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1 From perceptual to conceptual categorization of wines: What is the effect of expertise?

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14 Highlights:

- 15 - Perceptual categorization is driven by sensory characteristics whatever the expertise
- 16 level
- 17 - Conceptual categorization is driven by wine knowledge and experience
- 18 - Blind tasting could have activated a script in expert memory instead of a prototype
- 19 - There is an effect of expertise in the vocabulary used to describe the wine groups

20 Abstract

21 Wine supply in the French market is structured in an intricate system of categories based on
22 origin. There is very little knowledge about consumers understanding of this complex
23 category system and the sensory styles behind these categories. This study investigated how
24 assessors with different level of expertise categorized Beaujolais wines from general to more
25 specific levels of categorization (grape variety, appellation, and "*lieu-dit*") in both perceptual
26 (wines) and conceptual (wine labels) conditions. Based on the literature on expertise, we
27 expected a stronger effect in the perceptual condition, in particular for the most specific levels
28 of categorization. For each wine categorization level, three sets of 12 wines were tasted by
29 three panels of 60 assessors: a panel of unfamiliar novices with no much exposure to
30 Beaujolais wines; a panel of familiar novices with regular exposure to Beaujolais wines; and a
31 panel of experts from the Beaujolais. In both perceptual and conceptual conditions, assessors
32 were asked to perform a binary sorting task, followed by a verbalisation task. Data were
33 analysed using DISTATIS. At each level, with a few exceptions, a clearer separation was
34 observed between the two categories in the conceptual condition than in the perceptual
35 condition. Although the experts categorized the labels by grape variety, they did not
36 spontaneously categorize the wines in that way. Finally, we observed a clear expertise effect
37 only in the conceptual condition. This result will be discussed in terms of expertise acquisition
38 and categorization processes.

39 Keywords: expertise; familiarity; blind tasting; categorization; binary sorting; wine

40

41

42 1. Introduction

43 Like many PDO food products, wine is a very diversified and complex product. To facilitate
44 consumers' understanding of this diversity, wine books or guides propose some classification
45 systems based on colour, vineyard (i.e. a wine-producing region) and/or grape variety. These
46 classifications, however, vary between countries or within a country according to law
47 regulations. For instance, in European countries like France, Italy, Spain, and Portugal, the
48 classification progressively extends across Protected Designation of Origin (PDO) level. In
49 France, the hierarchy of appellation globally starts with regional appellations, and goes till
50 communal appellations, with occasionally *premier cru* or *grand cru* designations. In addition,
51 the wines produced in the different vineyards within each country are very diversified and
52 complex because of specific regulations within a same vineyard, as is the case in France. This
53 complexity is reinforced by the high diversity of wine labels. Wine labels are diversified in
54 terms of colours, level of information, pictures and styles within a same wine category. The
55 type of information provided on the label also depends on the country regulation policies:
56 certain information, like the name of the grape variety or the vineyard, is not mandatory
57 whereas others are. As a consequence, it is rather complicated for consumers to identify
58 information in relation to wine classifications.

59 The perception of the hierarchical and complex wine organization had been investigated in a
60 previous study by Honoré-Chedozeau, Lelièvre-Desmas, Ballester, Chollet, & Valentin
61 (2017). Three panels of different levels of expertise: wine professionals, familiar consumers
62 and unfamiliar consumers with Beaujolais wines performed a free hierarchical sorting task
63 (FHS) of wine labels of different vineyard, grape varieties and Beaujolais PDO wines. The
64 FHS results showed that the three panels formed common groups that followed the wine
65 taxonomy system indicating a common conceptual knowledge of this system. Interviews
66 conducted after the sorting task, however, revealed that the panels had not used the same
67 strategies for categorizing the wine labels: most of the experts and the familiar consumers
68 used top-down strategies based on their knowledge while the unfamiliar consumers used
69 bottom-up strategies based on the search of clues to compensate their lack of
70 knowledge/exposure to wines. This study, conducted with wine labels, raises the question of
71 whether such a difference in categorization strategy would occur during blind tasting.

72 A number of studies addressed this question. For instance, Ballester, Abdi, Langlois, Peyron,
73 & Valentin (2009) asked expert and novice assessors to smell a set of red, white and rosé
74 wines presented in dark glasses and to sort them into colour categories. A clear separation was
75 observed between the white and the red wines for both groups indicating that experts and
76 novices have developed a clear representation of the odour of red and white wines. In
77 contrast, Ballester, Patris, Symoneaux, & Valentin (2008) and Solomon (1997) showed that
78 whereas wine experts clearly sorted white wines by grape variety, novices tended to sort them
79 according to surface-based criteria such as sweetness or fruitiness. The ability of experts to
80 categorize wines according to grape variety was also demonstrated by Llobodanin, Barroso, &
81 Castro (2014): Sommeliers were able to recognize the correct grape varieties among certain
82 South American red wines (particularly for Malbec, Cabernet Sauvignon and Carménère
83 wines). Finer categorizations can also be observed for experts. For example, Parr, Green,

84 White, & Sherlock (2007) report that wine experts from New Zealand were able to classify
85 Sauvignon blanc wines by area of production. For a same vineyard (Touraine area from the
86 Loire Valley), Pagès (2005) showed that wine experts could separate white wines from two
87 different origins and different grape varieties (Chenin wines from Vouvray PDO vs
88 Sauvignon blanc wines from Touraine PDO). However, experts are not always able to classify
89 wines according to PDO when the wines are made from a single grape variety. For instance,
90 Jaffré (2009) showed that wine professionals did not distinguished the Fleurie PDO wines
91 from other Beaujolais PDO wines.

92 Most of the authors of the previously cited studies build on psychological models of
93 categorization to explain their results. Following Rosch & Mervis (1975)'s work they assume
94 that the expert superiority in wine categorization can be explained in terms of prototype
95 abstraction. Through repeated exposures to wines from different categories, experts would
96 develop some kind of prototypes or central tendency that represents the sensory "signature" of
97 these categories (Parr, Valentin, Green, & Dacremont, 2010). As Parr *et al.* (2007, p. 851) put
98 it when talking about Sauvignon blanc wines: "*those experienced with Marlborough*
99 *Sauvignon blanc will have developed internalised standards (i.e., a concept) about the wine*
100 *that will have a central tendency (an ideal or typical example) and boundaries (i.e., limits in*
101 *terms of variation from the ideal example that can be tolerated before a wine is deemed*
102 *outside the concept)*". Further categorization would then be made with reference to these
103 prototypes. This interpretation supposes that experts have a holistic perception of wines by
104 unconsciously activating prototypes when asked to categorize a set of wines. Yet, according
105 to Rabin (1988), during training experts are taught to focus on wine distinctive features and
106 thus taste wines analytically. Further work is thus needed to understand how wine tasters
107 apprehend wine, to what extent experts develop a clear representation of the wine complex
108 hierarchical classification system and, whether this representation differs from that of familiar
109 (*i.e.* previously exposed to) and unfamiliar consumers, both at a perceptual and at a
110 conceptual level.

111 To address this question, we compared Beaujolais red wine categorization by wine
112 professionals and consumers. The Beaujolais region mainly produced red wines, made from
113 the single Gamay grape variety. This vineyard includes 12 PDOs red wines that are organized
114 and regulated by law, according to two regional appellations (Beaujolais PDO and Beaujolais-
115 Villages PDO) and 10 communal appellations, referred to as *crus*, (Régnié, Fleurie, Morgon,
116 Moulin-à-Vent, Brouilly, Côte-de-Brouilly, Juliéna, Saint-Amour, Chénas, and Chiroubles
117 PDOs). Some *crus* are further divided into *lieux-dits* (a French term for wines which are made
118 exclusively from a small historical plot with a locality name). For instance, among the
119 Morgon PDO wines, we can find "Morgon *Côtes-du-Py*" or "Morgon *Grand Crus*".

120 We asked three groups of participants with different levels of expertise/familiarity in
121 Beaujolais wines to perform binary sorting tasks at three levels of categorization: 1) grape
122 variety level, which is the most general level, 2) appellation level, which is an intermediate
123 level, and 3) "*lieu-dit*" level, which is the most specific one. The first group of participants
124 were wine professionals from the Beaujolais area, which we call experts. The second group
125 were consumers from the Beaujolais area which we call familiar novices, and the third group

126 were consumers from a very distant region of Beaujolais area and non-wine producing (the
127 North of France) which we called unfamiliar novices.

128 To evaluate if the effect of expertise affects differently wine tasters' perceptual and
129 conceptual representations, we used two experimental conditions. In the first condition,
130 experts and novices blind tasted the wines and were asked to sort the wines in two groups,
131 without any information (perceptual condition). In the second condition, they had to perform
132 the same sorting task but with the labels of the wines they previously tasted in the first
133 condition, without any tasting (conceptual condition). For the perceptual condition (blind
134 tasting), we expected that the experts would rely more on top-down processes based on their
135 experience and knowledge (*e.g.*, concepts or prototypes) about the wines to make the
136 categorizations, than on bottom-up processes based on their sensory perception of the wines.
137 In contrast, based on previous work we expected that novices would rely more on bottom-up
138 processes (*e.g.*, sensory characteristics) than top-down processes to perform the task,
139 especially unfamiliar novices. We focused our research on chemosensory aspects of the
140 samples, therefore we used dark glasses in order to avoid results either biased or dominated
141 by the visual cues (Morrot, Brochet, & Dubourdieu, 2001). For the conceptual condition
142 (labels), we expected a lesser effect of expertise than for the perceptual condition as novices
143 (especially familiar novices) might have derive some kinds of representation of the Beaujolais
144 wine classification system *via* wine books, guides or restaurant menus (Honoré-Chedozeau et
145 al., 2017).

146 2. Material and methods

147 2.1. Wines

148 We studied three levels of categories: (1) grape variety, (2) appellation, and (3) *lieu-dit* levels.
149 For each level, we respectively selected two categories of wines (1) Gamay from Beaujolais
150 vineyard (G) *vs.* Pinot Noir from Burgundy vineyard (P), (2) Morgon PDO (M) *vs.* Régnié
151 PDO (R), and (3) "*lieu-dit*" (L) *vs.* not "*lieu-dit*" (NL) within the Morgon PDO. In order to
152 generalize the results of this study, three sets of wines were selected to represent each of the
153 three category levels.

154 For each level, twelve wines were randomly selected to constitute each set, six per wine
155 category. This wine selection was realized from the different lists given by the
156 interprofessions (Inter Beaujolais and Bureau Interprofessionnel des Vins de Bourgogne) for
157 each category level. Each bottle has been checked by a sniffing after the bottles have been
158 opened before the wine tastings to avoid off-flavours. The selected wines were all from the
159 2011 vintage for the grape variety level and all from the 2013 vintage for the appellation and
160 the "*lieu-dit*" levels. Table 1 provides a list of the selected wines for the grape variety, the
161 appellation and the *lieu-dit* levels.

162

163

164 Table 1: Overview of the selected wines for each set of the grape variety, the appellation and
 165 the *lieu-dit* levels.

Category level	Wine category	Wine PDO (code)		
		Set 1	Set 2	Set 3
Grape variety	Gamay	Julié纳斯 (G1)	Fleurie (G7)	Fleurie (G13)
		Morgon (G2)	Moulin-A-Vent (G8)	Beaujolais-Villages (G14)
		Fleurie (G3)	Côte-De-Brouilly (G9)	Régnié (G15)
		Fleurie (G4)	Moulin-A-Vent (G10)	Régnié (G16)
		Moulin-à-Vent (G5)	Moulin-A-Vent (G11)	Fleurie (G17)
		Julié纳斯 (G6)	Beaujolais (G12)	Beaujolais-Villages (G18)
	Pinot Noir	Nuits-Saint-Georges (P1)	Santenay (P7)	Bourgogne Côtes-d'Auxerre (P13)
		Marsannay (P2)	Vosne-Romanée (P8)	Chorey-Lès-Beaune (P14)
		Monthélie (P3)	Irancy (P9)	Pernand-Vergelesses (P15)
		Saint-Romain (P4)	Marsannay (P10)	Bourgogne Hautes Côtes-de-Beaune (P16)
		Gevrey-Chambertin (P5)	Gevrey-Chambertin (P11)	Bourgogne Côte Chalonnaise (P17)
		Volnay (P6)	Bourgogne Côtes-d'Auxerre (P12)	Marsannay (P18)
Appellation	Morgon	Morgon (from M1 to M6)	Morgon (from M7 to M12)	Morgon (from M13 to M18)
	Régnié	Régnié (from R1 to R6)	Régnié (from R7 to R12)	Régnié (from R13 to R18)
<i>Lieu-dit</i>	<i>Lieu-dit</i>	Morgon <i>Corcelette</i> (L1)	Morgon <i>Côtes-du-Py</i> (L7)	Morgon <i>Charmes</i> (L13)
		Morgon <i>Côtes-du-Py</i> (L2)	Morgon <i>Grands Cras</i> (L8)	Morgon <i>Côtes-du-Py</i> (L14)
		Morgon <i>Charmes</i> (L3)	Morgon <i>Côtes-du-Py</i> (L9)	Morgon <i>Côtes-du-Py</i> (L15)
		Morgon <i>Côtes-du-Py</i> (L4)	Morgon <i>Douby</i> (L10)	Morgon <i>Côtes-du-Py</i> (L16)
		Morgon <i>Charmes</i> (L5)	Morgon <i>Côtes-du-Py</i> (L11)	Morgon <i>Grands Cras</i> (L17)
		Morgon <i>Corcelette</i> (L6)	Morgon <i>Côtes-du-Py</i> (L12)	Morgon <i>Grands Cras</i> (L18)
	Not <i>Lieu-dit</i>	Morgon (from NL1 to NL6)	Morgon (from NL7 to NL12)	Morgon (from NL13 to NL18)

166

167 2.2. Panels

168 For each wine set, we recruited three panels of assessors: (1) an expert panel including wine
 169 professionals from the Beaujolais vineyard including winemakers, vine and wine consultants,
 170 vine and wine engineers, laboratory technicians located around Villefranche-sur-Saône
 171 (experts), (2) a familiar novice panel including wine consumers who lived around the
 172 Beaujolais vineyard (familiar novices that are used to drink Beaujolais wines), and (3) an
 173 unfamiliar novice panel including wine consumers from Lille, an area without vineyards
 174 (unfamiliar novices). The panel characteristics are shown in Table 2. For both novice panels,
 175 red wines are the most frequently consumed. More precisely, the familiar novices drink more
 176 frequently wines from Beaujolais, Burgundy and the Northern Rhône while the unfamiliar
 177 novices drink more frequently wines from Bordeaux and Champagne (Table 3). For the
 178 perceptual condition, the two panels of novices (familiar and unfamiliar) were recruited by
 179 means of an online questionnaire in order to verify that they consumed wines but were not
 180 oenophiles. The online questionnaire included socio-demographic questions (gender, year of
 181 birth, town, and length of residence, socio-professional group and types of wines consumed)
 182 as well as wine tasting and consumption habits. The criteria used to select wine consumers
 183 were: not under the age of 18, consume wine at least annually, no professional wine

184 experience, no registration at a tasting club and no formal training in wine tasting or wine
 185 production. The conceptual condition task took place six months later with the same
 186 assessors, in order to minimize the memory bias of the perceptual task. This important time
 187 period between the two sessions had unfortunately generated unavailability among assessors
 188 for the second condition, which explains why the number is lower for the conceptual
 189 condition.

