The free-linking task: Graphs for better discrimination of sensory similarity

Jacob Lahne*[1], David Orden†[2], Katherine Phetxumphou‡[3], and Marino Tejedor-Romero§[4]

[1]Department of Food Science & Technology, Virginia Tech, Blacksburg, VA 14060, USA.
[2]Departamento de Física y Matemáticas, Universidad de Alcalá, 28805, Spain.
[3]Berry Tasting Lab, Driscoll's, Watsonville, CA 95076, USA.
[4]Departamento de Automática, Universidad de Alcalá, 28805, Spain.

Identifying similarities and differences between foods is of great importance for both sensory science and industry, particularly useful to understand how consumers perceive a product. This analysis was traditionally performed by a trained panel, but the need for fine training implies large costs in time and money. Therefore, in the last few decades a number of alternative, cheaper and faster, methods have been proposed.This talk reviews a new rapid method which, for the first time, used graphs for both gathering and processing consumers' opinions [1].

One of the most popular sensory rapid methods is *free-sorting*, in which the participants are asked to distribute the products in disjoint groups according to their own criteria, without restrictions on the number of groups or the number of products in each group. See Figure 1, left.

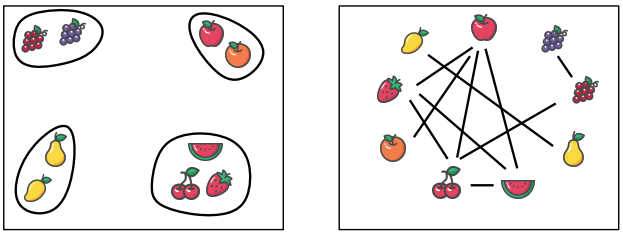

Figure 1: Examples of a participant's opinion using free-sorting (left) and free-linking (right).

Despite its usefulness, free-sorting has disadvantages. First, the groups being disjoint implies transitive similarity, i.e., each group corresponding to a clique. In the example, the participant had to choose whether to group the red grape with the black grape (as in the figure) or with the cherry (included in a group of other red fruits). Second, free-sorting accounts for purely binary similarity. In the example, the participant might consider the black grape being just two steps away from the cherry, since both are similar to the red grape.

In order to overcome these issues, we have recently proposed the *free-linking* method for gathering opinions [1]. In this method, the participants are asked to join with a link those pairs of samples they consider similar. For this connect-the-dots task, the samples are presented on the vertices of a regular polygon, randomizing the sample positions for each participant in order to avoid bias. See Figure 1, right.

This method was tested against free-sorting in two tasting sessions, with spice blends (10 samples, 58 participants) and chocolate bars (10 samples, 63 participants). The results were compared using both standard statistical techniques and graph parameters, finding that the latter allowed to highlight that the results from free-linking were more robust and realistic. Figure 2 compares some parameters for the linking and sorting global graphs obtained merging all the participants' opinions.

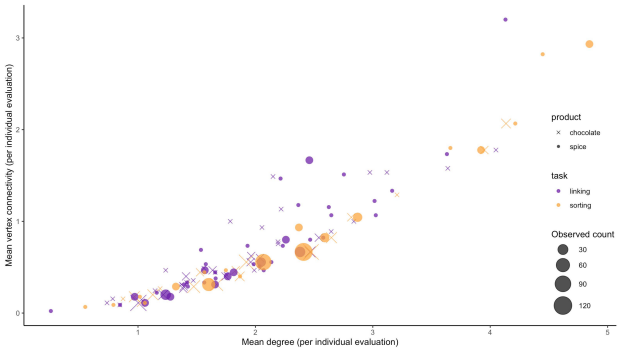

Figure 2: Comparison of mean degree versus mean vertex connectivity for free-sorting and free-linking.

References

[1] J. Lahne, K. Phetxumphou, M. Tejedor-Romero, D. Orden, The free-linking task: A graph-inspired method for generating non-disjoint similarity data with food products, *Food Quality and Preference* **95** (2022) 104355.

*Email: jlahne@vt.edu.
†Email: david.orden@uah.es. Supported by Project PID2019-104129GB-I00/MCIN/AEI/10.13039/501100011033.
‡Email: Kat.Phetxumphou@driscolls.com.
§Email: marino.tejedor@uah.es. Supported by Project PID2019-104129GB-I00/MCIN/AEI/10.13039/501100011033.