Methods to analyse sensory profiling data – a comparison

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To analyse sensory profiling data, two different methods are mainly used, namely Generalized Prokrustes Analysis (GPA, Gower 1975) and STATIS (Lavit *et al.* 1994, Schlich 1996). To compare the performance of these methods for practical applications, Meyners *et al.* (2000) considered a simulation study which showed the advantage of GPA. Furthermore, this result was supported by some theoretical considerations. From these it was outlined that the consensus of STATIS is too complex and overestimates the number of relevant dimensions to explain the differences between the products of interest. Meyners (2001) generalized these theoretical results to other circumstances. In addition, he proposed a correction of the STATIS consensus which effectuated an improvement of the results. Two other versions of STATIS have also been considered: One of those uses the arithmetic mean of the association matrices instead of a weighted mean (see also Kunert and Qannari 1999) and hence simplifies the calculation of the consensus. The other one uses the asymptotic weights in case of an increasing number of products. In any way, this method is not applicable with real data since the asymptotic results depend on the unknown assessor error variances. This method was only considered within a simulation study to examine the outcomes of STATIS if the optimal weights were known.

The results of the simulation study showed systematic differences between the methods considered here. With it, the corrected version proposed by Meyners (2001) outperformed the other versions of STATIS except for the one using the asymptotic weights, which performed equally well. Furthermore, the corrected STATIS version performed as well as GPA does. Even though it is more complicated than the original STATIS version, it is still easier to perform than GPA since it has no need of an iterative algorithm with unknown convergence properties. Hence it might be considered as a reasonable alternative to the latter one.

We will give some insight into the details of the alternatives mentioned above in order to allow the use of these methods. However, we will not mainly focus on mathematical details but consider the differences within the methods with respect to practical aspects. For this purpose, we re-analyse different data sets given in the literature (cf. Gower 1975, Dijksterhuis and Gower 1991) as well as an artificial example. For this, we considered a rectangular true consensus of four products in two dimensions. The results of a couple of assessors have been simulated according to the model of Meyners *et al.* (2000) respectively Meyners (2001). From these assessors, the consensuses of the different methods mentioned above are calculated and graphically displayed. This graphic confirms the theoretical results: It can be seen, that the differences between the outcomes are minor, but however we'll find that the consensuses of the original STATIS version and the one using the arithmetic mean are more complex than the true consensus, whereas this is only given to a lower extent for the corrected version, the one using the asymptotic weights and GPA, as we expected.

For the data sets from the literature, of course the true consensus is unknown as well as the assessor variances are, and hence also the asymptotic weights cannot be used any more. Thus we compare only the remaining four consensuses from three STATIS versions and GPA. From this comparison, again the theoretical results can be confirmed, since the consensuses of the original STATIS and the alternative using the arithmetic mean are more complex than

the consensuses of the corrected version as well as of GPA. However, it can be seen that the graphical representation of the product differences only slightly differs between the methods. The main differences between the products are identically displayed, thus, which is of even more importance, the interpretation of the outcomes will be identical for all methods. From this, it might be reasonable to use the simplest version to analyse the data. This might indeed be the version using the arithmetic mean. However, usually different methods are available for the applicant, from which she or he might chose the one that is the simplest to use for her-/himself. If some software programme is available for GPA or STATIS, it seems not to be of much use to investigate in also programming the other method.

References

- Dijksterhuis G. and Gower J.C. (1991). *The interpretation of generalized procrustes analysis and allied methods.* Food Quality and Preference 3, 67-87.
- Lavit, C., Escoufier, Y., Sabatier, R. and Traissac, P. (1994). *The ACT (STATIS method).* Computational Statistics and Data Analysis 8, 97-119.
- Gower, J.C. (1975). *Generalized Procrustes Analysis.* Psychometrika 40, 33-51.
- Meyners, M. (2001). *Statistische Eigenschaften der STATIS-Methode – Propriétés statistiques de la méthode STATIS.* Cuvillier, Göttingen.
- Meyners, M., Kunert, J. and Qannari, E.M. (2000). *Comparing Generalized Procrustes Analysis and STATIS.* Food Quality and Preference 11, 77-83.
- Kunert, J. and Qannari, E.M. (1999). *A simple alternative to generalized procrustes analysis: application to sensory profiling data.* Journal of Sensory Studies 14, 197-208.
- Schlich, P. (1996). *Defining and validating assessor compromises about product distances and attribute correlations.* In: T. Næs and E. Risvik (eds.), Multivariate analysis of data in sensory science, 259-306.