190 Table 2: Panel characteristics.

Panel		Experts		Familiar novices		Unfamiliar novices	
Condition		Perceptual	Conceptual	Perceptual	Conceptual	Perceptual	Conceptual
Set 1	Number	19 (15/4)	13	20 (9/11)	12	20 (6/14)	18
	(Men/Women)						
	Mean age	49		44		51	
Set 2	Number	20 (17/3)	14	20 (11/9)	10	20 (9/11)	18
	(Men/Women)						
	Mean age	45		46		45	
Set 3	Number	19 (12/7)	12	20 (13/7)	16	20 (8/12)	20
	(Men/Women)						
	Mean age	51		43		46	

191

192 Table 3: Wine drinking habits of the novice panels for each set.

Type of novice panel		Familiar novices			Unfamiliar novices		
Type of set		Set 1	Set 2	Set 3	Set 1	Set 2	Set 3
Frequency of wine consumption							
	One to ten times a year	0	1	0	0	2	2
	One to ten times a month	5	6	4	5	5	4
	Once or twice a week	5	5	9	8	7	4
	Every week-end	7	2	6	4	1	7
	Every day	3	6	1	3	5	3
Types of wines consumed (%)							
	White wine	40	35	45	65	60	60
	Rosé wine	20	30	30	60	55	65
	Red wine	85	80	80	75	65	90
	Sparkling wine	10	5	0	50	40	40
Origin of wines most frequently consumed (%)							
	Alsace	5	10	10	20	15	20
	Beaujolais	80	80	65	15	30	15
	Bordeaux	20	15	35	55	50	75
	Burgundy	55	60	45	20	15	10
	Champagne	5	5	10	50	40	35
	Charentes	0	0	0	5	10	5
	Corsica	0	5	0	0	0	0
	Jura/Savoy	5	0	0	15	35	10
	Languedoc-Roussillon	10	10	15	10	10	25
	Provence	15	15	0	30	40	30
	South-West France	0	0	5	15	5	15
	Loire Valley	5	5	15	25	25	15
	Northern Rhone	75	75	50	5	5	25

193

194 2.3. Experimental design

195 For each panel, assessors participated to four sessions: a perceptual condition (wine
196 categorization) carried out into three sessions (one per level), and a conceptual condition
197 (wine label categorization), carried out into a single session six months after the third session.
198 The whole procedure is schematized in Fig 1 to facilitate understanding.

199 2.3.1. Procedure

200 For each set of wines and each condition, assessors were asked to perform a binary sorting
201 task coupled to a verbalization. For each assessor within a panel, the three category levels
202 were randomly distributed into the three sessions for the perceptual condition. For the
203 conceptual condition, a same assessor received the three category levels in the same order
204 than those of the perceptual condition. No information was given about the wines, or the
205 purpose of the study. There was no time limit to perform each sorting. Each session lasted
206 about 30 minutes. Water was available during each session.

208 2.3.2. Perceptual condition sessions

209
210 For the perceptual condition, the twelve wines were presented simultaneously, in a random
211 order following Latin squares. Twenty-mL wine samples were served at ambient temperature
212 in black ISO glasses, identified by a random 3-digit code, and covered with plastic Petri
213 dishes. For each session, assessors were asked to taste the wines and to sort them in two
214 groups according to the following instruction: “*Please group the wines into two groups, by*
215 *putting together the wines that are similar*”. After the sorting task, assessors were asked to
216 briefly describe with their own words and expressions the two groups they formed.

218 2.3.3. Conceptual condition session

219 For the conceptual condition, the labels of each bottle of the three category levels were
220 removed (front label, back label, award, and particular vintage label), scanned, and printed as
221 colour cards (14.8 x 21 cm) for each set. Each card was then identified by a random 3-digit
222 code on the reverse side, different from that of the corresponding wines in the perceptual
223 condition. The assessors had to make three successive binary sorting tasks, one for each
224 category level, by sorting the labels into two groups according to the following instruction:
225 “*Please look at the wine labels and group the wines that, in your opinion, belong to the same*
226 *wine category into two groups*”. After each binary sorting, assessors were asked to briefly
227 describe with their own words and expressions the two groups they formed.

229 2.4. Data analysis

230 2.4.1. Binary sorting data analysis

231 For each panel, each set, each level and each condition, data from the binary sorting were
232 encoded in a rectangular matrix where the rows represent the wines (or the labels) and the
233 columns represent the corresponding group numbers of wines (*i.e.* “1” for each wine (or label)
234 placed in the first group, and “2” for each wine (or label) placed in the second group). The
235 matrices were analysed separately using DISTATIS, and then compared. DISTATIS is a

236 statistical method which is a generalisation of classical multidimensional scaling (Abdi &
237 Valentin, 2007). This method permits to take into account individual sorting data and provides
238 graphical representation of wines and assessors (for a tutorial about the method, see Abdi,
239 Valentin, Chollet, & Chrea, 2007).

240 The coordinates of the wines (or labels) for all the dimensions on the DISTATIS maps are
241 then used as input to a Hierarchical Ascending Classification (HAC), in order to identify the
242 two groups formed by each panel. These statistical analyses were performed using the free
243 software R, version 3.2.3 for Windows (R Core Team, 2015) with the additional R packages
244 *DistatisR* (Beaton, Fatt, & Abdi, 2013) and *FactoMineR* (Lê, Josse, & Husson, 2008).

245 To evaluate the match between the groups made by the assessors and the *a priori* categories
246 from the Beaujolais wine classification, we computed a score for each assessor. This score
247 varied from zero (the two groups are made of an equivalent number of wines of each *a priori*
248 category) to six (*i.e.* a perfect sorting of the wines into the two *a priori* categories). This score
249 was calculated as the absolute value of the number of wines from the first category (x_1) minus
250 the number of wines from the second category (y_1) in the first group ($|x_1 - y_1|$) plus the absolute
251 value of the number of wines from the first category (x_2) minus the number of wines from the
252 second category (y_2) in the second group ($|x_2 - y_2|$) divided by 2 ($(|x_1 - y_1| + |x_2 - y_2|)/2$). For
253 example, if an assessor formed a first group of three Pinot Noir and one Gamay, and a second
254 group of three Pinot Noir and five Gamay, the score will then be equal to $(|3 - 1| + |3 - 5|)/2 =$
255 2 . Then, we calculated an average score for each panel, each level, each set and each
256 condition in order to quantify the tendency of the assessors to separate the wines (or the
257 labels) into the two *a priori* categories within each panel, at both the panel and the individual
258 levels. A mixed design three-way analysis of variance (ANOVA) was carried out considering
259 the panel as between-subject fixed factor and the condition and level of categorization as
260 within-subject fixed factors. Individual scores were used as dependent variable. As the design
261 was unbalanced, we used Type III Sum of squares. Duncan multiple comparison tests were
262 performed with $\alpha = 5\%$ when a significant effect of panel and level was found. These analyses
263 were performed under XLSTAT Premium (version 19.5).

264 2.4.2. Verbalization data analysis

265 All the terms and expressions used by the assessors to describe the groups of wines (or labels)
266 for each level of categorization and each set were first compiled in a list for each condition. A
267 semi-automatic procedure was used to lemmatize and to categorize the words in the lists by
268 using the SPAD software (version 8.2, CISIA-CESRESTA, Montreuil, France). For each
269 condition, terms were then encoded in a rectangular matrix where the rows represent the terms
270 and the columns represent the three levels of categorisation for each of the three panels. Data
271 were finally analysed by Correspondence Analysis (CA) for each condition, using the SPAD
272 software, in order to determine and to compare the type of verbalization used by each panel
273 for the description of the two groups of wines (or labels) whatever the level. Only the terms
274 that best characterized each type of panel for each level (*i.e.* v -test value > 2) according to a
275 hypergeometric law (Lebart, Piron, & Morineau, 2006), are shown on the first two CA
276 dimensions.

277 3. Results

278 Results from the sorting task were analysed in two ways: (1) at a panel level by using
279 DISTATIS analysis for the sorting data and CA analysis for the verbalization data, and (2) at
280 an individual level by calculating individual scores. To evaluate the generalizability of our
281 results, each binary categorization task was performed on three sets randomly picked from a
282 pool of wines. Our results showed that for all categorization tasks, with a few exceptions, the
283 results obtained for the three sets were similar. All these results are presented for the
284 individual categorization scores and the verbalization analysis but to avoid redundancy and
285 having too many figures, only the results obtained with one wine set will be presented for the
286 DISTATIS analysis.

287 3.1. Binary sorting task in the perceptual and conceptual conditions

288 3.1.1 DISTATIS analysis

289 Figs 2, 3 and 4 show DISTATIS compromise maps of the wines for respectively the grape
290 variety, the appellation and the *lieu-dit* levels. Globally, the HAC groups showed that at the
291 panel level, the wine labels are separated into the two *a priori* categories (Figs 2b, 2d, 2f, 3b,
292 3d, 3f, 4b, 4d and 4f), with an exception for the *lieu-dit* level for the novice panels (Figs 4d
293 and 4f). However, the wines are not clearly separated into the two *a priori* categories (Figs 2a,
294 2c, 2e, 3a, 3c, 3e, 4a, 4c and 4e). As an example, Fig 2a and b show the first two dimensions
295 of the DISTATIS compromise maps obtained for the expert panel in the wine (Fig 2a) and
296 label (Fig 2b) categorization tasks at the grape variety level. In the conceptual condition, the
297 first dimension (81.05% of variance) opposes clearly the Gamay to the Pinot Noir wines. The
298 small size of the confidence intervals reflects a good agreement among assessors. This
299 opposition between Gamay and Pinot Noir wines is not as clear in the perceptual condition:
300 The first dimension explains only 46.22% of variance and the confidence intervals are much
301 larger and tend to overlap. The HAC performed on the coordinates of the wines in the
302 perceptual condition shows that the Gamay wine G3 is grouped with the six Pinot Noir wines.
303 Whereas for the conceptual condition, the separation into the two *a priori* categories is quite
304 clear. The same pattern of results is observed for the familiar novice panel (Figs 2c and 2d).
305 For the unfamiliar novice panel, some overlap between confidence intervals are observed in
306 the conceptual condition indicating a fuzzier conceptual representation of Gamay and Pinot
307 Noir wines for this panel (Figs 2e and 2f).

308 Interestingly for the appellation level (Fig 3), a greater overlap between confidence intervals
309 appears for experts in the conceptual condition (Fig 3b) than for the two other panels (Figs 3d
310 and 3c). The opposite is observed for the *lieu-dit* level: Only experts were able to separate
311 *lieu-dit* from not *lieu-dit* at the conceptual level. Important overlaps are observed for the two
312 other panels. This suggests that only experts developed a conceptual representation of *lieu-dit*
313 even though the size of the confidence and the inter-assessor's disagreement for wines NL3
314 and L3 indicates that this representation is not as clear as the one observed for the grape
315 variety level.

316

317 3.1.2. Individual scoring analysis

318 The individual score analysis shows the same global trend as observed through the DISTATIS
319 analysis, but important inter-individual differences appear even in the conceptual condition.
320 For instance, despite a clear separation of the Pinot Noir and the Gamay labels at a panel
321 level, only 25% of all the assessors have perfectly sorted the labels into the two expected
322 categories.

323 As expected, the three-way ANOVA showed:

- 324 • A significant main effect of expertise level ($F[2, 914] = 15.2, p < 0.0001$). The Duncan
325 test indicates that on the whole, the experts (mean = 2.4) significantly outperformed
326 the two groups of novices. However, contrary to our hypothesis, no significant
327 difference was observed between both novice types (mean = 2.1 and 1.9 for familiar
328 and unfamiliar novices respectively).
- 329 • A significant main effect of the level of categorization ($F[2, 914] = 15.1, p < 0.0001$).
330 The Duncan test showed that significantly higher categorization scores were obtained
331 for the more general categorization level, grape variety (mean = 2.4) followed by the
332 appellation level (mean = 2.1) which was significantly different from the more
333 specific categorization level, *lieu-dit* (mean = 1.7).
- 334 • A significant main effect of condition ($F[1, 914] = 234.5, p < 0.0001$): Higher
335 categorization scores were obtained in the conceptual (mean = 3.0) than in the
336 perceptual (mean = 1.4) condition.

337 These main effects, however, should be interpreted with caution as all interactions were also
338 significant. The effect of expertise depends both on the level of categorization ($F[4, 914] =$
339 $4.4, p < 0.01$) and on the condition ($F[2, 914] = 5.7, p < 0.01$) and also on the interaction
340 between these two factors ($F[4, 914] = 3.2, p < 0.05$). The effect of expertise is stronger in the
341 conceptual condition than in the perceptual condition. In the perceptual condition, the
342 superiority of experts over novices (familiar and unfamiliar) holds only for the grape variety
343 and to a lesser extent the *lieu-dit* level. No effect of expertise was seen for the appellation
344 level (Fig 5a). This goes against our hypotheses as we expected the effect of expertise to
345 decrease with the specificity of the categories. In the conceptual condition (Fig 5b), familiar
346 novices are closer to experts, both having higher scores than unfamiliar novices, whereas in
347 the perceptual condition they are closer to unfamiliar novices. Finally, the effect of
348 categorization level holds only for the conceptual condition. The two more general levels
349 (grape variety and appellation) led to higher scores than the most specific level (*lieu-dit*) in
350 the conceptual condition for the novices only. No difference was observed in the perceptual
351 condition.

352

353 3.2. Verbalization

354 In the perceptual condition, a total of 92 terms was elicited after lemmatization for all panels,
355 all levels and all sets. Fig 6 shows the projections of the 92 terms on the first two dimensions

356 of the CA (82.45% of the variance). Although some terms are used by all panels, such as
357 *fruity, body, aroma, bitter, correct,* and *pronounced*, other terms are specific to each type of
358 panel. The first dimension (67.33% of variance) opposes a basic sensory vocabulary
359 generated by the two novice panels (on the right) to a more specialized sensory vocabulary
360 generated by the expert panel (on the left). The expert panel used specific terms like *woody,*
361 *tannins, complexity, lively, supple, spicy,* and *warm*. Among these specific terms, some terms
362 like *Brett, oxidation-reduction, ethyl,* and *fault* correspond to wine faults. The second
363 dimension (15.12% of variance) opposes the two groups of novices. The familiar novices, like
364 experts, generated specialized terms like *thick, harsh, aggressive, green, persistence, nut,*
365 *floral,* and *straightforward* while the unfamiliar novices used more basic terms such as
366 *strong, dry, full-bodied, rich, pungent, aftertaste,* and *rough*. Interestingly, the results also
367 showed that, for a given panel, the terms used do not depend on the level of categorization
368 (Grape variety, Appellation, *Lieu-dit*). This last result suggests that panelists used the same
369 strategy to perform the sorting task independently of the category levels.

