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Relating Expert and Consumer Sensitivities

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Background: It is often necessary to conduct expensive, time-consuming experiments in order to obtain reliable information on product characteristics from consumer samples. This report investigates reducing product testing costs by improving measurement sensitivity. In some cases, such as when estimating sensory intensity differences, smaller samples could be used if sensitivity could be increased.

Companies usually rely on trained panels which are readily available and allow the testing of numerous product modifications at a fraction of the cost involved in consumer studies. Results from these panels are then used to make decisions about whether a product can be released on the market, requires more work or should simply be rejected.

One of the disadvantages to using trained panels is that they most likely do not represent the consumer population. Therefore, conclusions reached might be in conflict with what is perceived by consumers. One important aspect is that consumers are probably less sensitive than panelists who have been trained and exposed repeatedly to a particular type of product; panelists can notice very slight changes that would be negligible in normal consumption conditions. This in turn might be financially costly for a company, as cost-saving opportunities might be missed by rejecting perfectly acceptable product modifications. This aspect of product testing underlines the importance of studying and using the relationship between trained panel and consumer sensitivities.

Scenario: Your company manufactures a lemon flavored beverage. In order to investigate the relationship between the relative sensitivities of your trained panelists and that of users regularly consuming your product, you carry out a series of 10 studies each involving pairs of samples with varying degrees of sensory difference. These differences are created through formulation or manufacturing process modifications. Your hypothesis is that your trained panel will be more sensitive than ordinary consumers, and you hope that the uncovered relationship will allow you to make predictions about consumers' discriminability from panel results, thus significantly reducing the need for repetitive consumer tests.

	Trained panel *(Triangle)*				Consumer panel *(Same-Different)*	
Study	**N**	**# Correct**	**P_c**	**d´**	**N**	**d´**
1	20	57/100	0.57	**1.82**	135	**1.07**
2	20	35/100	0.35	**0.43**	198	**0.00**
3	19	66/95	0.69	**2.47**	143	**1.48**
4	19	36/95	0.38	**0.72**	153	**0.38**
5	21	90/105	0.86	**3.59**	165	**1.79**
6	22	51/110	0.46	**1.27**	210	**0.40**
7	23	55/115	0.48	**1.35**	155	**0.49**
8	21	68/105	0.65	**2.22**	205	**1.40**
9	20	60/100	0.60	**1.98**	195	**0.77**
10	22	83/110	0.75	**2.83**	178	**1.58**

Table 1. For each study, experimental data and d´ values

Table 1 summarizes the results from the 10 studies. Trained subjects were sampled from a pool of 24 panelists, while a new group of consumers was sampled from a consumer population with similar demographics and usage patterns for each study. Your company uses the triangle test methodology with trained panelists and the same-different methodology with consumers.

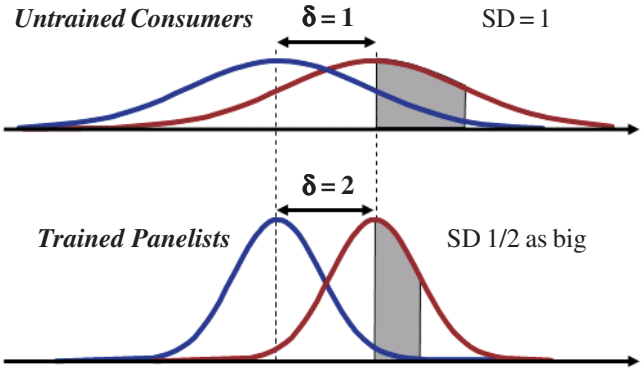

Figure 1. Thurstonian representation of training effect

Effect of Training on Perceptual Variance: The top part of Figure 1 describes the difference between two products on a particular attribute. Each product is represented by a perceptual distribution of a given variance set at one[1,2,3]. The perceptual variance is due to factors inherent to the subject (neural noise, slight adaptation effects, memory, …) and factors inherent to the samples (distribution of the flavor compounds, temperature differences, sample-to-sample variability, …) The two distribution means are separated by δ, measured in terms of the standard deviation of the distributions. The experimental estimate of δ is called d´. As subjects become more sensitive through training, the perceptual variance will decrease (more concentration, more consistency in the way the panelists evaluate the products, less forgetting of the sensations…) Therefore, for the same distance between the means, a larger d´ is estimated, indicating better discrimination between the products. It is worth noting that if the variance comes mainly from the products under study rather than from factors associated with the subjects, the improvement through practice might be minimal.

This perceptual variance effect is analogous to that described for experimental variables such as resampling, memory and adaptation effects[4,5]. Smaller perceptual variance means better discrimination.

Figure 2 shows the theoretical relationship between trained panel values and consumer values as perceptual variance is decreased due to training. The slope of the line relating trained panel values to consumer values decreases as the perceptual variance decreases. For a given consumer difference, the trained panel difference will be greater if the variance is less. It can be seen that, theoretically, the plot begins at (0,0) and increases linearly. Therefore, by using this type of relationship one can predict consumer discrimination based on trained panel information. Regarding the relationship at low δ values, it may be unrealistic to assume that δ can be reliably estimated when it is very small.

