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Mara Virginia Galmarini, Michel Visalli, Pascal Schlich

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Advances in representation and analysis of mono and multi-intake Temporal Dominance of Sensations data

^{1,2}Galmarini, Mara V.; ¹Visalli, Michel; ¹Schlich, Pascal*

¹ Centre des Sciences du Goût et de l'Alimentation (CSGA), INRA, Dijon, France; ² Consejo Nacional de Investigaciones Científico Tecnológicas (CONICET), Argentina

Temporal Dominance of Sensations (TDS)

A multi-dimensional temporal method in which assessors choose from a list of descriptors the dominant one (the one that catches most their attention) at every moment of consumption.

😊 Its advantages?

- ✓ No use of scales
- ✓ Instinctive answers
- ✓ Friendly for consumers
- ✓ Can be used to evaluate multiple successive intakes.

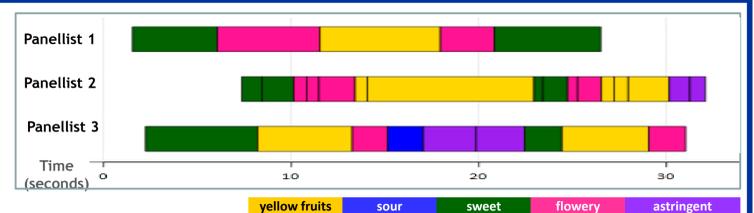
😞 Its drawbacks?

- ✓ Data representation and analysis not so friendly so far
- ✓ Some comparison methods lack statistical power
- ✓ Representation of multiple intakes can be cumbersome to evaluate

What does TDS data (by panellist) look like?

SEQUENTIALITY

For each panellist a sequence of dominant attributes along time is obtained. Time can be standardized and individual dominances are added to obtain TDS curves representing the sequence at a panel level.



DURATION

Duration of dominance is obtained, at individual level, by adding all the time periods during which the attribute was dominant, regardless of the moment of perception.

Panellist	Yellow fruits	Sour	Sweet	Flowery	Astringent
Panellist 1	6.4	0	10.2	8.4	0
Panellist 2	13.2	0	4.6	5.1	1.9
Panellist 3	9.7	1.9	7.9	3.8	5.4

Our proposal

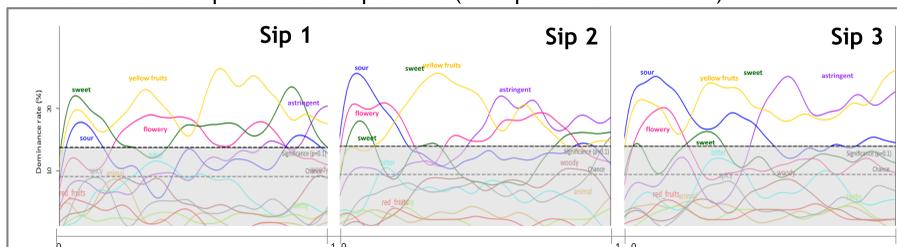
A new graphical tool for representing SEENTIALITY based on current TDS curves

TDS curves the classical representation

TDS curves show the dominance rate of attributes along time at panel level (standardized or not). Significance and chance levels are shown.

- 😊 Pros: - Representation of dominance rate, a reflection of panel agreement.
- 😞 Cons: - Everything below the significance level (grey area in the figure) is noise.
- Difficult to make multiple visual comparisons (over products or intakes).

TDS curves of a wine (Prod1) evaluated over three consecutive sips. Data was standardized between 0 and 1.



Data analysis based on dominance DURATION

Use of ANOVA/MANOVA models to analyze differences among samples, intakes of a sample, or both. Information on sequentiality is lost, but statistical power is gained.

Example: data set consisting of 4 wines evaluated by 62 consumers over 3 consecutive sips.

Global model (comparison of all products and intakes)