370 In the conceptual condition, a total of 116 terms was obtained after lemmatization for all
371 panels, levels, and sets. Fig 7 shows the projections of the 116 terms on the first two
372 dimensions of the CA (55.64% of the variance). Contrary to what was observed in the
373 perceptual condition, the level of categorization impacted the terms used to describe the
374 groups formed in the conceptual condition. The first dimension (30.09% of variance) opposes
375 the terms used for the grape variety level to the terms used for the two other category levels.
376 This distinction was particularly true for experts who used the same terms to describe the
377 wines from the appellation and the *lieu-dit* levels, but different terms to describe the wines
378 from the grape variety level. The second dimension (25.55% of variance) opposes the experts
379 to the two groups of novices. Although the difference between the three panels is not as clear
380 as in the perceptual condition, some terms were more specific to certain panels. Among the
381 terms that characterized the most each panel (hypergeometric law, alpha risk =5%), the
382 experts use both visual terms (*classic, traditional, trendy,* and *prestige*) and specific terms
383 about the wines that are related to the *a priori* categories (*climat, cuvée, lieu-dit, cru,* and
384 *Terra Vitis*). In contrast, the familiar novices used more the label information: They looked
385 for information on the type of wine and producer (*grape variety, bottling, establishment,*
386 *producer*) and were also attracted by visual cues (*busy, readable, standard*). The unfamiliar
387 novices seemed to search for all the clues they could find on the labels like the back label
388 information (sensory description, food pairing (*occasion, meal*)), the presence of *medal,* of
389 *legal mention,* the visual (*austere, strict, serious, festive, authentic,* and *refined*), and the type
390 of appellation, without necessarily making distinctions between the relevant and the irrelevant
391 information.

392 To sum up, the verbalization task highlighted the strategies used by the three panels to sort the
393 wines and the labels. The words generated show that, in the perceptual condition, the
394 assessors focused mainly on their sensory perception of the wines without making any
395 inference about their origin for instance, whatever the level of expertise. An effect of
396 expertise is observed on the type of terms used: The experts used a specialized sensory
397 vocabulary while the unfamiliar novices used a global vocabulary to describe the wines. The

398 familiar novices are intermediates for the vocabulary used. A higher effect of expertise is
399 observed for the conceptual condition.

400 4. Discussion

401 Based on the literature, our main hypothesis was that the level of expertise would
402 considerably affect the wine categorization for the perceptual condition (wines), and for the
403 most specific levels of categorization (appellation and *lieu-dit*). We expected that, for the
404 perceptual condition, the experts would rely more on top-down processes based on their
405 experience and knowledge about the wines, than bottom-up processes based on their sensory
406 perception of the wines. We expected the opposite result for the two novice panels. For the
407 conceptual condition (labels), we expected a lesser effect of the level of expertise than that for
408 the perceptual condition. Our second hypothesis was that the experts would use more the *a*
409 *priori* categories, through their professional background and exposure to Beaujolais wines,
410 than the familiar and unfamiliar novices with a lower level of expertise and/or familiarity with
411 the Beaujolais wines.

412 4.1. Blind wine tasting categorization: only perceptual?

413 For the perceptual condition, the effect of expertise was less strong than we expected.
414 Concerning the grape variety level, our results are not fully in line with the assumption that
415 experts have developed a mental representation of wines based on grape variety prototypes,
416 through their prior experience and knowledge with wines (Ballester et al., 2008; Hughson &
417 Boakes, 2002; Solomon, 1997). However, in our study, no information about the wines or the
418 categories were provided to the assessors, that could explain the difference observed between
419 our study and the studies mentioned previously. We expected that the expert panel would
420 spontaneously use their mental representation of grape variety to interpret the wine sensory
421 characteristics they perceived in the perceptual condition, leading them to categorize the 12
422 wines according to the grape variety. Our results for the three sets showed only a tendency to
423 categorize the wines by grape variety, but this pattern of categorization was not systematic for
424 each expert.

425 For the two most specific levels, the experts did not categorize the wines into the *a priori*
426 categories (reminder: Morgon vs. Régnié for the appellation level, and Morgon vs. Morgon
427 *lieu-dit* for the *lieu-dit* level). For all levels, the descriptions of the groups of wines used by
428 the three expert panels showed that they mainly used their sensory perception of the wines as
429 criteria. Whatever the level of categorization, it seems that experts did not spontaneously
430 activate a wine prototype in memory to make inferences about the properties of the wines they
431 tasted (no name of grape variety, origin, or type of winemaking). Instead, the results of the
432 verbalization show that they rather looked for the presence of wine faults among the samples.
433 These results indicate that when experts have no information about the wines or about the aim
434 of a tasting, they use an analytical approach to categorize the wines. As they were looking for
435 specific characters based on their knowledge and past experience, the famous wine tasting
436 definition from Ribéreau-Gayon takes on its full meaning in our results: “*Wine tasting is to*
437 *taste a wine with care in order to appreciate its quality; to submit it to examination by our*
438 *senses, in particular those of taste and smell; to try and understand it by discovering its*

439 *various qualities and faults and putting them into words. It is to study, analyze, describe,*
440 *define, judge and classify.”* (Peynaud & Blouin, 2013, p. 1). It is important to note that experts
441 used many wine fault terms in their verbalizations. However, a closer look to the individual
442 results reveals that experts did not agree on which wines were faulty or on which faults they
443 found in a given wine. That behavior is probably not due to the wines themselves, but rather
444 to the type of experts we recruited. Indeed, a major part of the experts who participated in our
445 study are used to characterize wines from other research studies, for which a judgment about
446 different wine faults is very often asked. So, this routine, gained for many years, might have
447 been applied to the binary sorting task. The presence of wine faults constituted the main wine
448 categorization criterion for more than half of our experts, whatever the set of wines or the
449 categorization level (five of them have systematically sorted the three sets of wines according
450 a fault criterion). However the lack of consensus for the given faults (*e.g.* some wines were
451 considered as “fault” for some experts, but the same wines were also considered as “no faults”
452 for others, and different types of faults were identified for a same wine), leaves us to think
453 that some of these experts, seek by any means a fault, where maybe there is none. In
454 agreement with this interpretation, at the end of the binary task, some of experts told us that
455 they tried to guess the purpose of the study. It leads us to think that it is probably necessary
456 for them to set a goal prior to categorize the wines, when no information or context is
457 provided. This phenomenon was also reported in a previous study on wine label
458 categorization (Honoré-Chedozeau et al., 2017).

459
460 Our study does not imply that experts are not able to categorize wine according to grape
461 variety. Rather it suggests that in absence of specific information, wine variety is not the most
462 salient criteria. In this regard, a recent study on the sensory characterization of 138 South
463 American monovarietal red wines by ten sommeliers showed that about one third of them
464 retrieved the country of origin and the grape variety of the wines (Llobodanin et al., 2014). In
465 this study, the sommeliers were previously informed that they have to evaluate South
466 American red wines from six different grape varieties (Cabernet Sauvignon, Carménère,
467 Malbec, Merlot, Tannat and Syrah) produced in four different countries of origin (Argentina,
468 Brazil, Chile and Uruguay). So, they were somehow helped for retrieving the correct grape
469 variety and country of the wines they evaluated, even if it is far for being easy for all the
470 sommeliers. One could question whether those sommeliers would have retrieved the “correct”
471 answers without any prior information about the wines.

472
473 An analysis of the descriptions of each group of wines of the experts reveals that rather than
474 activating a prototype, experts activated a wine tasting script. For instance, one expert wrote
475 “*Aromatic and fruity wines. Supple in the mouth. Harmonious finish*”, showing different steps
476 during his wine tasting. Another expert wrote each description as a list of three dashes,
477 indicating a specific step for each dash such as:

- 478 - *The nose is often expressive, simple (sweet, rose, chocolate)*
- 479 - *« Stiff » and cold tannins*
- 480 - *Heat on the finish*

481 Through those descriptions, we can observe that a first step concerned the perceptions “*in the*
482 *nose*”, then a second one showed those “*in the mouth*”, and a final one concerned those after

483 spitting out the wine. Many of those descriptions are structured like that, with some “*in the*
484 *nose*” and “*in the mouth*” steps like “*balanced nose with empyreumatic and fruity aromas.*
485 *Pleasant on the palate, thin, round*” or “*fruity nose (red fruits) + sweet, acidity in mouth +*
486 *astringent + less intensive but long aftertaste*”.

487 The same script seems to be used whatever the level of categorization. The script-theory was
488 initiated by Schank & Abelson (1977) from the computer science and psychology, suggesting
489 that our knowledge would be organized into a lot of stereotyped situations from routine action
490 like “*going to a restaurant*”, “*taking a bus*” or “*visiting a doctor*” (Bower, Black, & Turner,
491 1979). Abelson (1981) defined a script as “*a standard sequence of events characterizing*
492 *typical activities in a restaurant from the point of view of the customer*” (p.1) in the case of a
493 “*going to a restaurant*” activity. That is, a script is a sort of structured list of different steps to
494 make routine actions in a specific situation, which is learnt from past experience (Bower et
495 al., 1979). That kind of “schema” could help people for understanding and for realizing
496 routine actions in specified conditions by providing and following a sort of active procedure
497 or a program, as it is the case for the development of computer programs in artificial
498 intelligence (Abelson, 1981; Dreyfus, Dreyfus, & Athanasiou, 1988; Rumelhart, 2017). Based
499 on the wine descriptions, we can imagine a “**wine tasting**” script that our experts could have
500 activated in memory during the tasting that deriving from their wine experience, by following
501 those overall recognized steps:

- 502 - **1/ Smelling the wine: is there a fault?**
 - 503 ○ *Yes: I describe the faults (e.g. dusty, acetate, Brettanomyces)*
 - 504 ○ *No: I describe the odours through orthonasal olfaction (e.g. rose, chocolate,*
505 *empyreumatic, fruity, red fruits)*
- 506 - **2/ Tasting the wine: is there a fault?**
 - 507 ○ *Yes: I describe the faults (e.g. corky, Brettanomyces, oxydised)*
 - 508 ○ *No: I describe the flavours and the mouthfeel characteristics (e.g. astringent,*
509 *round, silky tannins, acid, supple)*
- 510 - **3/ Judging the global harmony of the wine (e.g. well-balanced, harmonious, length)**

511 This potential script follows a kind of “wine tasting process” that is retrieved in the sensory
512 descriptions of experts that often going from “*the [...] colour*”, then “*in the nose*” to “*in the*
513 *mouth*” statements (Gawel, 1997; Lawless, 1984). For instance, we can find this kind of wine
514 tasting note for a Morgon wine: “*A garnet red colour. The nose opens up with undergrowth*
515 *and fresh fruit notes. Supple, round, without roughness, the mouth makes you want to serve*
516 *the bottle in the year.*” (Guide Hachette des vins 2012, 2011, p. 177). That wine tasting
517 process is also reinforced by wine tasting books (Jackson, 2017; Klem, 2009; Peynaud &
518 Blouin, 2013; Sato, 2012; Zraly, 2014), wine training courses or even through wine tasting
519 sheets (Danner et al., 2017; Gomes, José-Coutinho, da Silva, & Ricardo-da-Silva, 2016;
520 Loureiro, Brasil, & Malfeito-Ferreira, 2016; Organisation Internationale de la Vigne et du
521 Vin, 2009; Thuillier, Valentin, Marchal, & Dacremont, 2015). Our results suggest to us that
522 their wine experience and wine tasting training, and even the wine tasting context of our
523 experiment, lead our experts to activate this hypothesized script instead of a potential
524 prototype.

525 Concerning the novices, they also based their categorization on their sensory perceptions
526 without a tendency to sort the wines into the *a priori* categories, whatever the level of

527 categorization. However, we notice an effect of expertise in the vocabulary used to describe
528 the groups of wines: the novices used a more basic vocabulary than that of experts, as shown
529 in the literature (Chollet & Valentin, 2000; Lawless, 1984; Sauvageot, Urdapilleta, & Peyron,
530 2006; Solomon, 1997; Valentin, Chollet, & Abdi, 2003). For the familiar novices, we
531 identified a trace of the previous wine tasting script through some descriptions of each group
532 of wines, with the use of “*in the nose*” and “*in the mouth*” sentence segments or “*odour*” and
533 “*taste*” terms. For instance, one wrote “*Those are perfumed, red fruit or prune notes and*
534 *pleasant in mouth.*”, and another wrote “*Aggressive nose. Acid taste””. So, like the experts, the
535 familiar novices could have activated a similar and potential “wine tasting” script, which is
536 less technical, less precise and not “fault” oriented. On the contrary, the descriptions of the
537 unfamiliar novices did not show a trace of any wine tasting script: the terms used are globally
538 basic and often based on liking. For instance, one wrote “*I like it*” and another one “*Light*
539 *wines with a discrete aftertaste*”.*

540

541 4.2. Wine label categorization: a question of knowledge

542 For the conceptual condition, although the results globally showed, at the panel level, a
543 categorization into the *a priori* categories whatever the level of expertise (with the exception
544 of the *lieu-dit* level), the results from the average scores at the individual level showed that the
545 separation of the labels into the *a priori* categories is far from being systematic and/or obvious
546 for each assessor, even for the experts. That result suggests the use of different strategies and
547 criteria to sort the labels according to the level of expertise of the assessors, indicating
548 different mental representations of the wines. The verbalization provided by the experts
549 showed that they used top-down processes, based on their knowledge about the wines, to
550 categorize the wines for each level into the expected *a priori* categories. By contrast, the
551 familiar novices used more bottom-up processes than the experts, based on label information,
552 to sort the wines and, the unfamiliar novices used mainly bottom-up processes in their
553 categorization, whatever the level. Those strategies could explain why the novice panels did
554 not sort the wines from the same appellation into the *lieu-dit* criterion, by probably a lack of
555 knowledge or of meaning about the information they read. As shown in our previous study,
556 the novice panels read carefully all the information on the wine labels for helping them in
557 their categorization (Honoré-Chedozeau et al., 2017). The task was perhaps difficult to sort 12
558 wines within the same appellation, and the label information could not be very helpful if we
559 did not know which information is relevant, or even the meaning of that different information.
560 The novice could be rapidly lost among the highest or the lowest level of information given
561 by the labels. In contrast, the task was perhaps easier for most novices for the appellation
562 level. In fact, only two appellations were represented, less than for the grape variety level. So,
563 the names of the two PDOs “Morgon” and “Régnié” were put forward in comparison with the
564 other label information, that probably leading the novices to separate the labels according to
565 those names. This obviousness of information could explain why there is a very little
566 variability for the appellation level at the panel level compared to the grape variety level
567 among the novice panels.