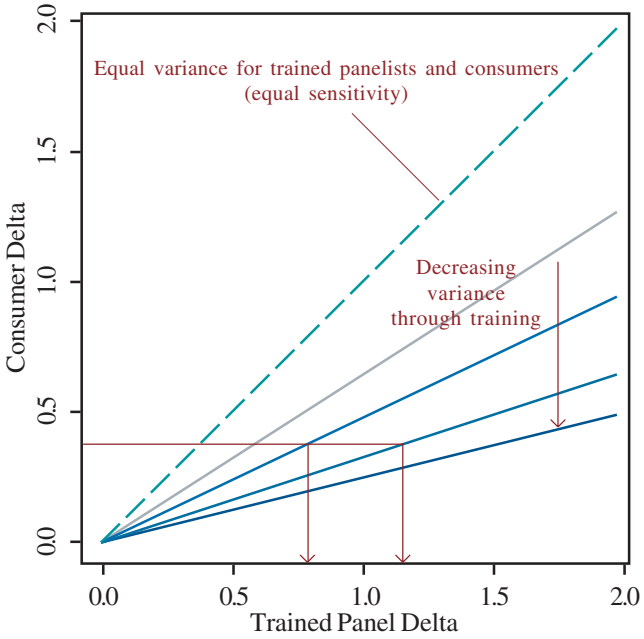

Figure 2. Decreasing panel variance relative to consumer variance causes the slope of the line to decrease

Trained Panel - Consumer Sample Relationship: Suitable models and consequent d´ values allow for the estimation of the degree of difference perceived independently of the methodology used. Each trained panelist performed 5 trials, while each consumer performed one trial. For the triangle method, d´ values were calculated using published tables of d´[6]. For the same-different method, a different model[7] can be utilized to estimate d´ (d´ values can be obtained directly from the *IFPrograms™* software).You observe that your trained panel is indeed more sensitive than your consumer sample, which motivates you further in your search for the relationship between the two. Figure 3 illustrates the relationship between the two panels' respective d´ values. As can be seen, a fairly linear relationship is found and the regression equation permits the prediction of consumer discrimination from the trained panel d´ value. It is worth noticing that the regression line does not include the origin of the graph, as would be assumed from the model described in Figures 1 and 2. This can be explained by the fact that consumers might encounter difficulties in identifying the relevant dimension(s) when the sensory difference is very slight. While trained panelists will more readily discriminate the samples, the consumers may focus on the wrong product dimension and exhibit a lower discriminative ability than that predicted by the model. This issue becomes negligible as the sensory difference (δ) becomes larger.

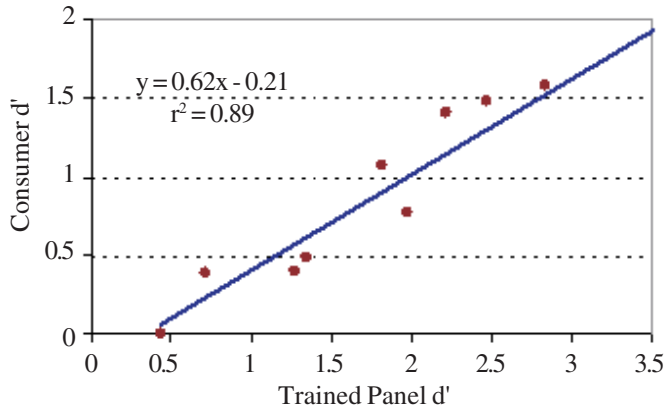

Figure 3. Relationship between trained panelist and consumer sensitivities

Once this relationship has been uncovered, it is necessary to decide what constitutes a non-negligible difference for consumers. A d´ of 0.5 for the experts corresponds to a d´ of about 0 for the consumers. Therefore any difference smaller than a d´ of 0.5 can be considered as acceptable if the test represents typical consumer use. A d´ of 1 for the consumers would correspond to a d´ of 1.95 for the trained panel. In order to measure the relevance of degrees of perceptual difference, an analysis that reveals the extent to which differences drive liking and preference may be required. For some attributes a δ of 3 may not matter to consumers. For others a δ of 0.5 may be highly influential.

Conclusion: The approach described here has been used in actual product testing and has shown its value by providing guidance when accepting or rejecting formulations and process changes[8]. The effect of training can be modeled by reducing the variance of the perceptual distributions. Consequently, a trained panel will generally be more sensitive than a consumer panel, i.e. will yield a larger d´ value. Models such as those described here permit the estimation of d´ values from numerous discrimination and rating methodologies. This in turn can be used to relate a trained panel's sensitivity to that of consumers, thus allowing predictions of consumer discriminability without requiring time and resource-intensive consumer testing.

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