Reprinted from IFPress (2009) 12(4) 2,3

Unfolding Liking using Landscape Segmentation Analysis® and Internal Preference Mapping

Benoît Rousseau

Background: A major objective for any company selling products or services is to uncover the characteristics that drive consumer acceptability. Every year, companies across the world spend a substantial portion of their research budgets for this purpose. Consumer products companies with this information have a significant competitive advantage since specific direction can be given to the development teams to produce one or more prototypes that will optimize consumer response. Once consumer, descriptive and analytical data has been collected according to protocols designed to ensure the highest-quality data possible, researchers use one or more of the many available techniques to search for a basis for consumer choice.

Data analysis involves the creation of a model or representation based on the observed data. In a previous technical report[1] it was shown that different models with different interpretations can be used to explain exactly the same data. It was suggested that the choice of model should be based on the most plausible account of the process that gives rise to the data. For instance, it is reasonable to expect that a suitable model for liking data will need to take into account some fundamental aspects associated with any hedonic measurement, such as that of satiety. Satiety occurs when a consumer likes a certain level of an attribute and dislikes higher or lower levels, as shown in Figure 1. Satiety is known to occur for a large number of product properties in the food/beverage and personal care industries, for example. In this report we explore two unfolding methods, the first of which, Landscape Segmentation Analysis®, was designed to account for satiety using individual ideal points. The second method, Internal Preference Mapping, was designed to represent individual ideals as vectors and does not account for satiety.

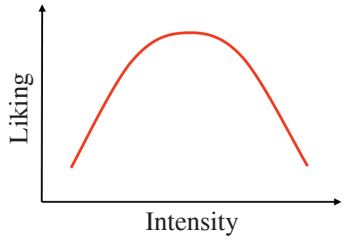

Figure 1. Satiety evident in relationship between attribute intensity and liking.

Scenario: Your company produces ketchup products that have many uses, ranging from an individual condiment consumed with various vegetables to an ingredient part of sauces and salad dressing recipes. You are interested in studying consumers' responses to a set of ten products, some already on the market and others resulting from R&D research. You recruit 350 regular consumers with a consumption frequency of at least once a week. All consumers evaluate the ten products according to rotations generated to control differential position and sequence effects in the design. The consumers complete a questionnaire for each product, starting with overall liking, then rate a variety of sensory and benefit attributes. Average liking ratings are shown in Table 1.

Your objective is to create a map, or spatial representation, of the products that explains the data as closely as possible. You would then like to explain this map using additional sensory information.

Product	Average Liking	Symbol
Own brand 1	7.45	
Competitor 1	7.10	
Own brand 2	6.79	
Prototype 1	6.43	
Competitor 2	6.14	
Competitor 3	5.51	
Competitor 4	5.19	
Prototype 2	5.16	
Competitor 5	3.85	
Prototype 3	3.64	

Table 1. Average mean liking ratings of the ten products over the 350 respondents.

Unfolding Liking: The concept of unfolding involves the idea that a one-dimensional measure, such as liking, for a set of stimuli can be represented in a many-dimensional space where inter-product distances can be determined and related to that measure. For instance, two products can both be rated 4.5 on a 7 point liking scale, but they can be liked and disliked for very different reasons and hence occupy very different locations in the unfolded map. It is reasonable to expect that if liking is successfully unfolded then many if not all drivers of liking will exhibit some satiety level as subjects in the center of the map will generally prefer intermediate levels on the various drivers. As a special case it follows that liking itself need not fit well in the unfolded space since individual subject liking decreases uniformly as we move away from that subject's ideal point in all directions.

Two common approaches to unfolding involve either the idea of individual vectors for ideals or the idea of individual points for ideals. In the former case, the objective is to find ideal directions and the actual location of the ideal points is never known. An example where this idea might apply is fuel efficiency as consumers typically want more fuel efficiency than they have right now. On the other hand, the idea of ideal points allows for individual levels of an attribute that are liked and other levels that are less satisfactory (Figure 1). An example where this idea is applicable is sweetness, as a product can be too sweet or not sweet enough. Internal preference mapping (IPM) is based on the idea of individual vectors for ideals and can be seen as a particular application of the biplot, developed by Gabriel in 1971[2]. Landscape Segmentation Analysis® (LSA) is based on the idea of individual ideal points and makes use of a similarity model developed by Ennis *et al.*[3] and Ennis and Johnson[4]. These two methods use very different modeling approaches and will often yield different outcomes. IPM will show the products as points and consumers as vectors pointing in each individual hedonic direction. It has been shown from simulations and numerous applications that IPM almost always creates a very

strong hedonic dimension in the space created by the first two components and this prevents the fit of any satiety-based attribute in that particular direction[1,5]. LSA is a probabilistic model where products are represented as distributions taking into account products' inherent variability, while consumers are represented as ideal points. The use of ideal points makes it very natural for the underlying drivers of liking to exhibit the intuitive satiety property.