568 Globally, each panel used more different words for the wines from the grape variety level
569 than for the appellation and the *lieu-dit* level. In addition, the high inter-individual variability
570 shown in Figs 3b, 4b, 4d and 4f suggest us to think that different strategies of categorization
571 were used among experts: one part of experts may use only visual criteria, and the other part
572 may use only their knowledge to categorize the wines. Likewise, the type of information
573 about the grape variety, the winemaking, and the origin is not always indicated on the labels,
574 that could explain why the use of these specific terms are not systematically mentioned and/or
575 shared by the novice panels.

576 5. Conclusions

577 Contrary to our main hypothesis, results showed a lesser effect of expertise for the perceptual
578 condition than for the conceptual one. Our results showed that, whatever the level of
579 categorization and the level of expertise, the assessors did not make inferences about the *a*
580 *priori* wine categories when they taste the wines of the different sets. Nevertheless, there is an
581 effect of expertise in both the categorization and the vocabulary used to describe the groups of
582 wines. So, when the experts have to categorize spontaneously the wines without any
583 information, their perception seems to be more directed by bottom-up processes, based on
584 sensory descriptions, rather than top-down processes, based on knowledge and experience,
585 whatever the level of categorization. It is important to note that contrary to other studies in the
586 literature, we did not seek for the representativeness of the wines during the selection of the
587 wines for each *a priori* category, as we wanted to know if the wines could be retrieved from
588 the chemosensory perceptions without any prior information. Part of our results could have
589 thus its source in this random wine selection. That could also explain why the grape variety
590 categorization was not as obvious for the expert panels, as we expected. By taking into
591 account the very fine level of categorization we studied, the differences of the selected wines
592 between the *a priori* categories were probably not salient enough to be perceived
593 spontaneously by the assessors without any clues, whatever their level of expertise. Moreover,
594 the lack of visual information probably made even more unlikely the categorization into the
595 expected grape variety categories (since young Gamay and young Pinot noir have quite
596 different colours). This lack of visual information may explain why the concepts or prototypes
597 of Gamay or Pinot noir might not have been activated during the wine tastings, which was
598 only based on chemosensory perceptions. For the PDO and *lieu-dit* levels, it would be
599 reasonable to think that visual information will be of little help in finding the *a priori*
600 categories since these wines came from the same grape variety and were from the same
601 vintage. Concerning the vocabulary, the experts used a more specialized wine sensory
602 vocabulary to describe the wines for the perceptual condition than the novices, as shown in
603 the literature. In contrast, the expert conceptual categorization seems to be mostly driven by
604 top-down processes while the novice conceptual categorization seems to be mainly based on
605 the type of information that they read on the label whatever their degree of relevance. These
606 strategies lead therefore to a little effect of expertise for the wine labels when the level of
607 categorization becomes finer.

608 Taking all these results into account, it would be interesting to compare our non-directed
609 binary task with a directed categorization task with the same wines (i.e. the same binary

610 sorting task with the name of the *a priori* categories), in order to know if the assessors
611 categorize the wines into the *a priori* categories when they are provided with an information
612 allowing for the activation of varietal concept/prototypes. These tasks could be carried out in
613 dark and clear glasses for further evaluation of the impact of colour. Finally, this work
614 suggests a construction of different perceptual and conceptual mental representations of the
615 wines, contrary to the hypotheses found in the literature. The conceptual representation seems
616 to be based on *a priori* wine categories as found in the wine books while the perceptual
617 representation seems to be based on sensory similarities of the wines, without a clear link with
618 the *a priori* categories. This result suggests that the *a priori* categories are not spontaneously
619 activated for the perceptual condition without information about the wines. For the experts,
620 when they taste wines, they looked at the fault, which seems to be an important activity that
621 goes beyond the *a priori* wine categories. Based on Jose-Coutinho *et al.*'s work (2015), it
622 would be also interesting to know further about the experts' representation of wines by
623 answering a same wine sensory questionnaire in two conditions: a condition for which the
624 experts should answer from memory compared to a condition for which they should answer
625 by tasting.

626

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632 Viallon for their help in the data collection for the conceptual condition.

633 Figure captions

634 Fig. 1: Schematic diagram of the procedure used for each wine set

635 Fig. 2: DISTATIS compromise maps of the wines with 95% tolerance ellipses for **the grape**
636 **variety** level and the expert panel for a) the perceptual condition (n=19) and, b) the
637 conceptual condition (n=13); the familiar novice panel for c) the perceptual condition (n=20)
638 and, d) the conceptual condition (n=12), and the unfamiliar novice panel for e) the perceptual
639 condition (n=20) and f) the conceptual condition (n=18); **P**: Pinot Noir category, **G**: Gamay
640 category. The dotted ellipses correspond to the two clusters resulting from the HAC.

641 Fig. 3: DISTATIS compromise maps of the wines with 95% tolerance ellipses for the
642 **appellation level** and the expert panel for a) the perceptual condition (n=19) and, b) the
643 conceptual condition (n=13); the familiar novice panel for c) the perceptual condition (n=20)
644 and, d) the conceptual condition (n=12), and the unfamiliar novice panel for e) the perceptual
645 condition (n=20) and f) the conceptual condition (n=18); **M**: Morgon PDO category, **R**:
646 Régnié PDO category. The dotted ellipses correspond to the two clusters resulting from the
647 HAC.

648 Fig. 4: DISTATIS compromise maps of the wines with 95% tolerance ellipses for the *lieu-dit*
649 **level** and the expert panel for a) the perceptual condition (n=19) and b) the conceptual

650 condition (n=13); the familiar novice panel for c) the perceptual condition (n=20) and, d) the
651 conceptual condition (n=12), and the unfamiliar novice panel for e) the perceptual condition
652 (n=20) and f) the conceptual condition (n=18); **L**: *Lieu-dit* category, **NL**: Not *Lieu-dit*
653 category. The dotted ellipses correspond to the two clusters resulting from the HAC.

654 Fig. 5: Interaction plots with standard errors of Expertise*Level for the a) perceptual
655 condition and the b) conceptual condition

656 Fig 6: Graphical representation of the terms used to describe the wines for each type of panel,
657 each level and all sets on the first two dimensions on the CA; **PG**: grape variety level; **MR**:
658 appellation level; **LD**: *lieu-dit* level; The colour terms represent the terms that are only
659 significant for the corresponding panel (experts in brown, familiar novices in pink, and
660 unfamiliar novices in green). The black terms are shared by two or all the panels.

661 Fig 7: Graphical representation of the terms used to describe the wine labels by each type of
662 panel for all levels and sets on the first two dimensions on the CA; **PG**: grape variety level;
663 **MR**: appellation level; **LD**: *lieu-dit* level; The colour terms represent the terms that are only
664 significant for the corresponding panel (experts in brown, familiar novices in pink, and
665 unfamiliar novices in green). The black terms are shared by two or all the panels.

666 Table captions

667 Table 1: Overview of the selected wines for each set of the grape variety and the *lieu-dit*
668 levels.

669 Table 2: Panel characteristics.

670 Table 3: Wine drinking habits of the novice panels for each set.

671 References

- 672 Abdi, H., & Valentin, D. (2007). Some new and easy ways to describe, compare, and evaluate
673 products and assessors. *New Trends in Sensory Evaluation of Food and Non-Food*
674 *Products*, 5–18. Ho Chi Minh, Vietnam: Vietnam National University-Ho chi Minh
675 City Publishing House: D. Valentin, D.Z. Nguyen & L. Pelletier.
- 676 Abdi, H., Valentin, D., Chollet, S., & Chrea, C. (2007). Analyzing assessors and products in
677 sorting tasks: DISTATIS, theory and applications. *Food Quality and Preference*,
678 18(4), 627–640. <https://doi.org/10.1016/j.foodqual.2006.09.003>
- 679 Abelson, R. P. (1981). Psychological status of the script concept. *American Psychologist*,
680 36(7), 715–729. <http://dx.doi.org/10.1037/0003-066X.36.7.715>
- 681 Ballester, J., Abdi, H., Langlois, J., Peyron, D., & Valentin, D. (2009). The Odor of Colors:
682 Can Wine Experts and Novices Distinguish the Odors of White, Red, and Rosé
683 Wines? *Chemosensory Perception*, 2(4), 203–213. [https://doi.org/10.1007/s12078-](https://doi.org/10.1007/s12078-009-9058-0)
684 009-9058-0
- 685 Ballester, J., Patris, B., Symoneaux, R., & Valentin, D. (2008). Conceptual vs. Perceptual
686 wine spaces: Does expertise matter? *Food Quality and Preference*, 19(3), 267–276.
687 <https://doi.org/10.1016/j.foodqual.2007.08.001>
- 688 Beaton, D., Fatt, C. C., & Abdi, H. (2013). *DistatisR-package*.

- 689 Bower, G. H., Black, J. B., & Turner, T. J. (1979). Scripts in memory for text. *Cognitive*
690 *Psychology*, *11*, 177–220. [https://doi.org/10.1016/0010-0285\(79\)90009-4](https://doi.org/10.1016/0010-0285(79)90009-4)
- 691 Chollet, S., & Valentin, D. (2000). Le degré d’expertise a-t-il une influence sur la perception
692 olfactive? Quelques éléments de réponse dans le domaine du vin. *L’année*
693 *psychologique*, *100*(1), 11–36. <https://doi.org/10.3406/psy.2000.28625>
- 694 Danner, L., Crump, A. M., Croker, A., Gambetta, J. M., Johnson, T. E., & Bastian, S. E. P.
695 (2017). Comparison of Rate-All-That-Apply (RATA) and Descriptive Analysis (DA)
696 for the Sensory Profiling of Wine. *American Journal of Enology and Viticulture*,
697 *ajev.2017.17052*. <https://doi.org/10.5344/ajev.2017.17052>
- 698 Dreyfus, H., Dreyfus, S. E., & Athanasiou, T. (1988). *Mind Over Machine—The Power of*
699 *Human Intuition and Expertise in the Era of the Computer*. Simon and Schuster.
- 700 Gawel, R. (1997). The use of language by trained and untrained experienced wine tasters.
701 *Journal of Sensory Studies*, *12*(4), 267–284. [https://doi.org/10.1111/j.1745-](https://doi.org/10.1111/j.1745-459X.1997.tb00067.x)
702 [459X.1997.tb00067.x](https://doi.org/10.1111/j.1745-459X.1997.tb00067.x)
- 703 Gomes, L. S., José-Coutinho, A., da Silva, A. G., & Ricardo-da-Silva, J. M. (2016). Sensory
704 profile characterization and typicality assessment of PDO “Bairrada” and PGI “Beira
705 Atlântico” red wines. *Ciência e Técnica Vitivinícola*, *31*(2), 73–87.
706 <https://doi.org/10.1051/ctv/20163102073>
- 707 *Guide Hachette des vins 2012* (édition 2012). (2011). Paris: Hachette Pratique.
- 708 Honoré-Chedozeau, C., Lelièvre-Desmas, M., Ballester, J., Chollet, S., & Valentin, D. (2017).
709 Knowledge representation among assessors through free hierarchical sorting and a
710 semi-directed interview: Exploring Beaujolais wines. *Food Quality and Preference*,
711 *57*, 17–31. <https://doi.org/10.1016/j.foodqual.2016.11.008>
- 712 Hughson, A. L., & Boakes, R. A. (2002). The knowing nose: The role of knowledge in wine
713 expertise. *Food Quality and Preference*, *13*(7), 463–472.
714 [https://doi.org/10.1016/S0950-3293\(02\)00051-4](https://doi.org/10.1016/S0950-3293(02)00051-4)
- 715 Jackson, R. (2017). *Wine tasting: A professional handbook*. Boston, MA: Elsevier.
- 716 Jaffré, J. (2009). *Arômes du vin: De la physico-chimie des composés clés à la perception et*
717 *aux représentations*. Thèse de doctorat, Université de Bourgogne, Dijon, France.
- 718 Jose-Coutinho, A., Avila, P., & Ricardo-Da-Silva, J. M. (2015). Sensory Profile of Portuguese
719 White Wines Using Long-Term Memory: A Novel Nationwide Approach. *Journal of*
720 *Sensory Studies*, *30*(5), 381–394. <https://doi.org/10.1111/joss.12165>
- 721 Klem, B. (2009). *WineSpeak: A Vinous Thesaurus of (Gasp!) 36,975 Bizarre, Erotic, Funny,*
722 *Outrageous, Poetic, Silly and Ugly Wine Tasting Descriptors*. Board and Bench
723 Publishing.
- 724 Lawless, H. T. (1984). Flavor description of white wine by “expert” and nonexpert wine
725 consumers. *Journal of Food Science*, *49*(1), 120–123. [https://doi.org/10.1111/j.1365-](https://doi.org/10.1111/j.1365-2621.1984.tb13686.x)
726 [2621.1984.tb13686.x](https://doi.org/10.1111/j.1365-2621.1984.tb13686.x)
- 727 Lê, S., Josse, J., & Husson, F. (2008). FactoMineR: An R package for multivariate analysis.
728 *Journal of Statistical Software*, *25*(1), 1–18. <https://doi.org/10.18637/jss.v025.i01>
- 729 Lebart, L., Piron, M., & Morineau, A. (2006). *Statistique exploratoire multidimensionnelle:*
730 *Visualisation et inférence en fouille de données* (4e ed.). Paris: Dunod.
- 731 Llobodanin, L. G., Barroso, L. P., & Castro, I. A. (2014). Sensory Characterization of Young
732 South American Red Wines Classified by Varietal and Origin: Typicality of South
733 American red wines. *Journal of Food Science*, *79*(8), S1595–S1603.
734 <https://doi.org/10.1111/1750-3841.12535>
- 735 Loureiro, V., Brasil, R., & Malfeito-Ferreira, M. (2016). A New Wine Tasting Approach
736 Based on Emotional Responses to Rapidly Recognize Classic European Wine Styles.
737 *Beverages*, *2*(1), 6. <https://doi.org/10.3390/beverages2010006>

738 Morrot, G., Brochet, F., & Dubourdieu, D. (2001). The Color of Odors. *Brain and Language*,
739 79(2), 309–320. <https://doi.org/10.1006/brln.2001.2493>

740 Organisation Internationale de la Vigne et du Vin. (2009). *Norme OIV des concours*
741 *internationaux de vins et de boissons spiritueuses d'origine vitivinicole—Résolution*
742 *OIV-CONCOURS 332A-2009*. Retrieved from
743 <http://www.oiv.int/public/medias/1848/oiv-concours-332a-2009-fr-avec-signature.pdf>

744 Pagès, J. (2005). Collection and analysis of perceived product inter-distances using multiple
745 factor analysis: Application to the study of 10 white wines from the Loire Valley.
746 *Food Quality and Preference*, 16(7), 642–649.
747 <https://doi.org/10.1016/j.foodqual.2005.01.006>

748 Parr, W. V., Green, J. A., White, K. G., & Sherlock, R. R. (2007). The distinctive flavour of
749 New Zealand Sauvignon blanc: Sensory characterisation by wine professionals. *Food*
750 *Quality and Preference*, 18(6), 849–861.
751 <https://doi.org/10.1016/j.foodqual.2007.02.001>

752 Parr, W. V., Valentin, D., Green, J. A., & Dacremont, C. (2010). Evaluation of French and
753 New Zealand Sauvignon wines by experienced French wine assessors. *Food Quality*
754 *and Preference*, 21(1), 56–64. <https://doi.org/10.1016/j.foodqual.2009.08.002>

755 Peynaud, É., & Blouin, J. (2013). *Le goût du vin—Le grand livre de la dégustation* (5e
756 édition). Paris: Dunod.

757 R Core Team. (2015). *R: A Language and Environment for Statistical Computing*. Vienna,
758 Austria: R Foundation for Statistical Computing.

