A Mixture Modelling Approach to Enhance the Multisensory Experience of Museum Visitors

Matteo Ventura[1], Ambra Macis[1], Marica Manisera[1], and Paola Zuccolotto[1]

[1]University of Brescia, Department of Economics and Management, C.da Santa Chiara, 50, 25122, Brescia, Italy

Museums and art galleries play a fundamental role in our society as they serve as a source of inspiration and cultural enrichment for people. Therefore, it is crucial to address decision-makers and improve the visitor experience in cultural places. Questionnaires are widely used for measuring satisfaction, opinions, emotions and other latent traits in various fields, including visitors' experience in museums and art galleries.

In the project *Data Science for Brescia - Arts and Cultural Places* we investigated sensations and emotions experienced by the visitors of Pinacoteca Tosio Martinengo in Brescia, Italy. We explored the sensory experience by using the concepts of synesthesia and ideasthesia, which respectively involve the involuntary triggering of a sense when another sense is stimulated, and the evocation of sensory experiences through mental concepts.

Through a multi-point semantic differential scale questionnaire, participants were asked to rate their perceptual experience in three distinct rooms - the Red, Green, and Blue rooms. The questionnaire included questions related to four primary senses - visual, gustatory, olfactory, and tactile. Participants were asked to position themselves on a scale between two opposite adjectives, such as rough/soft or spicy/fruity.

The rating data were analyzed using the CUM model (*Combination of discrete Uniform and a - linearly transformed - Multinomial random variable*) [1], which belongs to the CUB class (*Combination of discrete Uniform and shifted Binomial random variables*) [2]. This model assumes that respondents start their decision-making process at the center of a response scale and move up or down based on their sensations. The CUM model assumes that the final rating is a combination of three latent components: the propensity of moving up, the propensity of moving down, and the degree of uncertainty. The parameters of the model can be visualized on a ternary plot. Each dimension of the plot represents the probability of moving up on the scale (red edge), down (blue edge) or staying still (green edge), with this last probability being the complement to one of the sum of the probabilities of moving up and moving down. The size of the points represents the degree of uncertainty, while the colour corresponds to the colour of the rooms.

The analysis provided valuable insights into the visitors' multisensory experience, which are presented in the ternary plots below. Regarding the Blue room, it seems to evoke sensations related to a smell of new, a sweet and fruity taste, and an image of something glacial. On the other hand, the Green room appears to be mainly associated with a smell of ancient, a spicy and bitter taste, and a visual image of something that would not be defined as either glacial or tropical. Finally, it seems that the Red room elicits perceptions related to a smell of ancient, a taste that is neither bitter nor sweet and is slightly more spicy than fruity, and a visual sensation that is strongly neutral between the adjectives *glacial* and *tropical*.

The outcomes of this research offer valuable insights that can drive the development of more effective and personalized visitor engagement strategies for museums and art galleries.
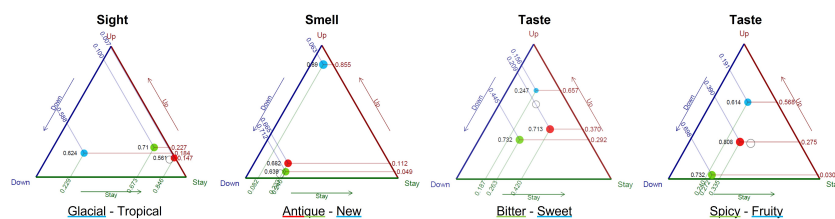
Keywords: rating, ordinal data, semantic differential scales, mixture model, synesthesia

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