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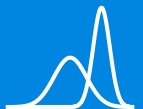
A Unifying Framework for Product and Concept Testing

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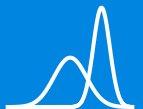
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Question:

Does the choice of testing methodology matter?

Why?



Gridgeman's Paradox

Discrepancy between Triangle Test and 3-AFC?

Triangle Test:



“Which one is different?”

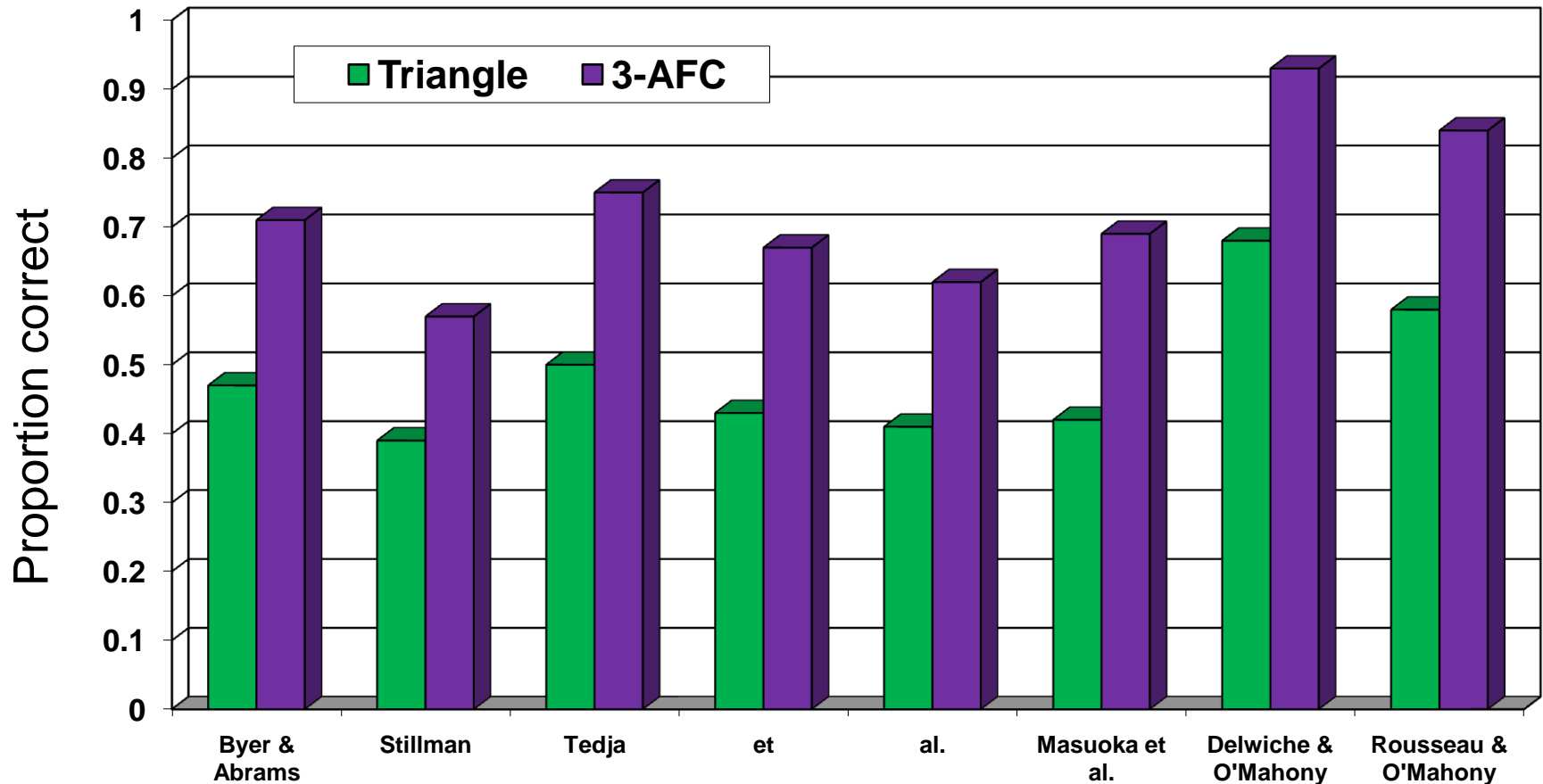
3-AFC :



“Which of the 3 is the most ... ?”