759 Rabin, M. D. (1988). Experience facilitates olfactory quality discrimination. *Perception &*
760 *Psychophysics*, 44(6), 532–540. <https://doi.org/10.3758/BF03207487>

761 Rosch, E., & Mervis, C. B. (1975). Family resemblances: Studies in the internal structure of
762 categories. *Cognitive Psychology*, 7(4), 573–605.

763 Rumelhart, D. E. (2017). Schemata: The building blocks of cognition. In *Theoretical Issues in*
764 *Reading Comprehension: Perspectives from Cognitive Psychology, Linguistics,*
765 *Artificial Intelligence and Education* (pp. 33–58). Routledge.

766 Sato, Y. (2012). *Wine Tasting: La dégustation*. Japan: Musée Co.,Ltd.

767 Sauvageot, F., Urdapilleta, I., & Peyron, D. (2006). Within and between variations of texts
768 elicited from nine wine experts. *Food Quality and Preference*, 17(6), 429–444.
769 <https://doi.org/10.1016/j.foodqual.2005.05.007>

770 Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals, and understanding: An inquiry*
771 *into human knowledge structures*. Hillsdale, N.J. : Lawrence Erlbaum Associates.

772 Solomon, G. E. A. (1997). Conceptual Change and Wine Expertise. *Journal of the Learning*
773 *Sciences*, 6(1), 41–60. https://doi.org/10.1207/s15327809jls0601_3

774 Thuillier, B., Valentin, D., Marchal, R., & Dacremont, C. (2015). Pivot© profile: A new
775 descriptive method based on free description. *Food Quality and Preference*, 42, 66–
776 77. <https://doi.org/10.1016/j.foodqual.2015.01.012>

777 Valentin, D., Chollet, S., & Abdi, H. (2003). Les mots du vin: Experts et novices diffèrent-ils
778 quand ils décrivent des vins? *Corpus*, (2).

779 Zraly, K. (2014). *Windows on the World Complete Wine Course* (30th New edition). New
780 York: Sterling Epicure.

781

Perceptual condition

random order of levels for each assessor

Session 1

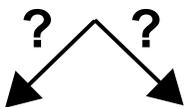
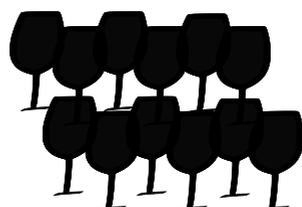
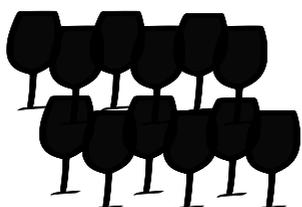
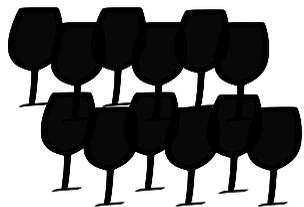
Session 2

Session 3

Grape variety level

Appellation level

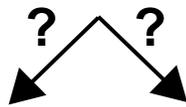
Lieu-dit level



Group 1 Group 2



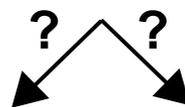
Verbalization 1 Verbalization 2



Group 1 Group 2



Verbalization 1 Verbalization 2



Group 1 Group 2

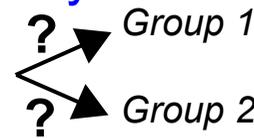
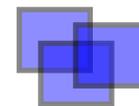


Verbalization 1 Verbalization 2

Conceptual condition

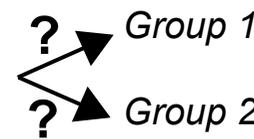
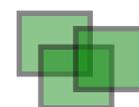
Session 4

