

Linking Expert Panelist and Consumer Sensitivities to Estimate Sensory Equivalence

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**MOLSON
COORS** beverage
company



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> ?



Tetrad

- Four samples



Variable A



Variable A



Variable B



Variable B

- Group into pairs based on similarity

Tetrad Test Ballot

Name: _____

Date: _____

Instructions: In front of you are four samples. Two samples are one type, and two samples are of another type. Taste the samples in the order indicated below from left to right. You are welcome to re-taste them if needed. Group the samples into two groups of two, based on similarity by writing the 3 digit codes into Group boxes below and comments for why you grouped these samples.

3 digit codes:

310

598

269

742

Group	
3 digit code	3 digit code
Comments	

Group	
3 digit code	3 digit code
Comments	

Same - Different

- Two samples



Variable A



Variable A

OR



Variable B



Variable B

OR



Variable A



Variable B

- Are the samples the same or different?

Same Different Test Ballot

Name: _____

Date: _____

Instructions: Taste the two samples from left to right. You are welcome to retaste the samples if needed. Are the samples the Same or Different and indicate how sure you are of your answer. Place an 'X' beside the corresponding statement.

Sample Numbers 485 109

- Samples are the same, I'm sure
- Samples are the same, I'm unsure
- Samples are different, I'm unsure
- Samples are different, I'm sure

Comments:

Tetrad Example

- Four samples
 - Two Variable A and two Variable B
- Group into pairs based on similarity



850



127



994



306

N	Correct	Incorrect	d'	p-value	Significant at 0.05	Comments (#)
21	14	7	1.59	0.00	YES	Test: More Bitter (5)

Thurstonian Method

Thurstonian modeling provides the comparison of the relative power of testing procedures

1. Variation in Product Perception
2. Decision Rule (Comparison of Differences)



Degree of Difference

Tau (τ)

Perceptual size of a difference above which two samples will be called “different”

Delta (δ)

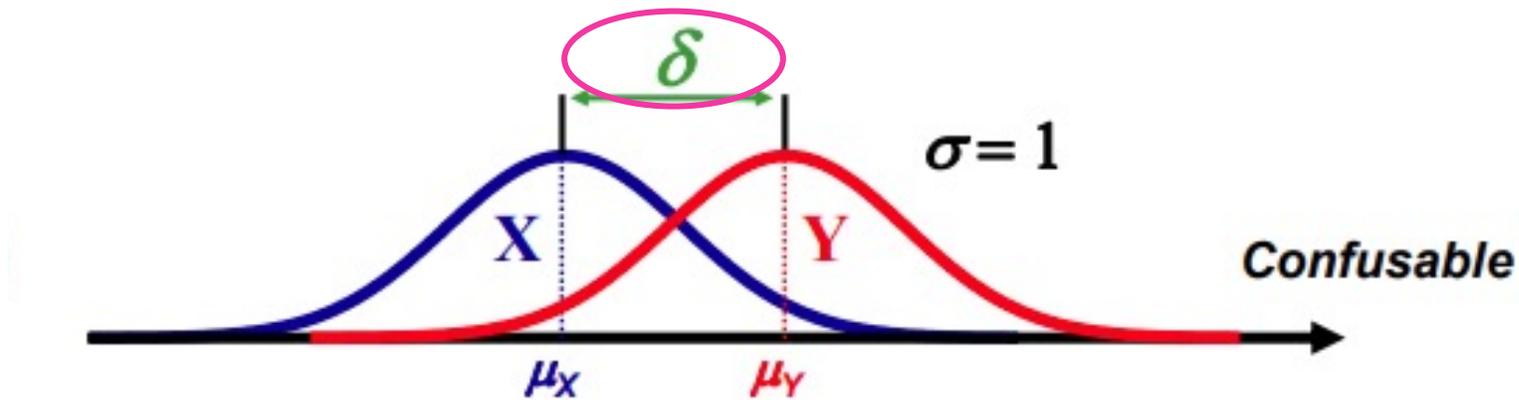
Size of the product difference or degree of difference in the population

D prime (d')

Experimental estimate of how far two distributions are

Product Distribution

$$\delta = \infty$$



δ = distance between the means (μ_X and μ_Y) of the distributions measured in terms of their standard deviation (σ)

d' = Experimental estimate of δ

Study #1

Purpose: To understand the correlation between expert panelist discrimination results and consumer relevance

Seltzer 1 was dosed with H₂S using certified flavor standards at the following intensities:

- A = 0 µg (control)
- B = 9 µg
- C = 27µg

Expert Panelists (n = 51-57 judgements)

- Tetrad
 - A vs B | B vs C | A vs C



Study #1 Cont.

