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TRENDS IN FOOD SCIENCE & TECHNOLOGY

Review

Measuring sensory and marketing influences on consumers' choices among food and beverage product brands

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Advance in food science depends on measuring the factors in human perception that influence eaters' activities with branded products. Assessed samples must include at least two levels of a sensed material characteristic (e.g. sucrose) or conceptual marketing attribute (e.g. "low fat"), minimally confounded by other features. Each feature needs to be measured for its effect on the individual's objective achievement of choosing among the samples for a familiar context of use. These influences interact, consciously and unconsciously. This theory of how a mind works has generated a wide range of scientifically illuminating and commercially practical examples, illustrated in this review.

Measurement of a food's impact

The basic conditions for measuring the performance of an inanimate material, or of a plant or animal, are well understood by the scientists and engineers who do such work. The measurement of human performance on food has to meet the same requirements, even though shoppers and eaters have the additional complexities of acting with intentions and thinking in concepts. Yet established practice in sensory analysis and in market research has neglected this logic and science. As a result, the usual computer-based collection and analysis of data fail to support the measurement of influences on choices among foods. Existing systems could easily be modified to give precise and operational answers.

The fundamental requirements of psychological food science are briefly summarised below. Then a variety of examples is given of the calibration of two or more factors in human perception and choice of a food.

Requirements for any measurement

A potential influence can only be investigated if it varies independently from all other factors. Otherwise it is logically impossible to pick out its effects from others. This requirement has been disastrously misunderstood in some laboratory science that is meant to be practically relevant. It is assumed that the hypothetical factor has to be manipulated by the experimenter. Worse, traditional methods are founded on isolating the factor under investigation from all other reality. On the contrary, appropriate selection among existing samples can minimise correlations between influences. If that were not so, observational sciences could not exist. Indeed, the best experiments in food science simulate the conditions of consumption as closely as feasible. It may be necessary to make the required samples but all or some may already be on the market or have been prepared as new propositions for pilot testing.

The set of food samples to be tested must have at least two levels of any sensory or marketing factor to be investigated. To measure one influence, only two samples are needed, presented twice each. If two or more potential influences are to be investigated at the same time, then the lower and higher ranges of those influences have to be crossed with each other, i.e. varied orthogonally. It is not necessary to limit the lower and higher ranges to a single value each. Furthermore, correlations between the levels of two influences can be as high as $r = 0.5$. The confounding between the variances is still only 25% – in practice leaving a good chance of distinguishing the two effects on choice (Booth, Mobini, Earl, & Wainwright, 2003a).

This logically required design can be extended to any number of factors that potentially influence perception

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and choice, so long as the number of samples is greater than the number of influences (Fig. 1, left-hand side). Only two levels of each factor are needed. The higher and lower levels may be ranges of values, because the analysis is by regression through the calibration line of raw data-pairs from individuals, not by differences between group mean responses to fixed levels.

So long as both the highest and the lowest values of a factor are realistic to the food being investigated, wider ranges provide more sensitive measurement. Nevertheless, the two values that are absolutely necessary have only to be as far apart as is distinguishable by an assessor familiar with the food.

The principle of the peak value

Measurement of influences on choice has to allow for a basic principle from psychological science, in addition to the above general logic of separating influences from each other. A person decides how to act by comparing the situation with a standard or norm built up in memory from similar situations (Booth, under review; Booth & Freeman, 1993; Booth, Thompson, & Shahedian, 1983; Conner, Haddon, & Booth, 1986). This personally learnt norm has a 'just right' value (ideal point) for each feature that has been relevant in the past. An item will have its strongest impact on action when each feature matches this level of the norm. If a feature in a test item is at a level either below or above the norm, the impact will be less. As a result, an overall response does not get stronger and stronger as the presented level of a feature gets higher and higher. The response reaches a peak at 'just right' and then decreases.

The immediate practical consequence of this peak principle is that an assessor's responses to test items should be anchored on that person's norm levels for their perceived features. Indeed, the data are not fully interpretable unless one of those anchors is a perfect match for the target of the investigation. This may be the leading brand, the assessor's usual product or personally the most preferred version.

Indeed, the fundamental psychological theory is that an exact match to the standard learnt from life is the primary category used in responding quantitatively to any layout, whether or not words equivalent to "just right" are used as an anchor point. In addition, it is a logical requirement for linear responding that there be only one other anchor phrase on the layout. Those words could be "just wrong" – that is, just too low or high to be acceptable as a match or for the sample food item to be used. The most versatile pair of phrases is "I'd always choose this" and "I'd never choose it". Room must be made for an undistorted response to a sample that is worse than just unacceptable (Fig. 1, right-hand side). In contrast, it is logically impossible to be better than perfect (unlike stronger than "extremely" intense or liked). This provision for responses worse than "just wrong" is also useful to check for the inclusion of a sample food that is personally unacceptable to an assessor – a mistake that too often undermines the validity of sensory experiments on consumer products.

Contrary to persisting opinion, relevant descriptive analysis is readily feasible along with such assessments of degree of preference or overall mismatch to target (Booth *et al.*, 1983; McBride & Booth, 1986). The assessor simply states whether a named feature is above or below its "always choose" or "just right" point (Fig. 1, right-hand side). Then each response can be plotted on the correct side of the peak point for any monitored factor that might influence that verbally characterised feature (Booth & Conner, 1991).

Analysis of performance

The strength of an influence on choice is the objective achieving of preferences that distinguish between levels

DESIGN OF TEST FOODS AND RATINGS

Quantity of factor		Levels of factors 1 to 4 in tested samples A to H								Rated distance from ideal	Concepts of non-ideal
										I'd always choose this □	*Too Too*
Range	Level	A	B	C	D	E	F	G	H	□	*little much*
										□	
	Higher	1		2			3	4	1	□	.....
Higher										□	
	Lower		2	1,3	3,4	4	2	1	3,4	□	.....
										□	
	Higher	2	4		1	3,2	4	2	2	□	.....
Lower										□	
	Lower	3,4	1,3	4	2	1	1	3		*I'd never choose this* □	.....
										(worse) □	

Fig. 1. Example of design of food samples and quantitative responses that meet the minimum requirements for measuring the interacting effect of up to four sensed or symbolic influences on the recognition or acceptance of a branded or unbranded edible material by each member of a panel. The level of a factor in a food sample is a physicochemical or labelled quantity, either selected from existing items or newly created. The higher and lower levels within a range do not have to differ: the same quantity can be replicated. The samples with the highest and lowest levels must be tolerably acceptable. The sequence of presentation of samples is not critical but the highest level of each factor is best tested earlier in the series. "Always choose" should be scored 0 (no difference from ideal); "never choose" = (−)9. The (interpolated) ideal can be personally most preferred or an exact match to a familiar version. Samples should be designed never to be worse than just unacceptable. Verbal characterisation of sensory or conceptual features stronger or weaker than wanted/expected should be avoided unless descriptive analysis is of interest. Those words can be each panellist's choice or a consensus vocabulary of a previous panel from the same population.