Grape variety level



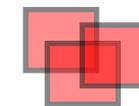
+ Verbalizations

Appellation level



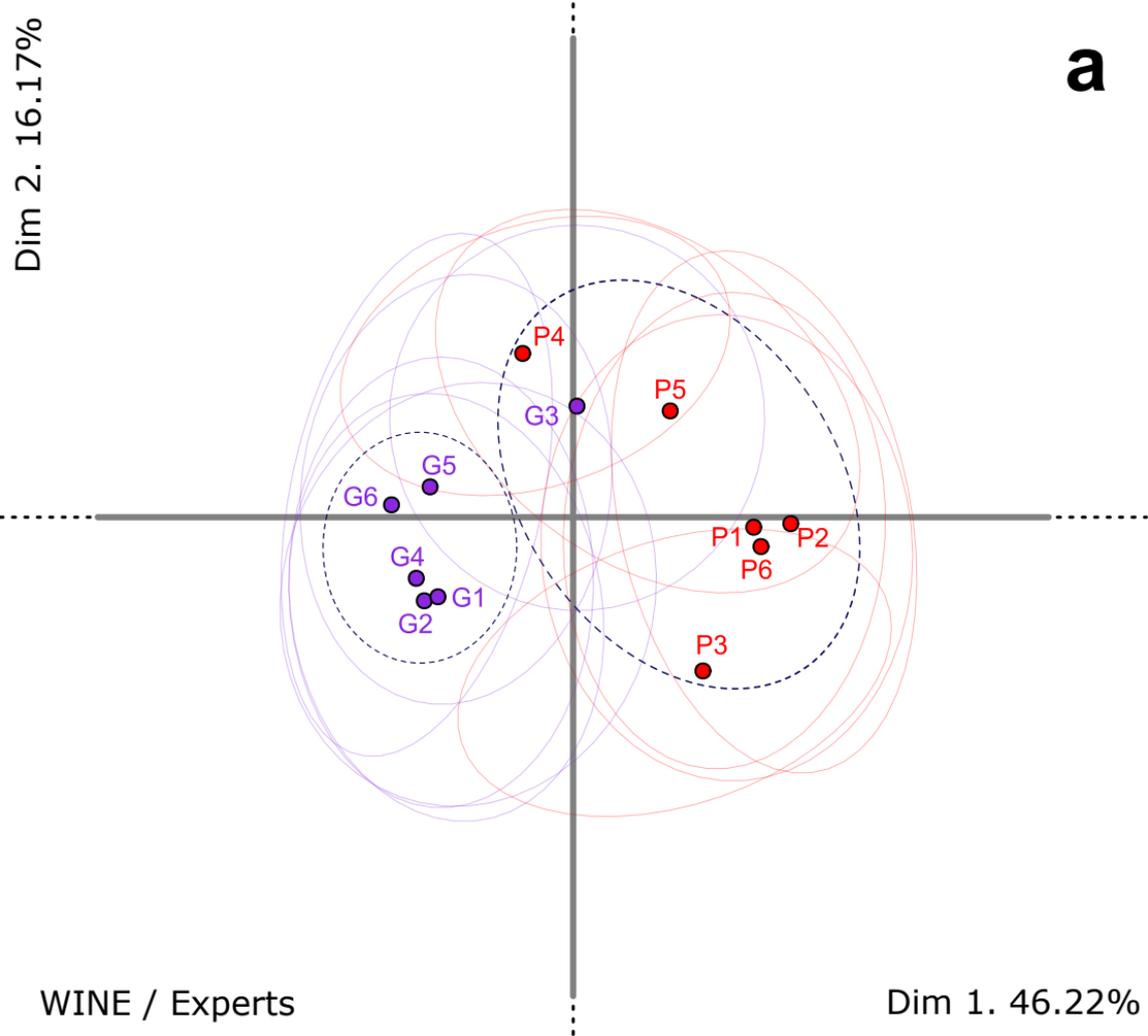
+ Verbalizations

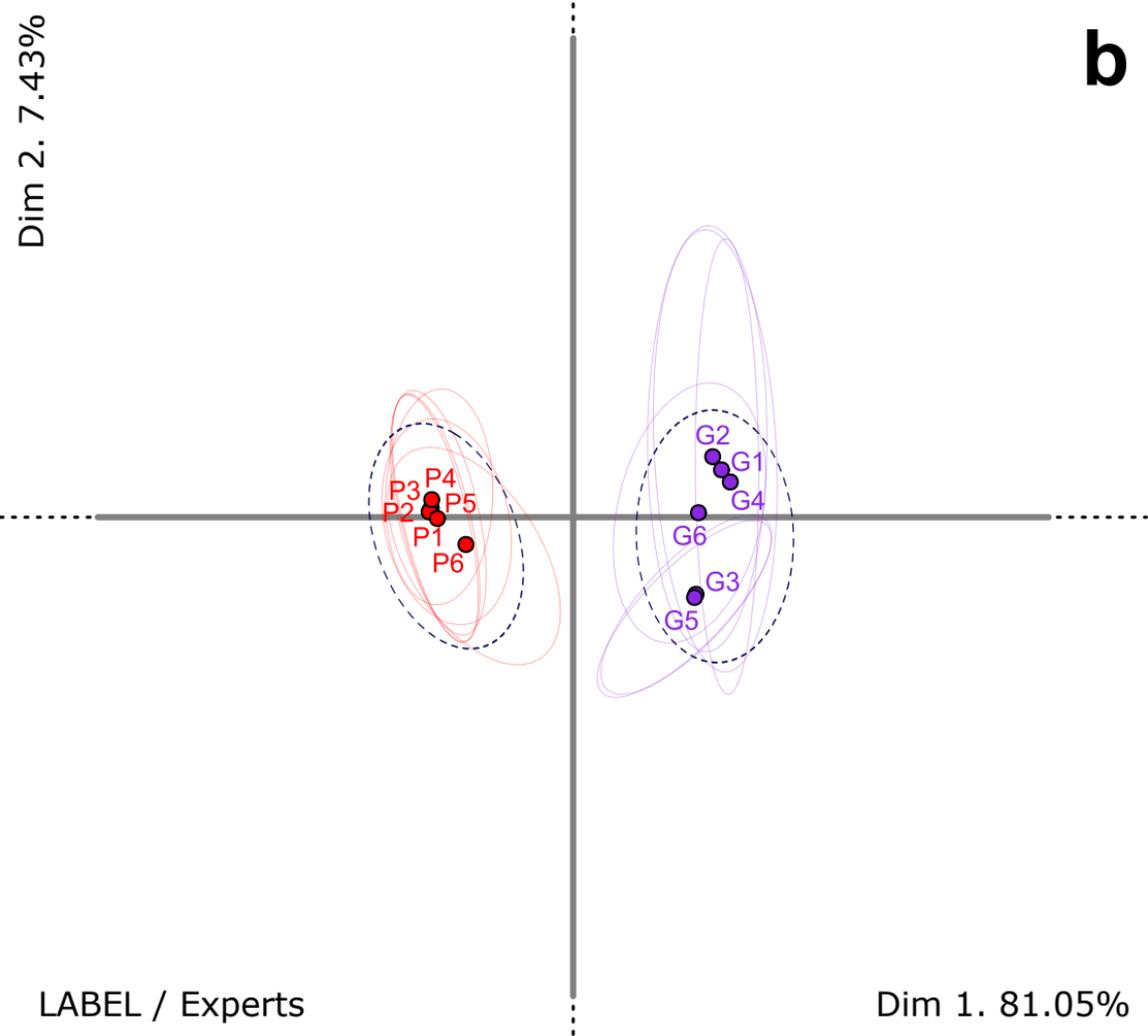
Lieu-dit level

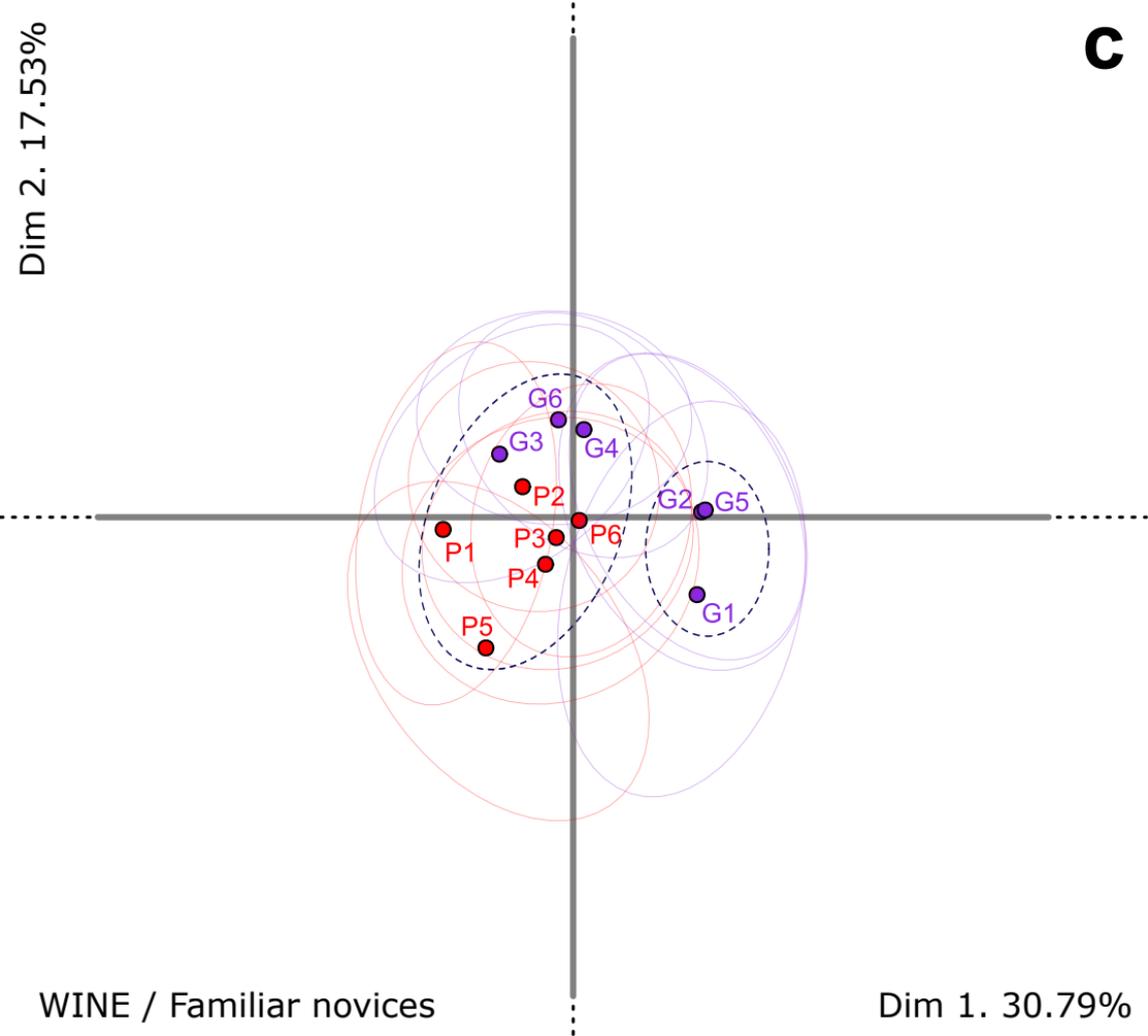


+ Verbalizations

random order of levels for each assessor

a

b

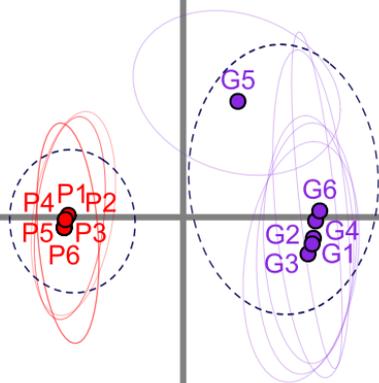
C

d

Dim 2. 9.10%

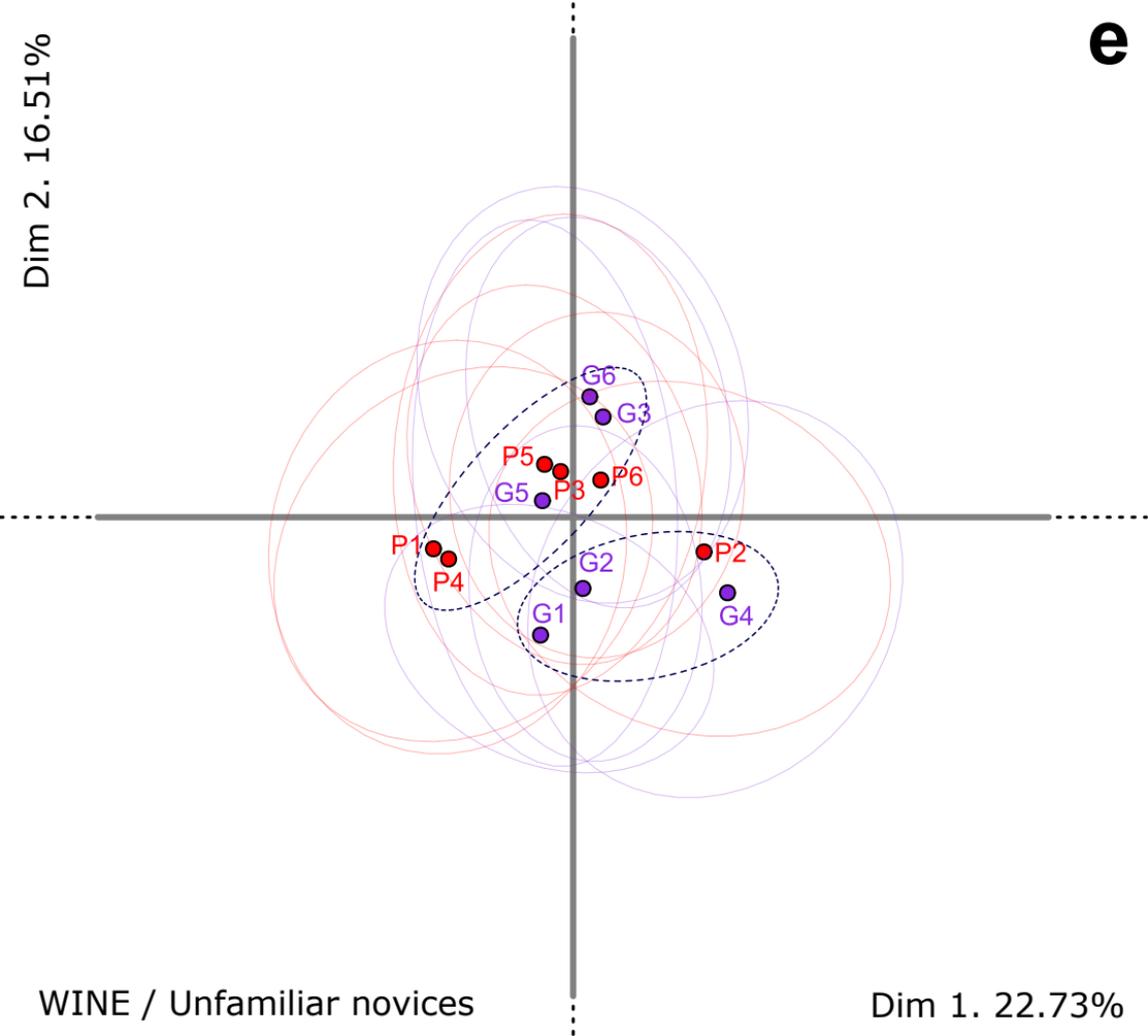
LABEL / Familiar novices

Dim 1. 86.55%



e

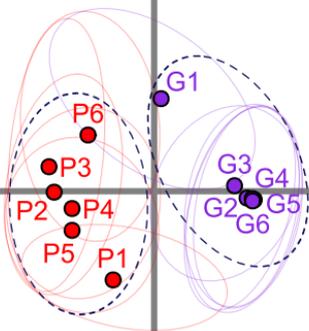
Dim 2. 16.51%



WINE / Unfamiliar novices

Dim 1. 22.73%

Dim 2. 15.15%

