Modelling consumer sensory preference heterogeneity:

A case study on how the choice of clustering method impacts implications for optimal product design

Mueller, Simone[a], Francis, Leigh[b], Lockshin, Larry[a]

[a] Ehrenberg-Bass Institute for Marketing Science, University of South Australia, GPO Box 2471 Adelaide, South Australia 5001, simone.mueller@unisa.edu.au, larry.lockshin@unisa.edu.au

[b] The Australian Wine Research Institute, PO Box 197 Glen Osmond, South Australia 5064, leigh.francis@awri.com.au

Abstract

Wine economists still debate to what extent consumers are homogeneous in their preferences, as often assumed in economic studies, or how strongly they may deviate in their behaviour and therefore have to be modelled as heterogeneous entities. In this study, we contrast the ability to explain consumer sensory liking using an aggregated sample compared to clusters based on consumer wine preferences. In addition, we compare the ability to find drivers of sensory liking for different clustering methods, which either consider individual differences in scale usage or not.

One hundred and twelve Australian consumers rated sensory liking of eight red wines which have been modified in a full factorial design using three sensory components known to be of interest to the wine industry: the alcohol level, oak flavour and Brettanomyces-derived flavour.

Sensory preference for the wines could only marginally be discriminated on the aggregated consumer sample level (p=0.085) and a complex three-way interaction of brett+alc+oak appeared to be a significant driver of consumer liking for the total sample. Once we allow groups of similar consumers to have different sensory preferences we find two distinct clusters with significant opposing impacts on product liking of all three sensory components including some interactions. These differences were hidden in the aggregated analysis.

The comparison of different cluster analysis techniques, belonging to two general clustering approaches to model consumer preference heterogeneity, either considering idiosyncratic scale usage or not, reveals that different methods result in comparable outcomes, but differ greatly between both approaches. Cluster methods not considering different scale usage, such as Latent Class Clustering, Ward Clustering and K-means, are similar in their result by splitting up the sample in low and high raters. Contrary, methods taking heterogeneous scale usage into account (Latent Class D-Factor Analysis, Ward clustering of standardised and mean centred data) allow the highest discrimination between the eight wines and are best able to find distinct drivers of product liking. Thus, choice of clustering methods can have substantial implications for optimisation of wine sensory properties by the wine industry.

Our results confirm that heterogeneous consumer wine preferences can cancel each other out on the aggregated level and thus invalidly imply that product liking is almost not influenced by the three sensory components investigated. This finding has strong implications for market research or wine economic studies trying to model consumers' stated preferences or revealed preferences. If heterogeneity is not taken into account there is a high risk that significant influences cannot be empirically validated because their opposing impact for different

segments cancels out on the aggregated level. This has been well recognised in the sensory research community, where sensory properties of a product can be identified that will meet consumer total group preferences, but that different products with quite dissimilar sensory attributes can be found that are highly preferred by smaller segments.

We not only confirmed wine consumers to differ in their sensory preferences for wine but also to deviate in their rating scale usage. This study has shown that optimal choice of clustering method can result in superior discrimination between products and better reveal significant drivers of product liking.