Consumers (n = 106)

- Hard seltzer drinkers at least a few times per month
- Non-rejectors of the brand family
- Considered the flavor of the seltzer appealing

- Same-Different test
 - AA | AB | AC | BB | BC | CC

- *“Are the samples the same or different and are you sure or unsure of your answer?”*



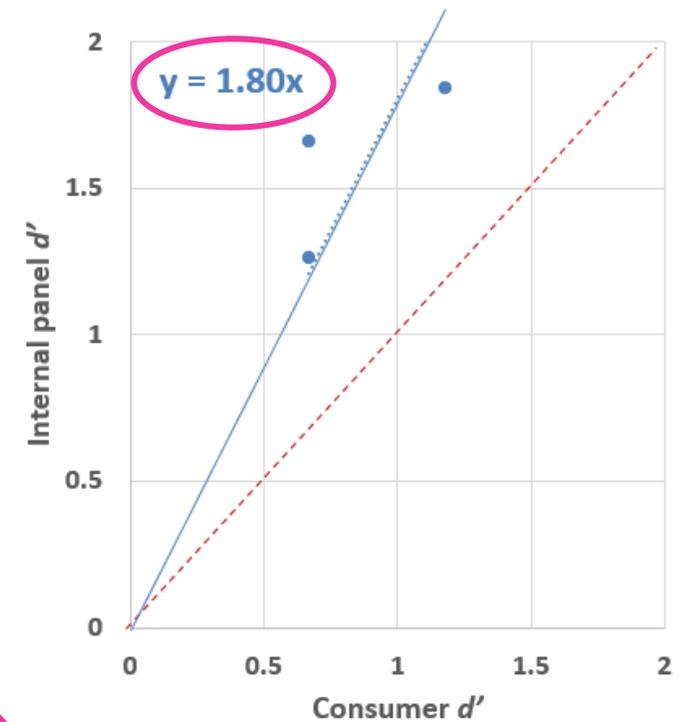
Study # 1 Discriminator Results

Expert Panel Tetrad Test

Pair	# correct	Total N	d'	Var d'	p -value
AB	29	51	1.26	0.05	<0.001
AC	42	57	1.84	0.05	<0.001
BC	35	51	1.66	0.05	<0.001

Consumer Same – Different Test

Pair	Same sure	Same not sure	Diff not sure	Diff sure	τ	d'	Var	p -value
AA + BB + CC	74	94	63	87	1.02		0.004	
AB	23	29	19	35		0.67	0.11	0.05
AC	18	24	19	45		1.18	0.05	0.05
BC	21	32	18	35		0.67	0.11	<0.001



Regression Coefficient {1.80} x Consumer Threshold (τ) {1.02} = 1.84 → d' risk profile

Study #2

Purpose: Repeat Study 1 with a different seltzer brand and stimulus to confirm that the results are replicable

Seltzer 2 was dosed with Mercaptan using certified flavor standards at the following intensities:

- A = 0 μg (control)
- B = 2.25 μg
- C = 4.5 μg

Expert Panelists (n = 105-129 judgements)

- Tetrad
 - A vs B | B vs C | A vs C



Study #2 Cont.

Consumers (n = 104)

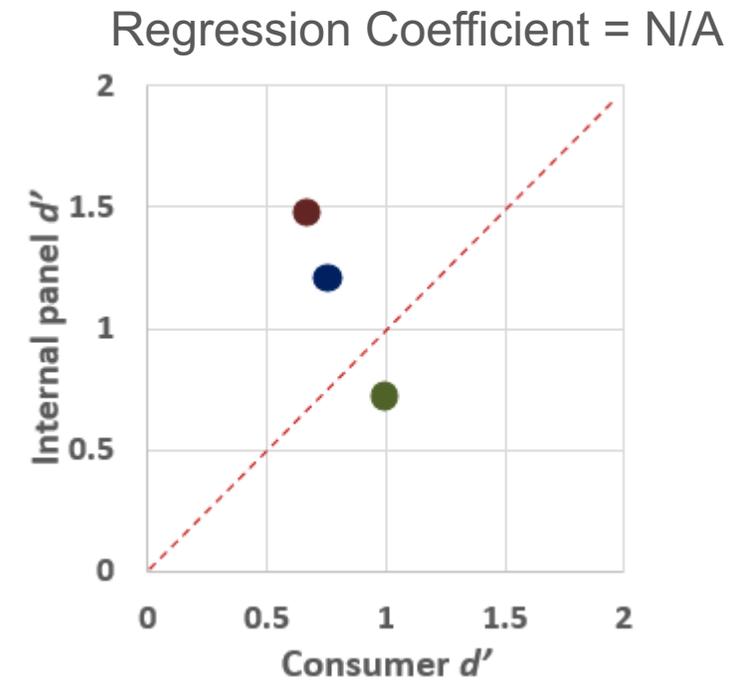
- Hard seltzer drinkers at least a few times per month
- Non-rejectors of the brand family
- Considered the flavor of the seltzer appealing
- Same-Different test
 - AA | AB | AC | BB | BC | CC
- *“Are the samples the same or different and are you sure or unsure of your answer?”*