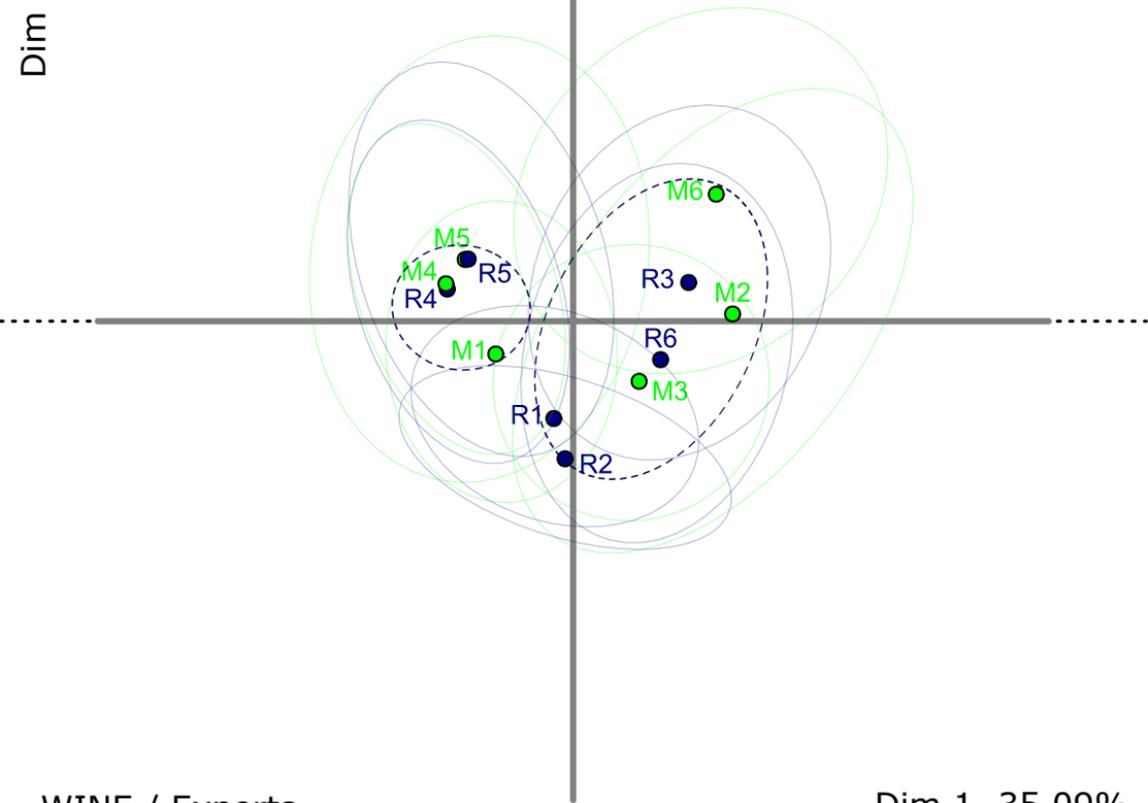


LABEL / Unfamiliar novices

Dim 1. 58.59%

a

Dim 2. 16.39%

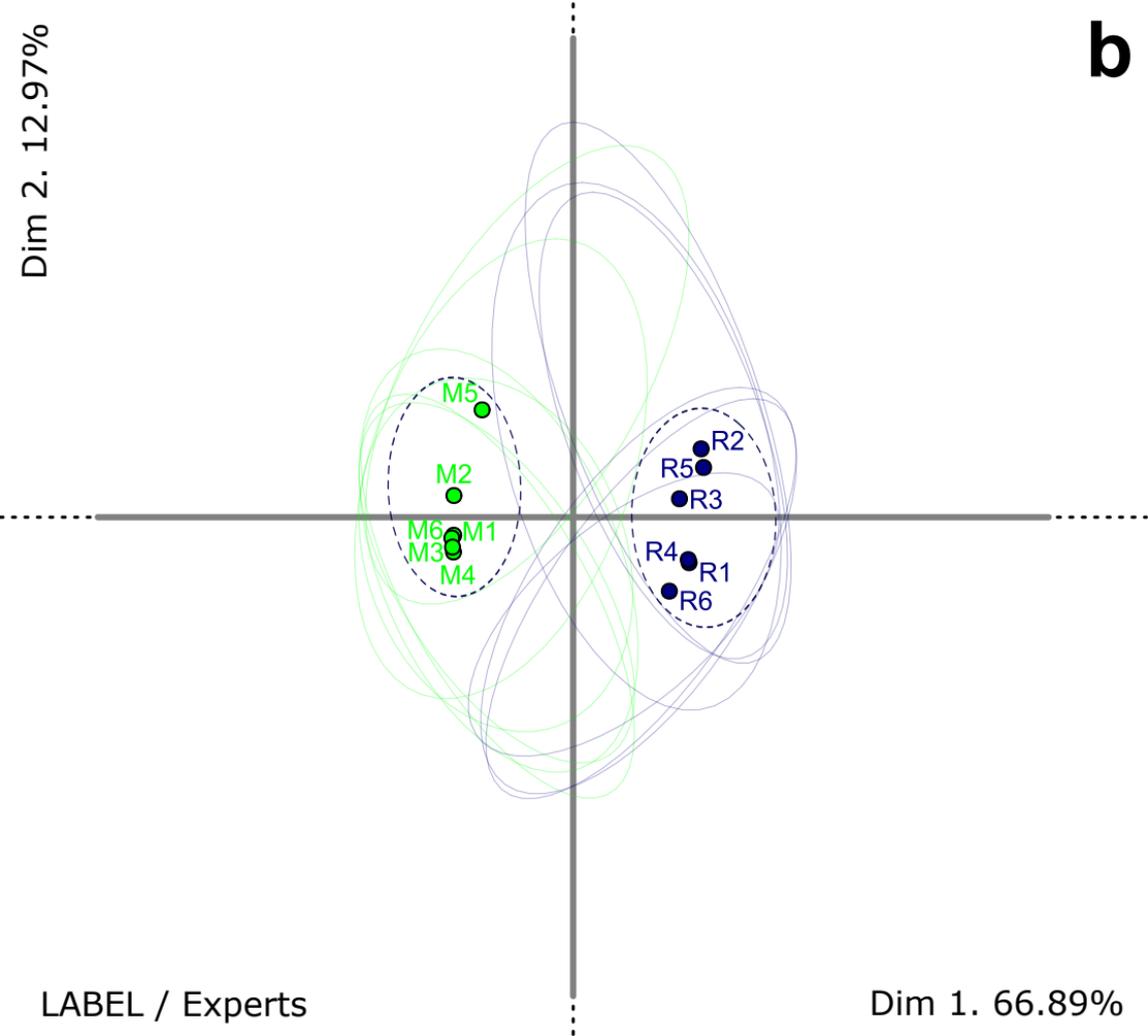


WINE / Experts

Dim 1. 35.09%

b

Dim 2. 12.97%

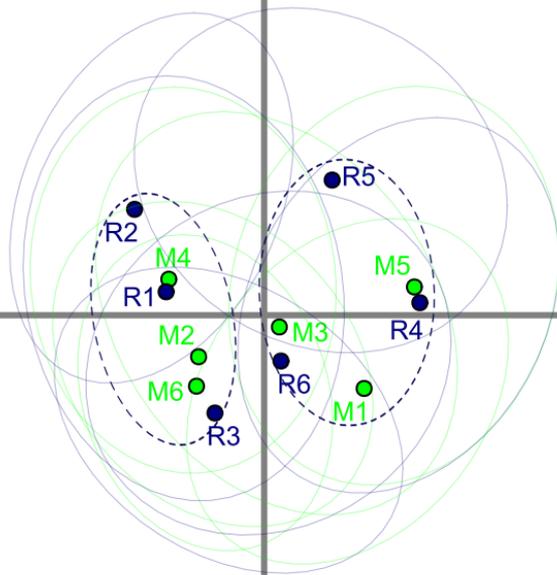


LABEL / Experts

Dim 1. 66.89%

C

Dim 2. 15.16%

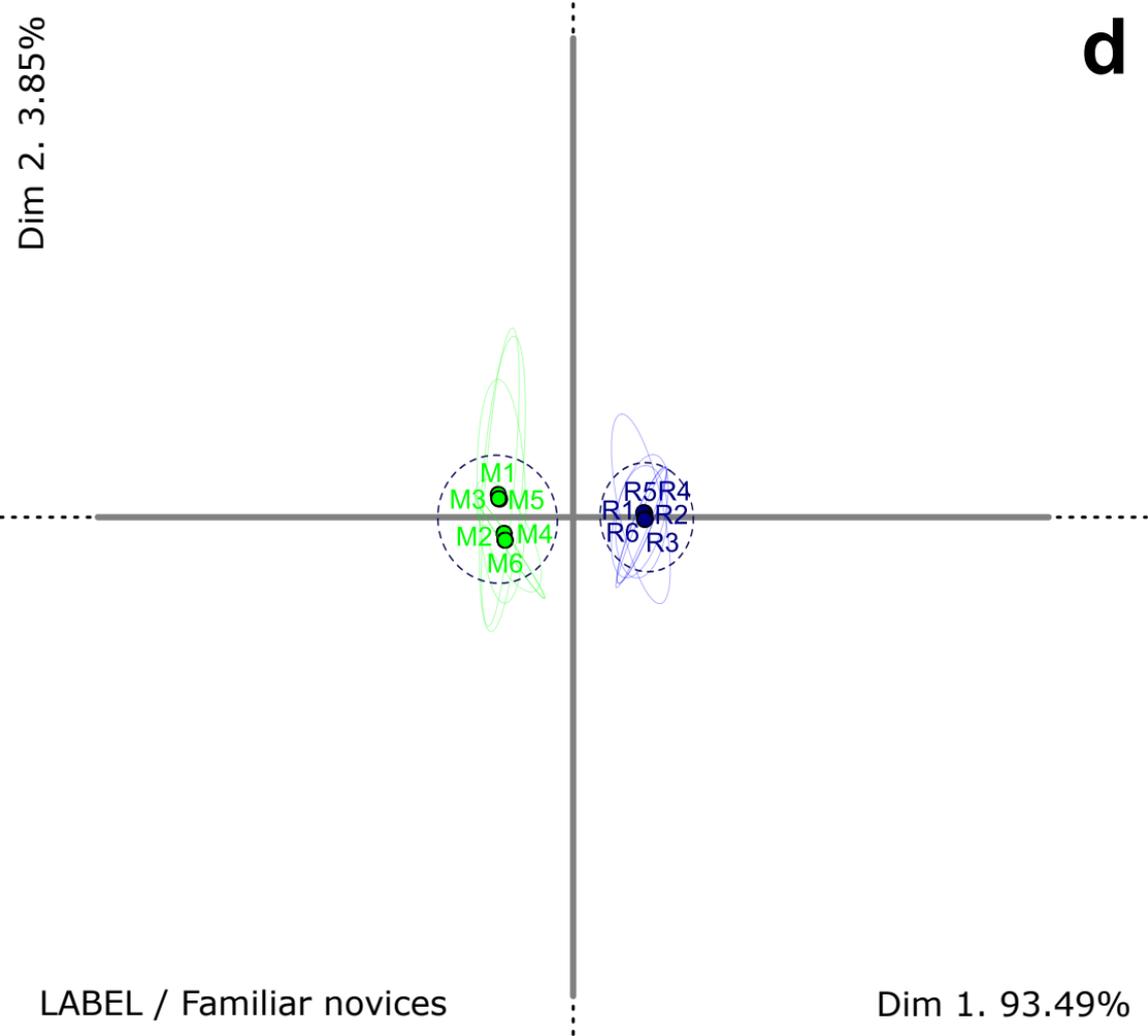


WINE / Familiar novices

Dim 1. 29.76%

d

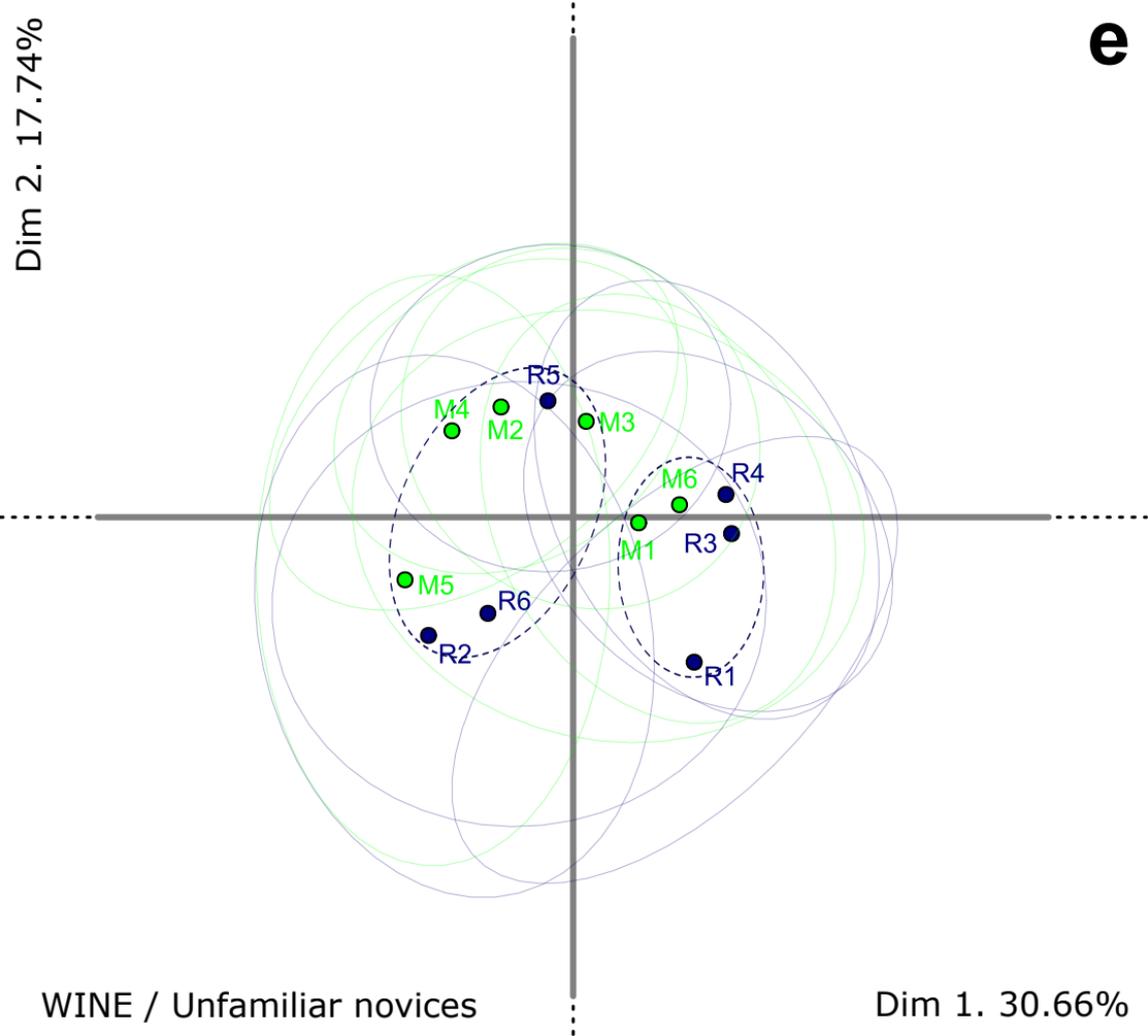
Dim 2. 3.85%



LABEL / Familiar novices

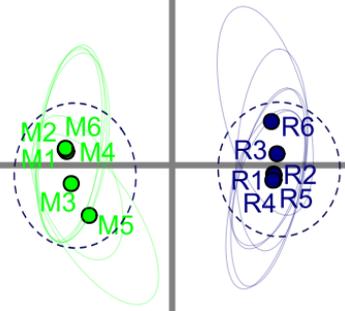
Dim 1. 93.49%

e



f

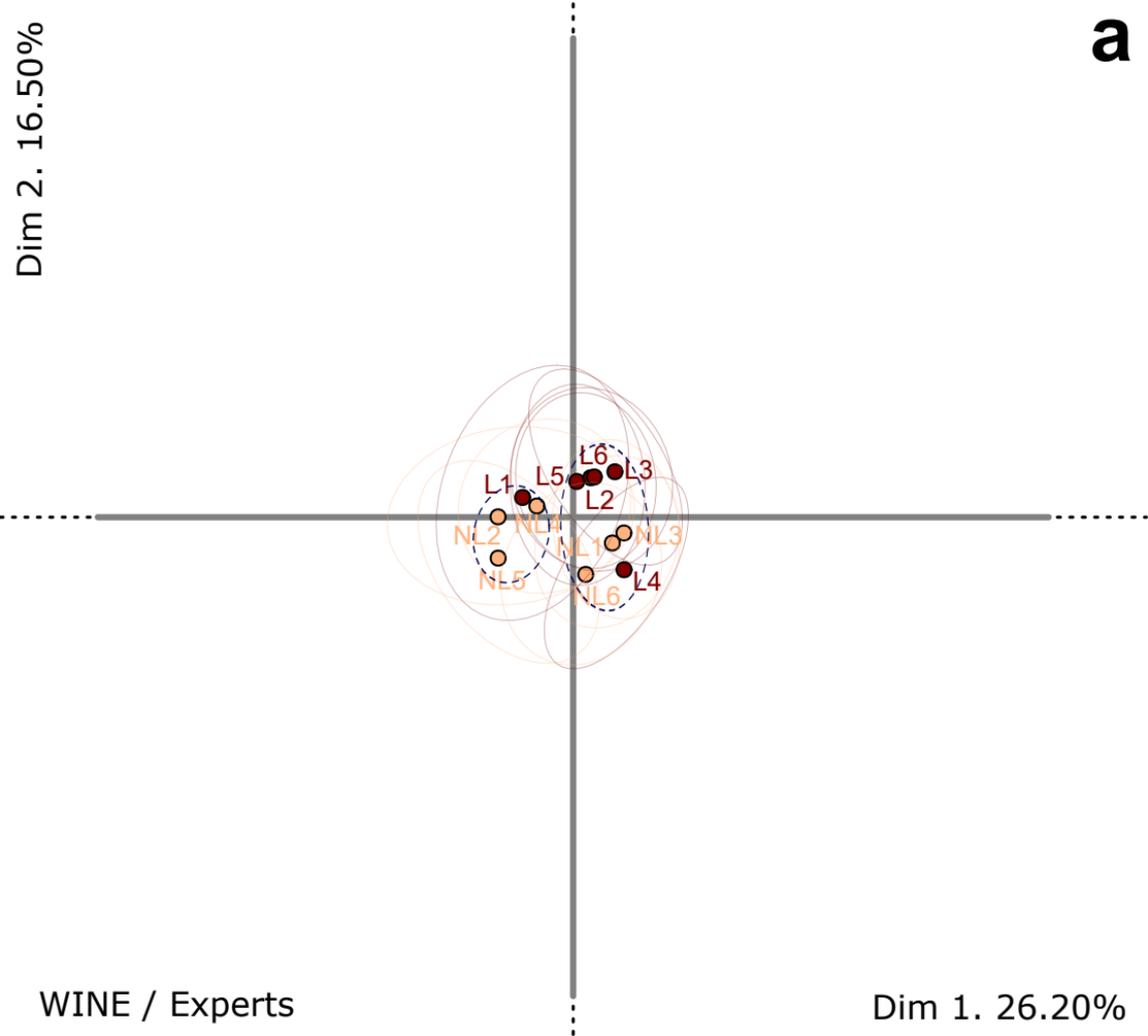
Dim 2. 4.52%



LABEL / Unfamiliar novices

