

Is the Tetrad Test always appropriate? Comparison of the Tetrad and Triangle methods using small panel sizes.

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Background

The Tetrad Test is becoming an increasingly popular discrimination test owing to its superior statistical power in comparison to the more established Triangle Test¹. Previous methodological comparisons have involved collecting results from a large number of subjects (>100)^{2,3}, however, it is not uncommon for difference tests to be conducted with a smaller number of semi-trained individuals. As a consequence it is currently unclear whether the Tetrad Test still retains a statistical advantage under these conditions.

Aim

Determine whether the Tetrad Test is more powerful than the Triangle Test when using a small panel size (<30 panelists).

Methods

Samples: A broad range of stimuli, ranging in odour complexity, assessed over 5 sessions. Samples included ARICHATM flavour standards, commercial wet cat food products and in-house flavour modules.

Assessors: WALTHAM sensory panel, varying from 24-30 assessors per session.

Sensory Testing: Each sample pair was assessed using the Triangle and Tetrad Test methodologies, with each test presented first an equal number of times. A warm up Tetrad Test was used at the start of the session.

Data analysis:

Tetrad and Triangle: p-values were calculated using a binomial test to determine if there was a significant difference between samples for each test.

Sensory difference: D-prime (d') values were compared using a z-test by estimating d' standard deviations to identify if there was a significant difference between d' values for each pair of tests.

Power analysis: Variance components estimated via modelling were used in a powering simulation to identify the optimum number of panelists for 1-3 test replicates and two correct answer probabilities for the two test types.

Results

The significance of the results remain consistent between the Triangle and Tetrad test when the same samples are compared.



Results: z-test

Table 1. Statistical comparison of d' value scores from Tetrad and Triangle tests conducted on the same samples.

Session	d' values (Tetrad vs Triangle)	p-value
Flavour standards	2.22 vs 2.45	0.038
Wet cat food	1.71 vs 2.90	0.036
Flavour mix in jelly	0.62 vs 1.29	0.316
Flavour mix in gravy	0.63 vs 0.36	0.740

Only one test pair was significant. Panelist were more able to identify the sensory differences between wet cat food samples using the Triangle Test.

Results: Power Analysis

When the probability of being correct is 0.55, the Tetrad Test requires two fewer judges to achieve the same power as the Triangle Test. This is reduced to one fewer judge when the probability of being correct is raised to 0.6.

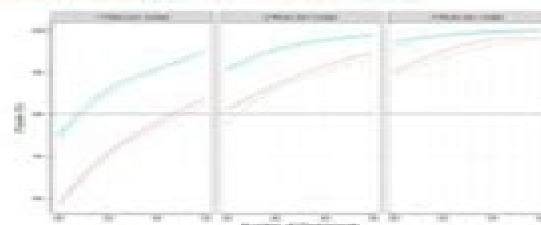


Figure 2. Power analysis results for a range of participant numbers under different probabilities of obtaining a correct answer for both Triangle and Tetrad methodologies.

Summary and Conclusions

Comparison of the p-values for Tetrad and Triangle Tests indicated there was little difference between both tests.

Statistical comparison of d' values revealed samples with a complex odour such as wet cat food may be better assessed using a Triangle Test.

The Tetrad Test is more powerful than the Triangle Test but the advantage of the additional power of the Tetrad is not evident with small panel sizes (<30 panelists).

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