Gridgeman's Paradox

Discrepancy between Triangle Test and 3-AFC?



Gridgeman's Paradox

Discrepancy between Triangle Test and 3-AFC?

Study	Product	# tests	# correct		Prop. correct	
			Triangle	3-AFC	Triangle	3-AFC
Byer and Abrams, 1953	Bitter solutions	45	21	32	47 %	71 %
Stillman, 1993	Party onion dip	108	42	62	39 %	57 %
Tedja <i>et al.</i> , 1994	Salt solutions	720	363	539	50 %	75 %
		240	104	161	43 %	67 %
		240	99	148	41 %	62 %
Masuoka <i>et al.</i> , 1995	Beer	108	50	75	42 %	69 %
Delwiche & O'Mahony, 1996	Pudding	156	106	145	68 %	93 %
Rousseau & O'Mahony, 1997	Yogurt	180	105	152	58 %	84 %

Observation:

Triangle test returns a lower proportion correct than 3-AFC

Is this important?

Issue: Same criterion for Triangle and 3-AFC

Example:

If sample size = 40

Number correct needed = 19

Which cookie is most (least) bitter?



Correct	Incorrect	Total
25	15	40

New Cookie found to be more bitter

Which cookie is different?



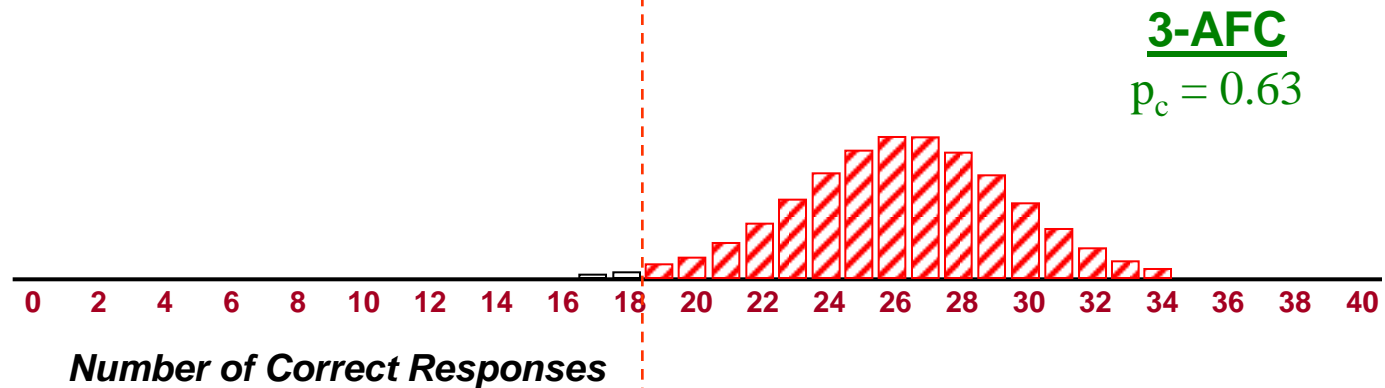
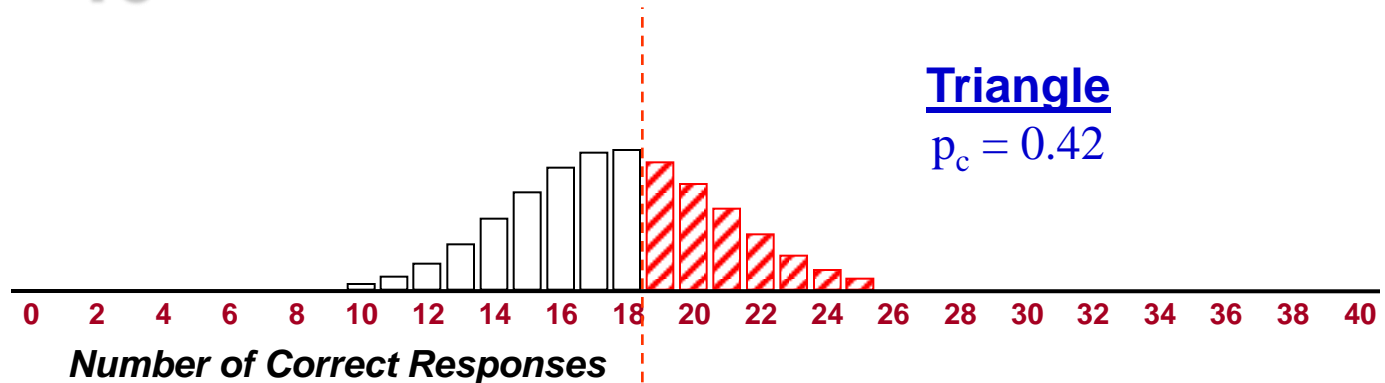
Correct	Incorrect	Total
17	23	40