Application of IPM: You first create the first two components of the map as shown in Figure 2. In order to explain the product locations in the space and thus in order to uncover the drivers of liking, you regress consumer attributes (in green along with liking) and expert attributes (in white). You conclude the IPM uncovered a direction highly correlated with liking (with a correlation of 0.999). Attributes in that direction are the same ones found when using a factor analysis and are attributes highly correlated to liking. Even the consumer tomato attribute can be seen as a surrogate to liking, as consumers always indicate that the products they like the most have more tomato character, even though expert information contradicts this finding. The rest of the space is otherwise unsatisfactorily explained, with only the north-south direction described by expert information.

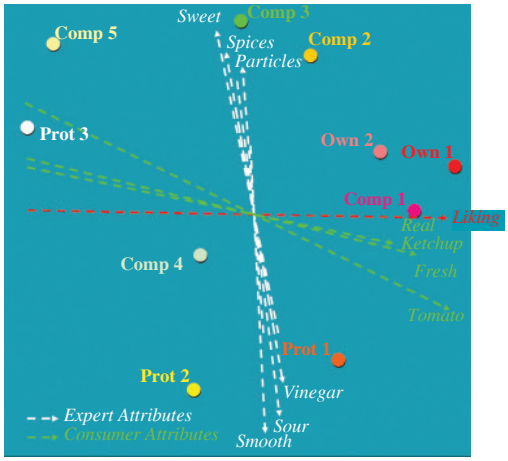

Figure 2. IPM map for the ketchup study.

Application of LSA: In order to explore the presence of ideal points, rather than ideal vectors, you re-analyze your data with Landscape Segmentation Analysis. The results are shown in Figure 3. Contours illustrate ideal point densities, with lighter colors indicating higher densities. Liking and other consumer hedonic-related attributes do not fit in the sensory space, while the expert information successfully explains the majority of the directions. The east-west and northwest-southeast directions relate to texture and appearance properties, while the north-south and northeast-southwest directions are well described by flavor-related attributes. A liking optimization analysis indicates that the optimal product would be fairly centrally located close to your Own Brand 1 product, while your two prototypes were rejected because of their unsatisfactory profile in terms of vinegar, spice, sweet and tomato characters. You conclude that your company is well positioned with a product that is well accepted, on average, by consumers. It might be more judicious to investigate opportunities for more specialized products that will expand your product portfolio.

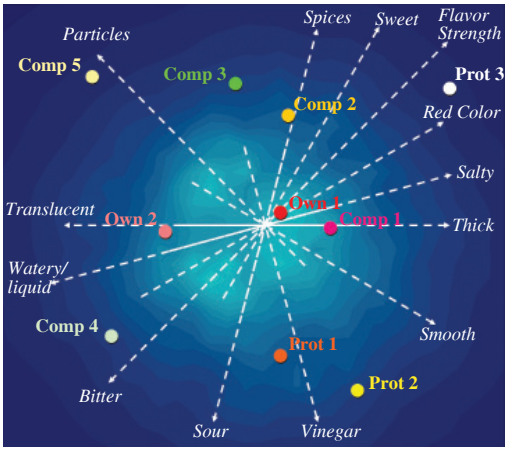

Figure 3. LSA map for the ketchup study.

Conclusion: Many techniques are available to investigate consumer responses to a set of products and to identify the underlying drivers of liking. Many of them lack an approach that models the liking ratings according to an intuitively sound process that accommodates fundamental properties such as satiety. Internal Preference Mapping, with a vector model for liking, is often unable to create a map which is relevant to the consumer perception of the products due to its lack of such an underlying process. Instead, Internal Preference Mapping often produces maps that are only a graphical representation of the liking means themselves and thus provide little diagnostic direction. Landscape Segmentation Analysis, on the other hand, unfolds liking to produce an internal representation of the consumers' perceptions of products, what the consumers desire and what drives that desire. It should be noted that the biplot technique has many useful applications, but unfolding liking is generally not one of them.

This report illustrates how critical it is to consider the process through which consumer data arise and how the corresponding models will provide a solid foundation for subsequent strategic decisions.

References:

1. Ennis, D.M. (2005). Analytic approaches to accounting for individual ideal points. *IFPress*, **8(2)**, 2,3.
2. Gabriel, K.R. (1971). The biplot graphic display of matrices with application to principal component analysis. *Biometrika*, **58**, 453-467.
3. Ennis, D.M., Palen, J. and Mullen, K. (1988). A multidimensional stochastic theory of similarity, *Journal of Mathematical Psychology*, **32**, 449-465.
4. Ennis, D. M. and Johnson, N. L. (1993). Thurstone-Shepard similarity models as special cases of moment generating functions. *Journal of Mathematical Psychology*, **37**, 104-110.
5. Rousseau, B., Ennis, D.M. and Rossi, F. (2009). Contrasting ideal point and vector models of liking. *8th Pangborn Sensory Science Symposium, Florence, Italy*.