Study #2 Discrimination Results

Expert Panel Tetrad Test

Pair	# correct	Total N	d'	Var d'	p -value
AB	58	105	1.20	0.03	<0.001
AC	74	117	1.47	0.02	<0.001
BC	54	129	0.71	0.04	0.03



Consumer Same – Different Test

Pair	Same sure	Same not sure	Diff not sure	Diff sure	τ	d'	Var	p -value
AA + BB + CC	104	70	51	87	1.05		0.004	
AB	28	16	27	33		0.76	0.10	0.07
AC	26	22	24	32		0.67	0.12	0.26
BC	24	18	24	38		1.00	0.07	0.06

Expert d' AB {1.20} / Consumer d' AB {0.76} = 1.58

AB Regression Coefficient {1.58} x Consumer Threshold (τ) {1.05} = 1.66 → d' risk profile

Study #3

Purpose: Use the same methodology as the previous two studies to understand if the d' values will be similar across a different beverage category

Beer 1 was dosed with Isoamyl Acetate using certified flavor standards at the following intensities:

- A = 0 μg (control)
- B = 1.75 μg
- C = 3.5 μg

Expert Panelists (n = 60 judgements)

- Tetrad
 - A vs B | B vs C | A vs C



Study #3 Cont.

Consumers (n = 107)

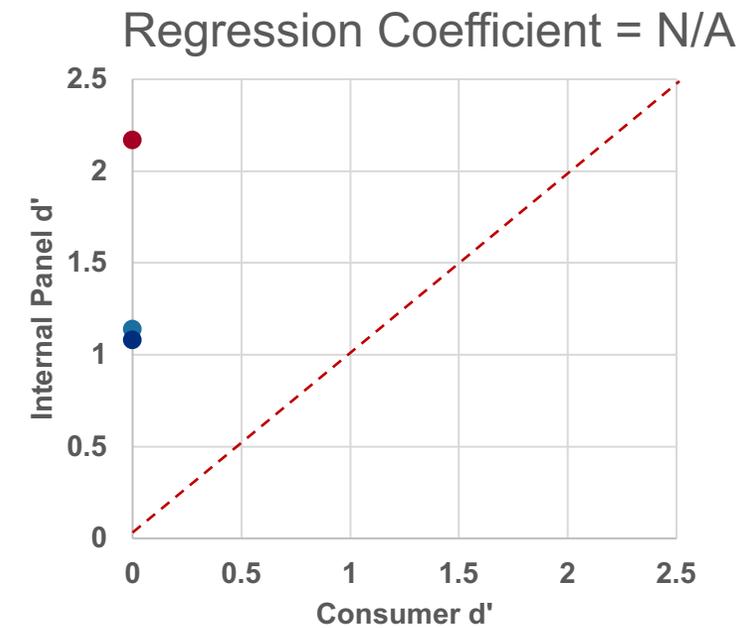
- ~50% had this beer as their drink of choice most often
- ~50% were premium light beer drinkers most often
- All respondents were at least 'somewhat interested' in drinking this brand within the next month
- Same-Different test
 - AA | AB | AC | BB | BC | CC
- *"Are the samples the same or different and are you sure or unsure of your answer?"*



Study #3 Discrimination Results

Expert Panel Tetrad Test

Pair	# correct	Total N	d'	Var d'	p -value
AB	29	60	1.14	0.05	0.001
AC	42	60	2.17	0.05	<0.001
BC	35	60	1.08	0.05	0.003



Consumer Same – Different Test

Pair	Same sure	Same not sure	Diff not sure	Diff sure	τ	d'	Var	p -value
AA + BB + CC	89	66	58	108	0.97		0.004	
AB	32	27	18	30		0	0.18	NS
AC	30	23	26	28		0	0.17	NS
BC	34	23	15	35		0	0.55	NS

Regression Coefficient = N/A

Consumer AB AC BC $d' = 0$ → Unable to generate the d' risk profile

Conclusions

- Expert panelists consistently found a difference between sample pairs while consumers only did in Study #1
- Consumers often overlook desired attributes when assessing for differences between samples
 - Consumers more easily detected and responded less favorably to negative attributes
- Mercaptan should be avoided for future consumer studies
- The flavor characteristic used in testing drives the differences in discrimination for the consumers
 - The base product does not have an impact
- When $d' > 1.66$, consumers will identify the samples as being different



What constitutes a “defective” or “positive” attribute to the consumer?



Future Research Questions



Should there be a d' value used for both “defective” and “positive” attributes?



Should a brewery focus more on the lack of “defective” attributes than increasing the intensity of “positive” attributes?

References & Acknowledgements

Mahoney, M & Rousseau, B. (2002) Discrimination testing: a few ideas, old and new. *Food Quality and Preference* (14), 157-164.

Ennis, D & Rousseau, B. (2015) A Thurstonian model for the degree of difference protocol. *Food Quality and Preference* (41), 159-162.

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