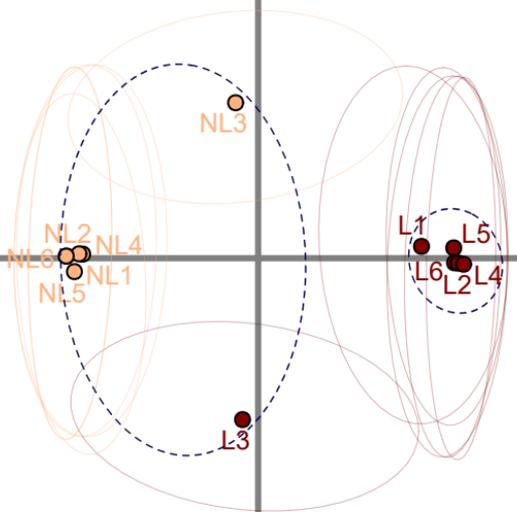
Dim 1. 87.90%

a



b

Dim 2. 10.59%

NL2 NL4
NL6 NL1
NL5

NL3

L3

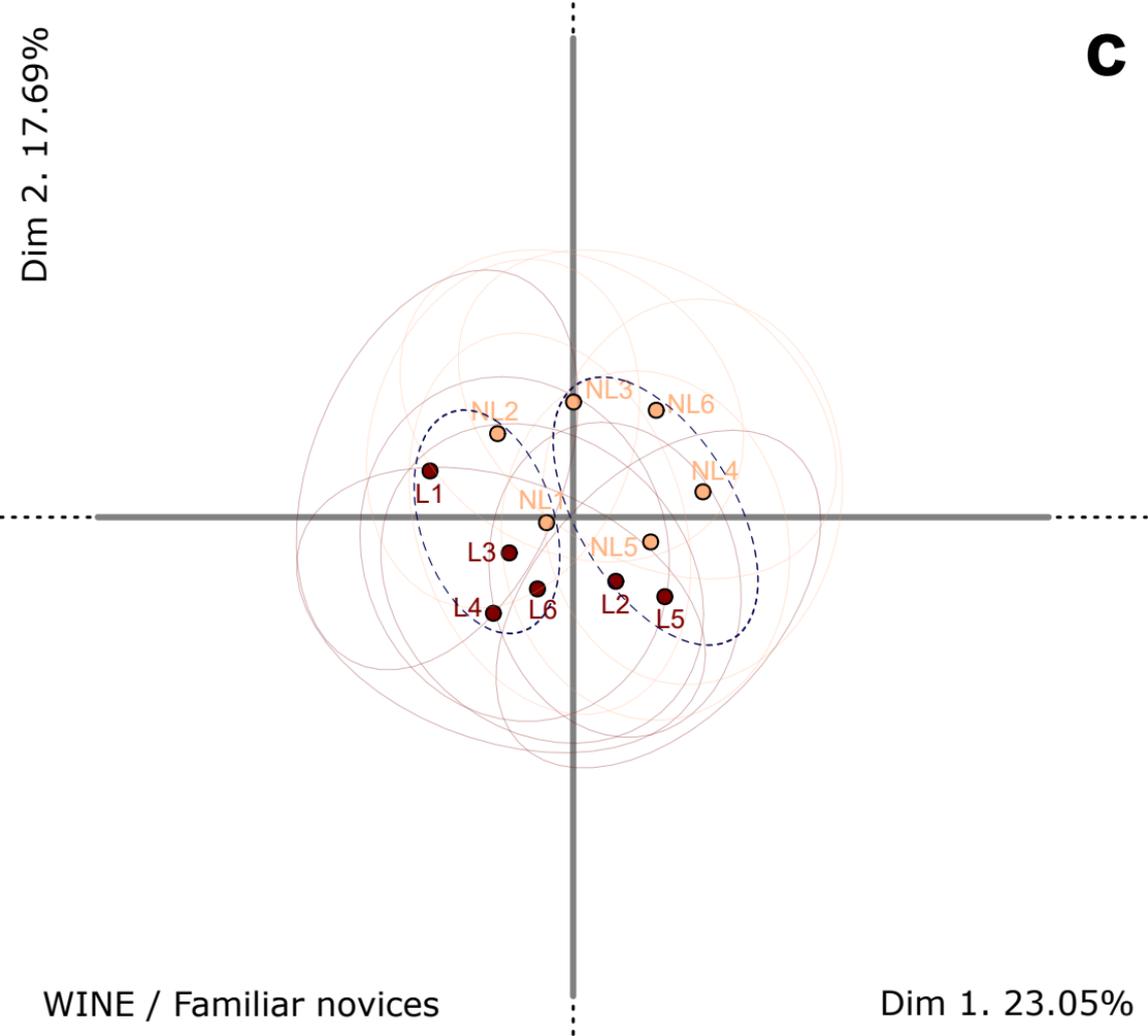
L1 L5
L6 L2 L4

LABEL / Experts

Dim 1. 75.52%

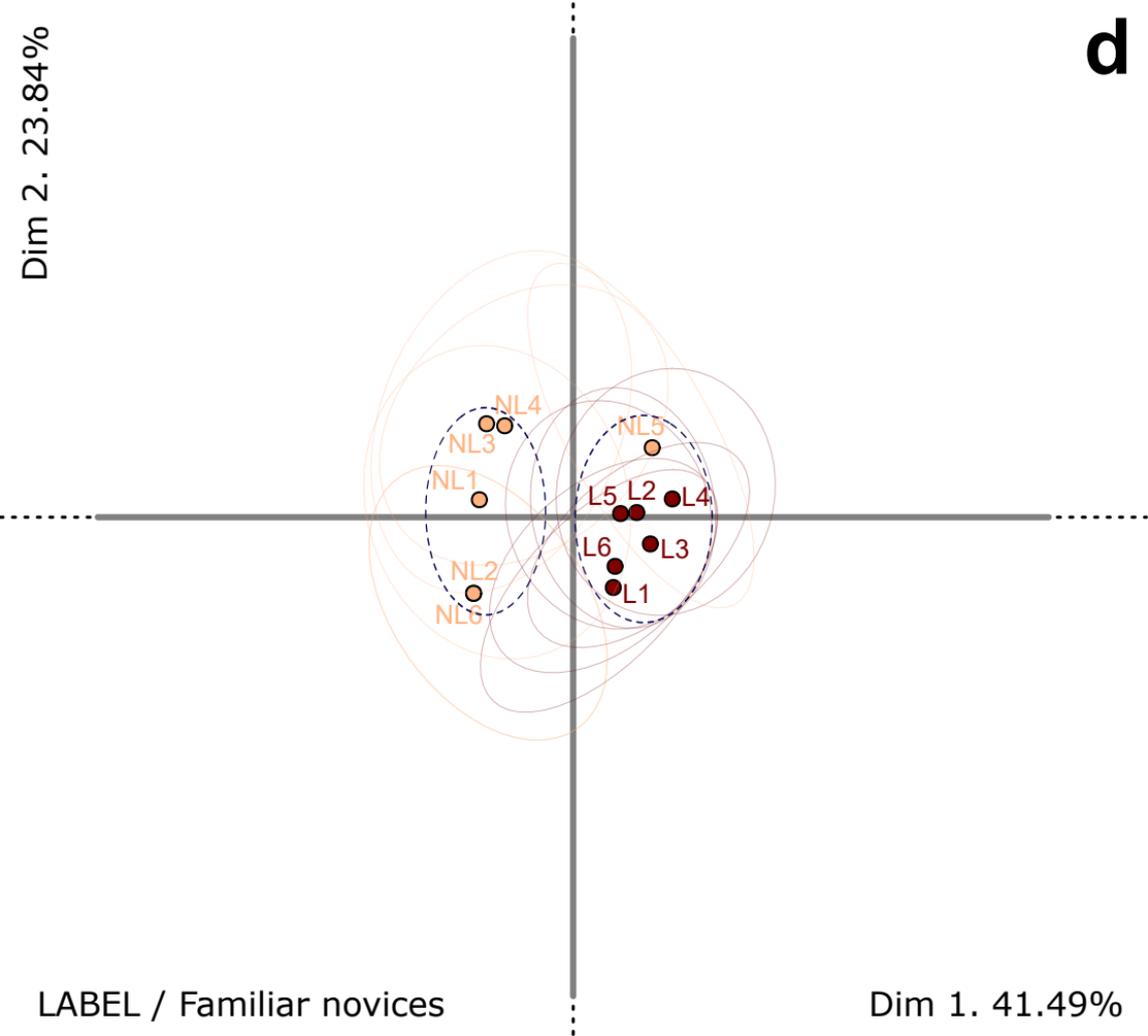
C

Dim 2. 17.69%



d

Dim 2. 23.84%

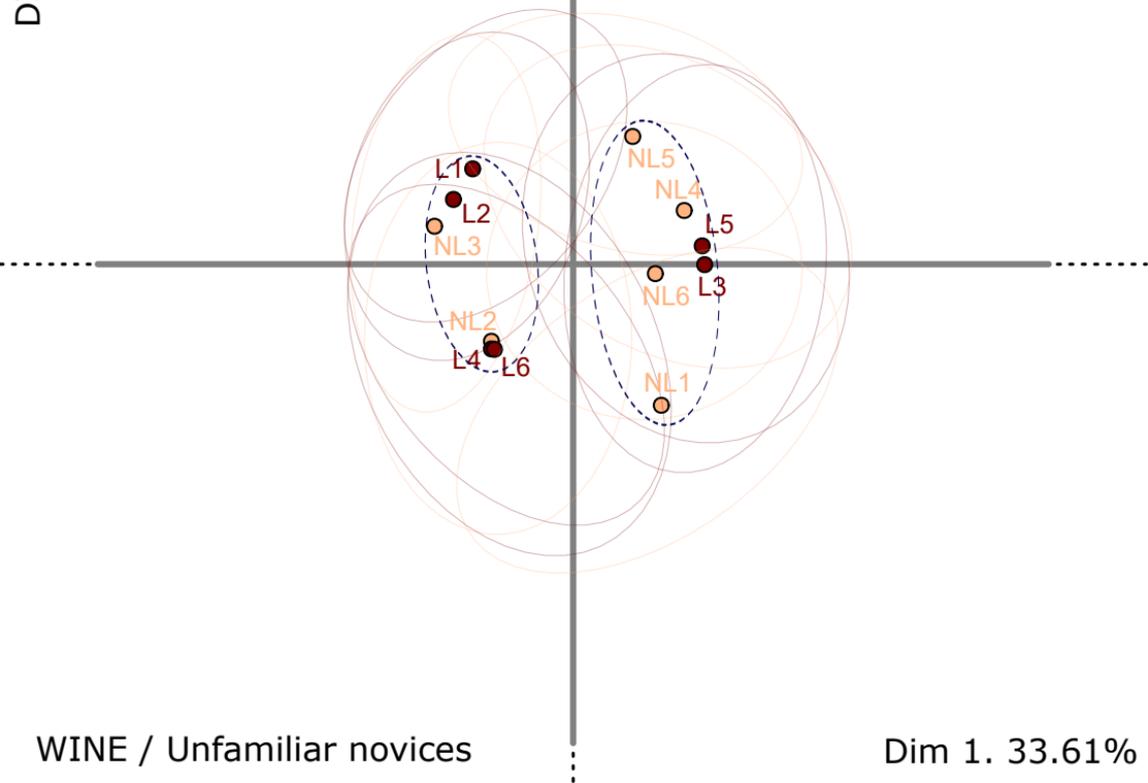


LABEL / Familiar novices

Dim 1. 41.49%

e

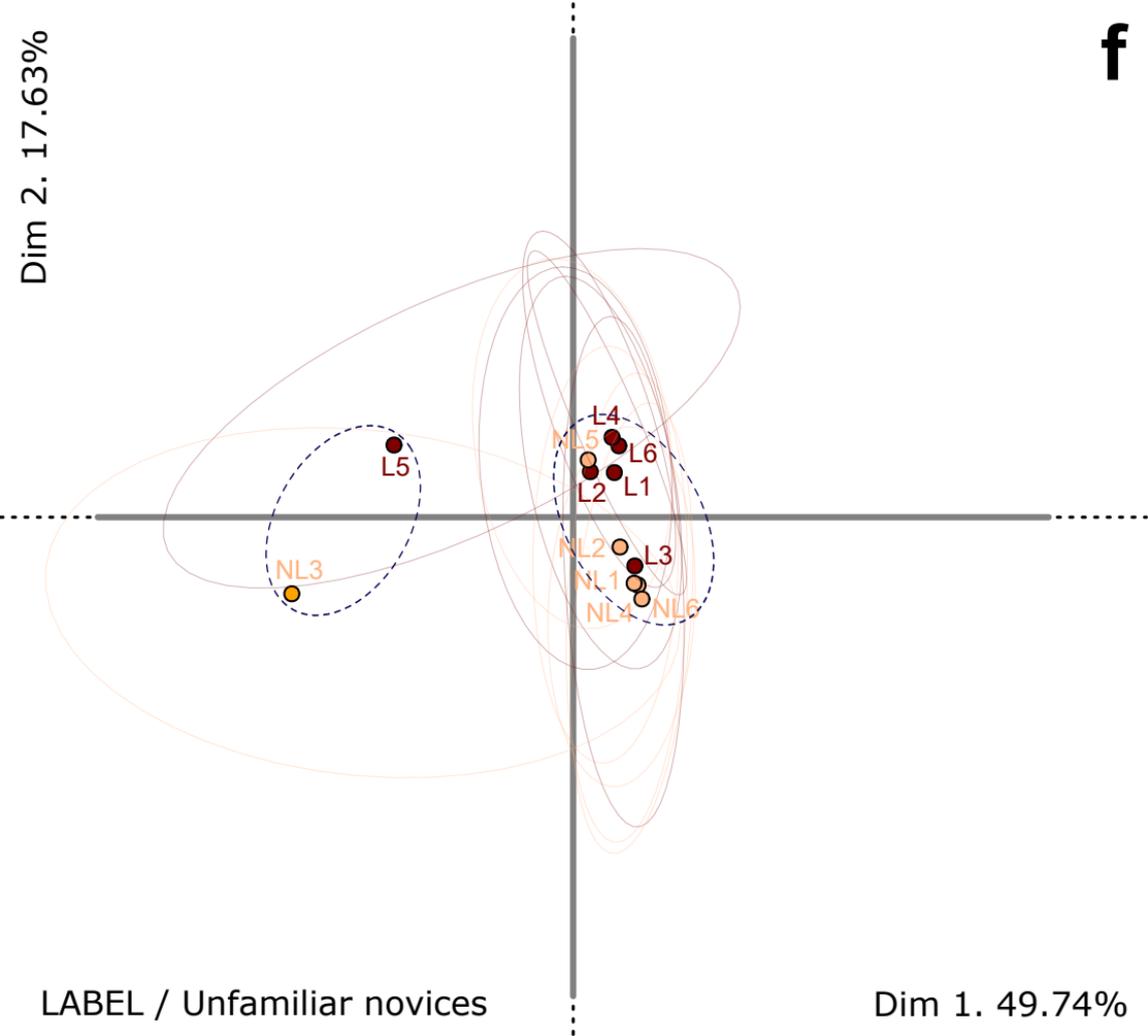
Dim 2. 19.39%



WINE / Unfamiliar novices

Dim 1. 33.61%

Dim 2. 17.63%

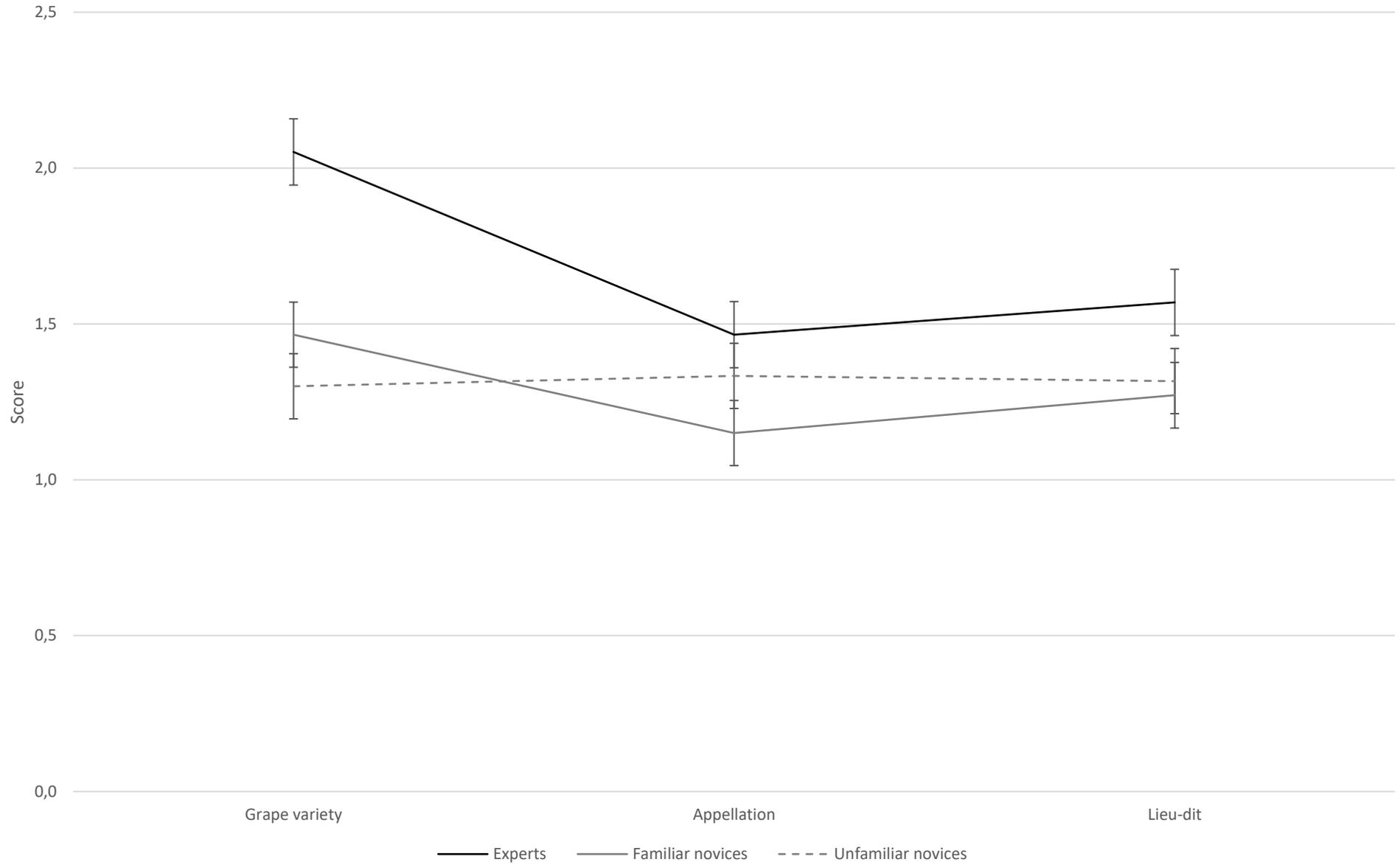


LABEL / Unfamiliar novices

Dim 1. 49.74%

WINE: Expertise*level

a



LABEL: Expertise*level

b