New Cookie not found to be different

n	0	1	2	3	4	5	6	7	8	9
10	7	7	8	8	9	9	10	10	11	11
11	7	12	12	12	13	13	14	14	15	15
12	7	16	16	17	17	17	18	18	19	19
13	7	20	20	20	21	21	22	22	23	23
14	7	24	24	24	25	25	26	26	27	27
15	7	27	28	28	29	29	29	30	30	31
16	7	31	31	32	32	33	33	34	34	34
17	7	35	35	35	36	36	37	37	38	38
18	7	38	39	39	40	40	41	41	41	42
19	7	42	43	43	43	44	44	45	45	46
20	7	46	46	47	47	48	48	48	49	49
21	7	50	50	50	51	51	52	52	53	53
22	7	53	54	54	54	55	55	56	56	57
23	7	57	57	58	58	58	59	59	60	60
24	7	61	61	62	62	62	63	63	63	64
25	7	64	65	65	65	66	66	67	67	67
26	7	68	68	69	69	69	70	70	71	71
27	7	71	72	72	73	73	74	74	74	75
28	7	75	75	76	76	77	77	78	78	78
29	7	79	79	79	80	80	81	81	82	82
30	7	82	83	83	83	84	84	85	85	86
31	7	86	86	87	87	88	88	88	89	89
32	7	90	90	90	91	91	92	92	92	93
33	7	93	93	94	94	95	95	96	96	96
34	7	97	97	97	98	98	99	99	100	100
35	7	100	101	101	101	102	102	103	103	103
36	7	104	104	105	105	105	106	106	107	107
37	7	107	108	108	108	109	109	110	110	111
38	7	111	111	112	112	112	113	113	114	114
39	7	115	115	115	116	116	116	117	117	118
40	7	118	118	119	119	119	120	120	121	121
41	7	122	122	122	123	123	123	124	124	125
42	7	125	126	126	126	127	127	128	128	128
43	7	129	129	129	130	130	131	131	132	132
44	7	132	133	133	133	134	134	135	135	135
45	7	136	136	137	137	137	138	138	139	139
46	7	139	140	140	140	141	141	141	142	143
47	7	143	143	144	144	144	145	145	146	146
48	7	146	147	147	147	148	148	149	149	150
49	7	150	150	151	151	151	152	152	153	153
50	7	153	154	154	155	155	155	156	156	157
51	7	157	157	158	158	158	159	159	160	160
52	7	161	161	161	162	162	162	163	163	164
53	7	164	164	165	165	165	166	166	167	167
54	7	168	168	168	169	169	169	170	170	171
55	7	171	171	172	172	172	173	173	174	174
56	7	175	175	175	176	176	176	177	177	178
57	7	178	178	179	179	179	180	180	181	181
58	7	182	182	182	183	183	183	184	184	185
59	7	185	185	186	186	186	187	187	188	188
60	7	189	189	189	190	190	190	191	191	192
61	7	192	192	193	193	194	194	194	195	195
62	7	196	196	196	197	197	197	198	198	199

