Reprinted from IFPress (1998) 1(1)2,3

Drivers of Liking

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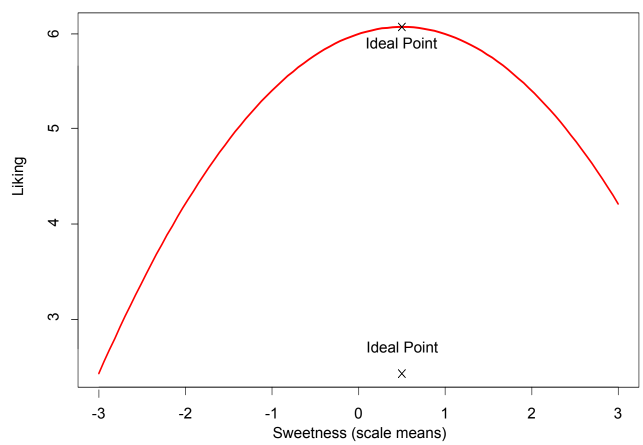
Background:

Assessment of the strengths and weaknesses of your own and your competitors' brands is an area of mutual concern to product developers and market researchers. In this report we assume that consumers base overall liking and preference decisions on the sensory effects that products have on them and on non sensory variables that the products evoke. Sensory effects may include any or all of the senses - visual, tactile, olfactory, auditory, and gustatory. For example, a consumer's liking response to a chocolate chip cookie may depend on how smooth it appears, how hard and sweet when tasted, how intense the chocolate flavor and how much noise it makes while eating it. Liking may also depend on non sensory variables such as the perception of the product as good/bad for health, the image projected by being a consumer of this type of product, perceived effects on mood and feelings of satiety. We discuss an approach to this problem that is quite general but apply it to the relationship between overall liking and sensory variables, of the type that would occur in blind product testing.

Although many classical techniques that represent product and attribute data (such as biplots, factor analysis, and multidimensional scaling with and without imposition of external information) have been used to relate sensory and hedonic information , they generally were developed as methods to summarize information rather than provide a process through which liking and preference responses are generated. In fact, none of the models on which these techniques are based provide an explicit process through which liking and preference data arise. Attributes that are highly correlated to one another and nonlinearly related to liking are very common in consumer product testing. There has been a need for a method that naturally accounts for these effects without imposing an artificial structure on the solution. Response surface methods, commonly employing quadratic models, have often been used to relate liking data to design variables. Why are quadratic models popular? The most likely answer is that subjects have individual ideal or reference points and that segments of consumers can be described using distributions of ideal points. If the intensity of a product changes about an ideal point, liking will respond in a nonlinear manner, reminiscent of a quadratic model (Figure 1). Using ideal point concepts, however, it is not necessary to resort to quadratic models to explain nonlinear effects, they can be predicted naturally from a process that assumes that subjects use reference or ideal points when providing liking or preference responses.

Probablistic Models - Liking and Preference responses to the same product by the same subject are not constant over time. This is a simple fact due to the probabilistic nature of sensory information. Variation arises from many sources - the products themselves, how their chemical/physical properties are transduced to sensory information and from fluctuations in perceptions within individuals. Probabilistic models account for this variation as part of their assumptions. Research on the development of probabilistic models that "unfold" liking and preference using distributions to represent products and ideals has led to some very practical marketing and sensory tools in recent years. "Unfolding" is a process by which hedonic information (on the surface one dimensional) can be used to provide multidimensional maps of product sensory variables and the location of ideal products. The sensory variables discovered through this process are the ones that the consumer uses to produce an hedonic response. These are the *drivers of liking and preference*. It is also possible to produce multidimensional maps of products from similarity data, but the variables in these maps may not be hedonic drivers. Models based on probabilistic preferential choice unfolding have been published recently[1,2,3]. The drivers of liking model discussed in this report is a derivative of this theory with the addition of a feature that uses external information (sensory scales, analytical and marketing data) to explain the latent driver space created by unfolding.

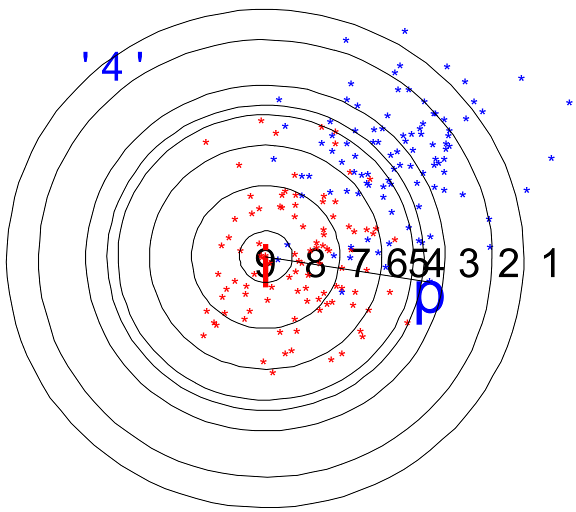
Figure 1. Relationship between liking and sweetness created by the existence of an ideal point



How Liking Ratings are Produced - Products and ideals are represented as multivariate normal distributions (see Figure 2). Selection of a liking category response depends on where a sensory value is relative to boundaries beginning at the ideal point. The further a sensory value is from the ideal, the less it is liked. Figure 2 shows how a liking rating of "4" is produced. The ideal distribution is represented as red dots and the product distribution as blue dots in a liking driver space. The circles represent boundaries that define regions producing each of the rating categories from 1 to 9. In Figure 2 an ideal point and a product value were selected. Based on the distance between these points and the location of the circular boundaries, a "4" would be produced on this occasion. Repeating this sampling process 100 times led to the general frequency result for all categories of (1 to 9): 6, 7, 21, 14, 5, 19, 16, 9, and 3 with a rating mean of 4.9. Notice how "5" ratings are avoided and "3" ratings favored as evidenced in Figure 2 from the spaces between the boundaries defining these categories.

