wines. The goal of our study was to check if the prototypes we created were still categorized as typical members of their respective categories. Is so, this would imply that red and white wine categories are convex (e.g., combinations of red wines will still considered red wines).

2. MATERIALS AND METHODS

2.1. Wines

Eighteen wines (six red, six white, and six rosé) were selected from a local supermarket. All wines came from different French vineyards, were from the 2008 vintage, and were considered as premium or popular premium (see Table 1).

Table 1. Samples used in the study

White wines	Code	Red wines	Code
AOC Touraine	W1	AOC Touraine	R1
AOC Bourgogne Aligoté	W2	AOC Beaujolais	R2
AOC Saint-Véran	W3	AOC Bourgogne H-C de Beaune	R3
AOC Entre deux Mers	W4	AOC St Emilion	R4
AOC Coteaux du Languedoc	W5	AOC Coteaux du Languedoc	R5
AOC Minervois	W6	AOC Côte du Rhône-Villages - Sablet	R6
AOC Muscadet Sèvre et Maine	W7	AOC Saumur Champigny	R7
AOC Alsace Pinot gris	W8	Vin de Pays Côtes de Brian	R8
AOC Roussette de Savoie	W9	AOC Corbières	R9
Vin de Pays d'Oc	W10	Vin de Pays d'Oc	R10
White prototype (1/10 of each sample)	Wp	Red prototype (1/10 of each sample)	Rp

2.2. Panel

Twenty participants participated in the study (15 females and 5 males; median age: 29). None of them had link with the wine industry. They were frequent wine drinkers.

2.3. Procedures

Binary sorting task. The whole set of wines were served in dark ISO glasses samples and were presented in a different order specific to each participant following a Williams Latin square. The wines were assessed only orthonasally. Panelists were asked to sort the different samples in two groups: red wine and white wine.

Typicality rating task. Two separate sets were served (white and red) following the same experimental conditions as before. For each set of wines, participants had to rate if the wines were good examples of white wine (for the white set) or red wine (for the red set) using an 11-point scales anchored "Very bad example" and "Very good example".

3. RESULTS AND DISCUSSION

First, an analysis of the % of correct categorizations showed that wines have been well categorized (90% for whites and 96% for reds on the average). Moreover, both prototypes were correctly classified by 100% of the participants. Second, a multidimensional scaling (MDS, non-parametric ALSCAL algorithm) analysis was performed on the 22 ×22 wine co-occurrence matrix. Two dimensions were selected as the most appropriate MDS solution (Figure 2). A clear perceptual difference can be observed between red and white wines. Interestingly, the red wine are tightly clustered around the red prototype whereas the white wines are more loosely clustered and the white prototype off-centered.

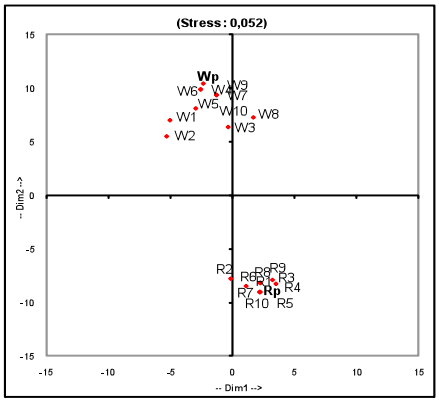

Figure 2. Two –dimension MDS plot derived from binary sorting task

An analysis of the average typicality scores of showed that for red wines, the average scores ranged from 4.1 to 6.75 and for white wines from 4.2 to 6.8. The white wine prototype obtained the highest average typicality score (6,8) whereas the red wine prototype obtained only the fifth highest score. Figures 3a and 3b show individual typicality scores for red and white wine respectively. For most participants the prototype scores were not different or higher that the average score in particular for the white prototype.

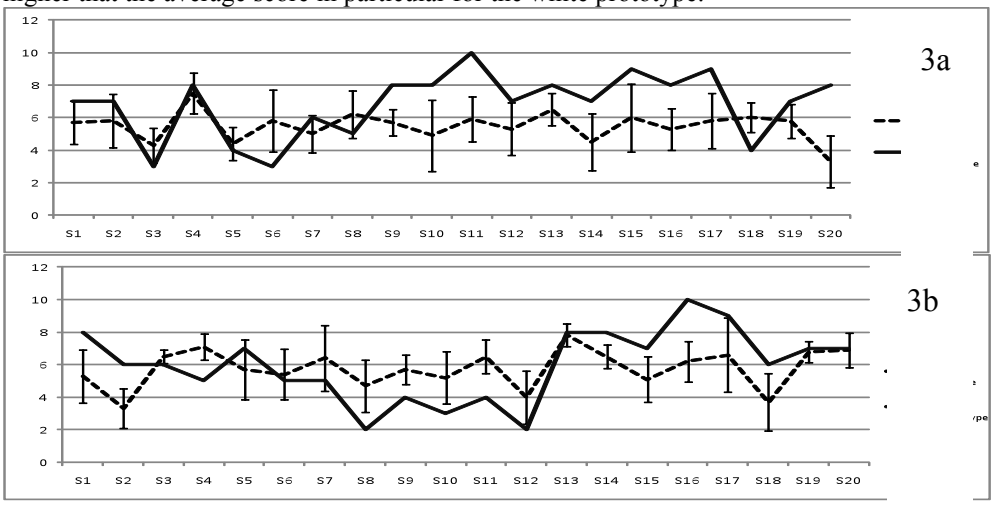

Figure 3. Individual typicality scores for white (a) and red wine (b). The error bar r ts the 5% confidence interval around the mean. The X-axis represents the participants ordered from 1 to 20.

Overall, the current study shows that mixtures of red or white wines were judged by panelists as more typical of red and white wines than some actual members of the categories. In other words, red and white wine categories are convex categories, but the mixtures of wines acts as prototypes because they have a central position the category. A corollary of this finding is that these categories might well be represented in memory in terms of prototypes. Yet further work is needed to confirm this conclusion. A way to do so will be to evaluate whether panelists would better recognize a prototype derived from a set of wines than the wines themselves as Posner and Keele (1968) did for random dot prototypes.

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