Relative Power of the Triangle and 3-AFC

N = 40



Criterion = 19

Cost Consideration: Sample Size



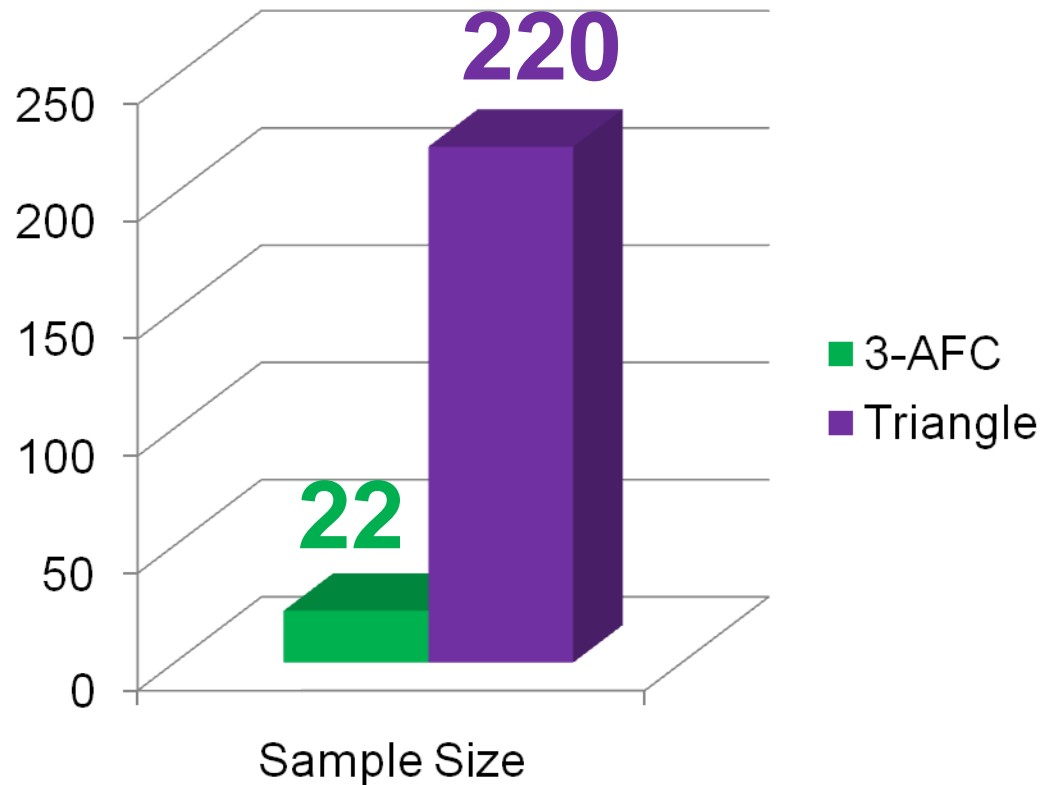
Scenario

➤ **Size of the difference:**

76:24 in a 2-AFC

➤ **Power:** 80% chance of detecting difference

➤ **α level:** 5%



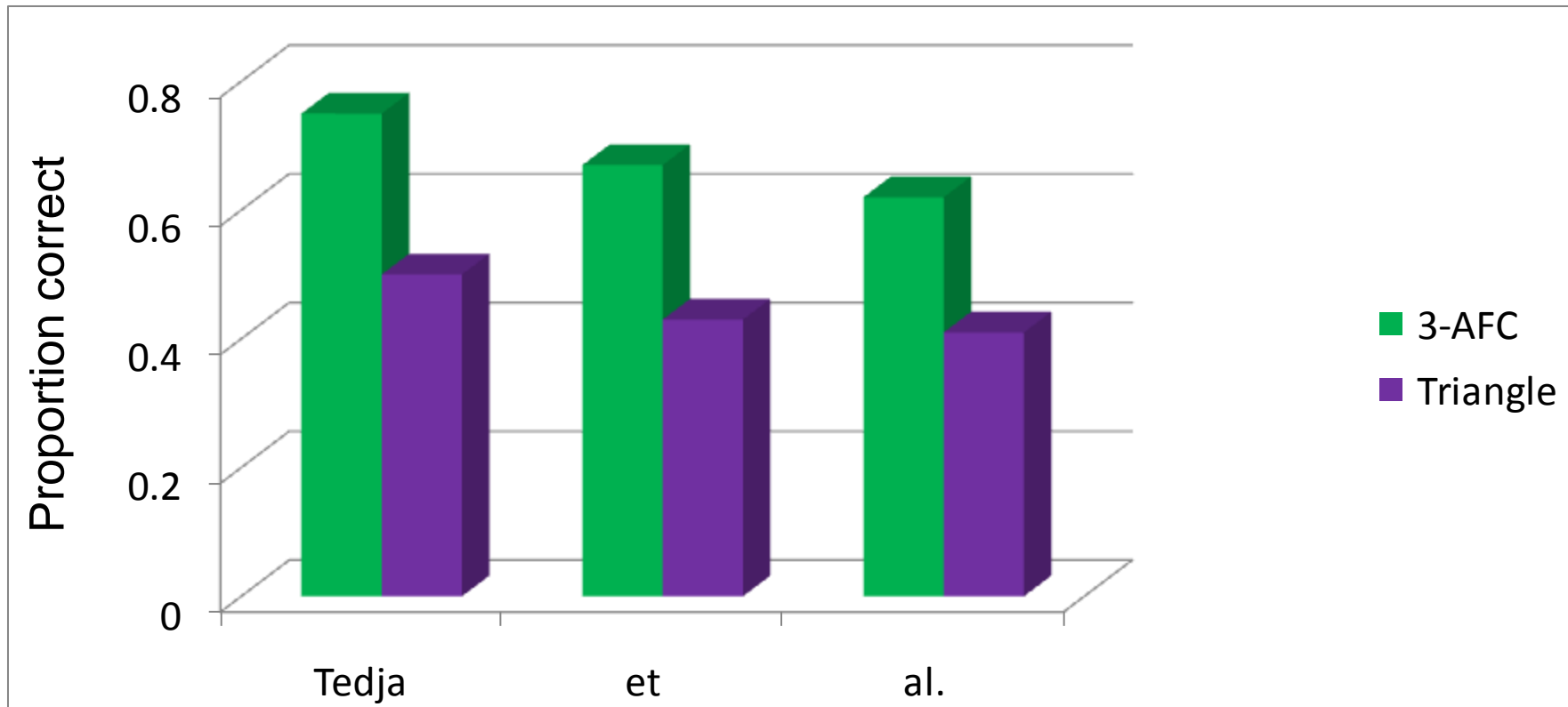
Consequence:

Low power leads to increased cost

But why is 3-AFC more powerful than Triangle?

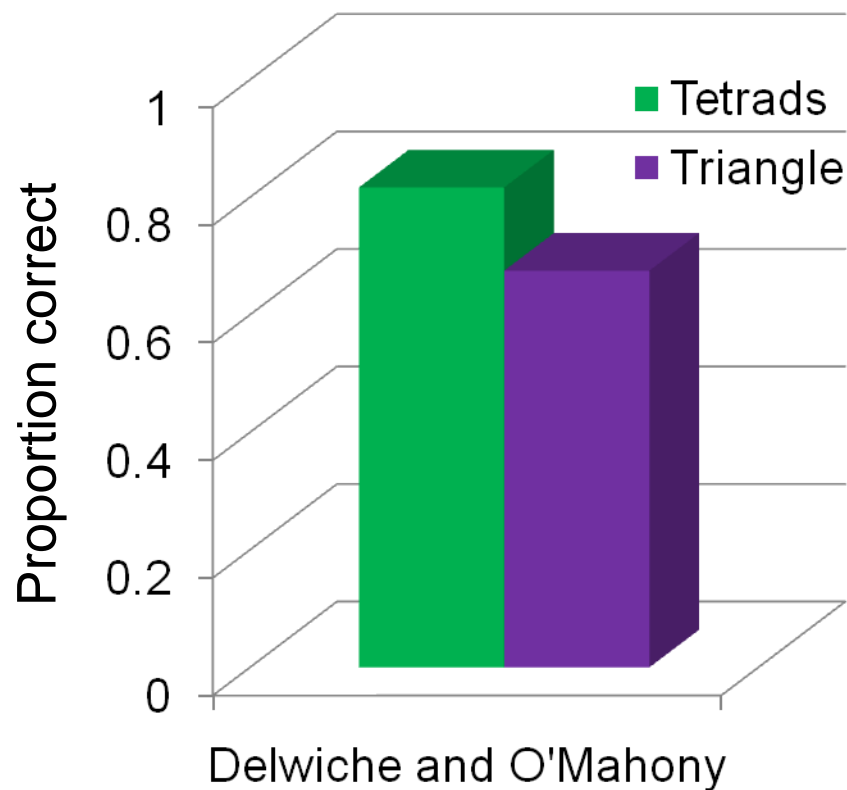
Observation 1

- Gridgeman's paradox occurs even when respondents know attribute of difference
- Example: Tedja et al. (1994) – Salt solution evaluations