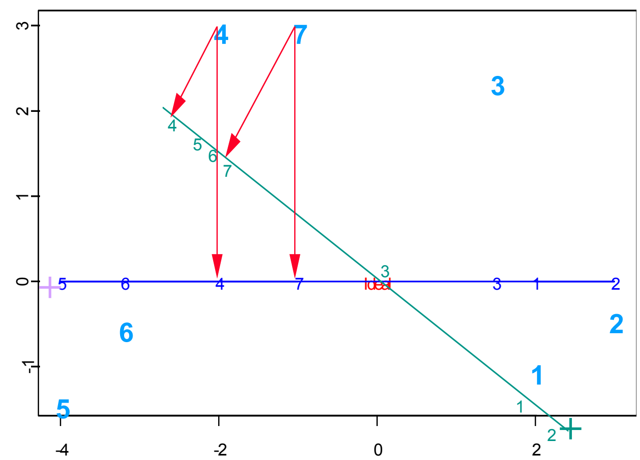
Unfolding and Identifying Drivers of Liking- Unfolding liking data involves fitting a mathematical model of the process in Figure 2 to liking frequency data from a selection of products using the method of maximum likelihood. This leads to a map of products in a sensory drivers of liking space. Tests can be conducted for dimensionality, variance and correlation structure and to see if the result is different from a perfect fit. Following the unfolding step, scale information is placed on the drivers map in such a way that projections of the product points onto the scales corresponds to the rating means as closely as possible. In this step product means cannot be chosen that would disturb their distances from the ideal or target mean. Some scales may not be compatible with the distance to ideal constraint and will be diagnosed as non drivers of liking. Others may be linear or nonlinear drivers depending on whether projections onto the scales fall on one side or both sides of the ideal product mean. In Figure 3, the two scales are placed so that projections of the product points agree with scale means. Notice that both are nonlinear drivers of liking because projections on both sides of the ideal occur.

Figure 2. Ideal (red) and product (blue) distributions showing a random selection of an ideal point and product point that produced a "4" response



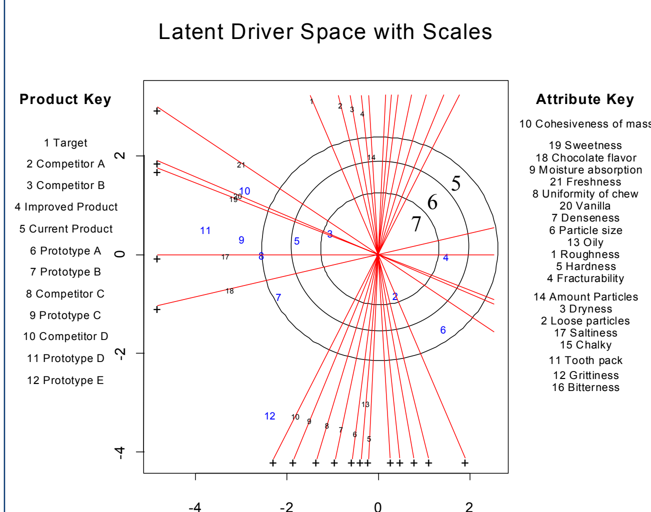
Product Strengths and Weaknesses - Drivers of Liking analyses provide a very convenient method for determining product strengths and weaknesses. Projections of product points onto the scales used allow the diagnosis of areas of needed improvement for a product and helps to explain why some products are liked and others disliked among a particular segment of consumers. We can also see that some products are liked equally to others for different reasons. These projections can be quantified so that precise direction can be given on the degree of change required to improve a product. The analysis also will show which scales are most important in driving liking and which ones should be ignored. A very common and important outcome of these analyses is that areas of the product space that drive liking can be identified that may not be well described by available scale information. This occurs because the space depends primarily on liking, and sensory information is used mainly to describe this space. This is the most fundamental difference between this method and others such as biplotting and factor analysis which attempt to summarize information irrespective of its importance to liking. Non linear and highly correlated effects are easily handled within the framework of the drivers of liking model.

Figure 3. Projections of product points onto scales to diagnose strengths and weaknesses (products closest to the + are highest in intensity on that attribute)



an ideal or target point so that distance from this point is directly related to liking. Scales can then be placed in this space so that the projections of the products onto the scales relates as closely as possible to the scale rating means. In Figure 4, the attributes are ordered by correlations of product projections to rating means. We can see that the most important drivers of liking are cohesiveness of mass, sweetness and chocolate flavor and the least important are grittiness and bitterness. Competitor A (2) is liked most and Prototype E (12) least, Most product weaknesses are associated with higher than ideal flavor attributes, although prototype E combines flavor and texture weaknesses. Since there are products on all scales that may be too strong or too weak, the drivers are nonlinear.

Figure 4. A Drivers of Liking Example



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