Duration = Product + Sip + Subject + two-way interactions

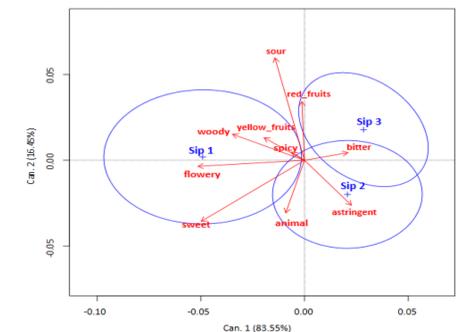
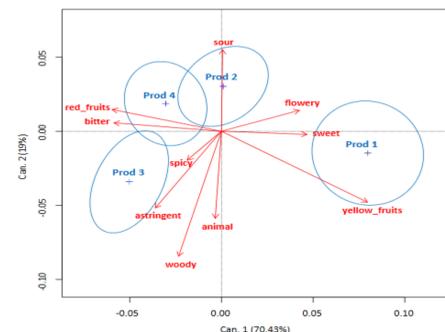
Attribute	Fprod	Prod1	Prod2	Prod3	Prod4	F sip	Sip 1	Sip 2	Sip 3	Fprod*sip
Yellow fruits	20.6***	5.4 b	1.3 a	0.2 a	1.1 a	2.6	2.4	1.7	2.0	1.1
Sweet	10.1***	3.6 b	1.6 a	0.5 a	1.6 a	10.3***	2.6	1.5	1.3	1.2
Red fruits	9.66***	0.6a	1.7ab	3.2 b	3.9b	0.31	2.5	2.3	2.3	0.8
Flowery	8.8***	4.1 c	3.0 c	0.9 a	1.8 ab	6.3***	3.1	2.3	1.9	1.5
Astringent	6.6**	4.3 a	5.3 a	7.5 b	5.9 a	4.2*(+)	4.9	6.1	6.3	2.1(-)
Woody	6.5**	1.9a	2.0a	4.9b	2.4ab	4.9*(-)	3.2	3.0	2.2	0.9
Bitter	6.0**	1.6 a	3.2 ab	3.6 b	3.4 ab	1.5	2.6	3.0	3.3	0.4
Sour	2.8*	3.9 ab	5.3 b	3.2 a	4.4ab	1.8	4.6	3.7	4.3	0.7
Spicy	2.36(-)	1.6	1.7	2.7	2.5	1.0	2.2	2.3	1.9	0.9
Animal	2.15(-)	1.0	0.9	1.7	0.7	1.3	1.1	1.1	0.9	1.6
Global MANOVA	4.5***	-	-	-	-	1.4*	-	-	-	1.1

What is this table showing?

- **Fprod**: significantly longer or shorter dominant period for an attribute across products.
- **Fsip**: significant changes of duration over sips.
- **Fprod*sip**: changes in duration of an attribute along sips is different from product to product.
- Differences over attributes can be extended in a multi-dimensional way thanks to a MANOVA.

Significance levels: (-)10%, *5%, **1%, ***0.1%
Small letters identify different product groups according to Tukey test.
+ and - symbols indicate significant increase (+) or decrease (-) along sips according to a sequential contrast.

Differences among products (MANOVA Fprod) and differences among intakes (MANOVA Fsip) can be represented by means of a Canonical Variate Analysis (CVA).



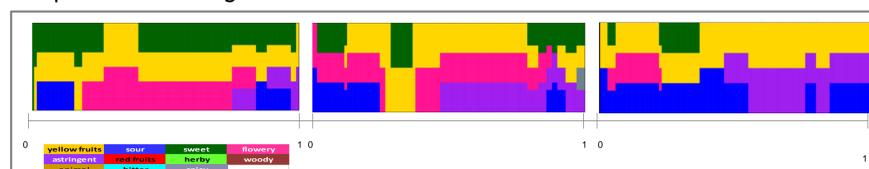
When the Fprod*sip interaction is significant (not the case of the present data set), products and their respective intakes can be represented on the same map. Also, a model by product can be used to look at the evolution of the products over sips: **Duration = Subject (random effect) + Sip**

Bandplot

This new representation only represents attributes above significance level.

- 😊 Pros: - Minimizes the space used in order to better allow multiple product comparison.
- 😞 Cons: - Dominance rate information is lost.
- It can be difficult to follow the evolution of dominance of a particular attribute, either between products or along intakes.

Bandplots corresponding to the TDS curves presented above.



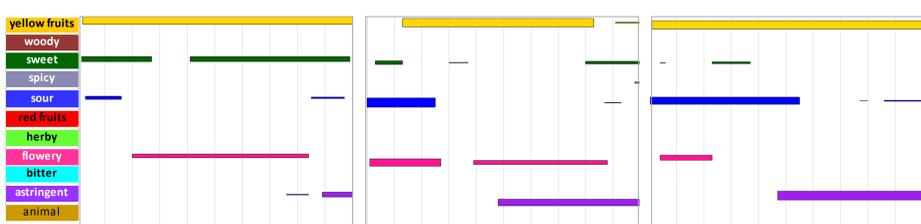
Color references are presented below the first sip.

Bandplot by attribute

This also represents only attributes above significance level. But, in this case the y-axis shows the different descriptors turning the plot into a two-dimensions graph.

- 😊 Pros: - Allows to easily follow the evolution of dominance of each attribute.
- Bar's height can be proportional to dominance rate, including information on agreement.
- Attributes available for description but which were not significant can be easily spotted.
- 😞 Cons: - They take up a little more space than the bandplots.
- Dominance rate is not as evident as in the curves.

Bandplots by attributes corresponding to the data presented above.



CONCLUSION

- Sequentiality and duration of dominant sensations are complementary information.
- Duration of dominant sensations can be analyzed using similar tools to those applied in traditional descriptive sensory analysis without forgetting that we are dealing with a time duration of dominance and not intensities.
- The bandplot and bandplot by attribute are a new option for data representation which can enable a more efficient visual comparison (among products or intakes).