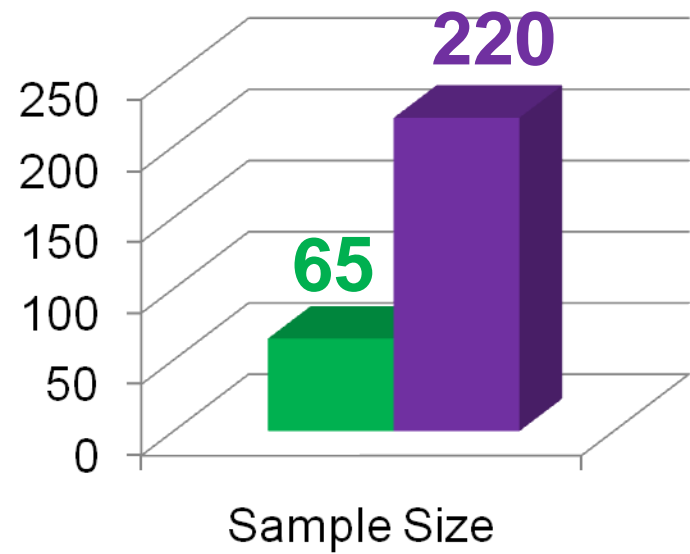


Observation 2

- Triangle has less power than other unspecified methods
- Example: Delwiche and O'Mahony (1996) – Tetrads

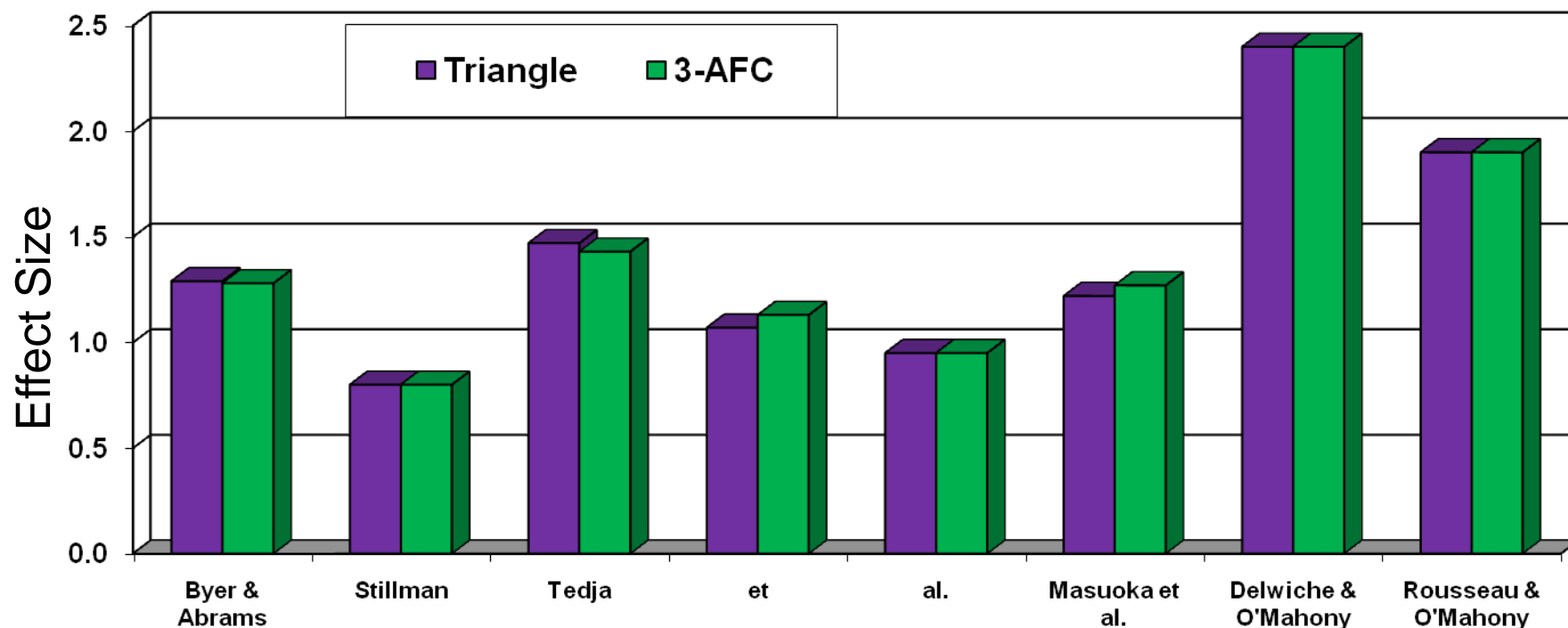


Sample sizes required for 80% power in previous scenario with $\alpha = 0.05$



Observation 3

- Gridgeman's paradox is resolved by finding an underlying measure of effect size (Frijters 1979)

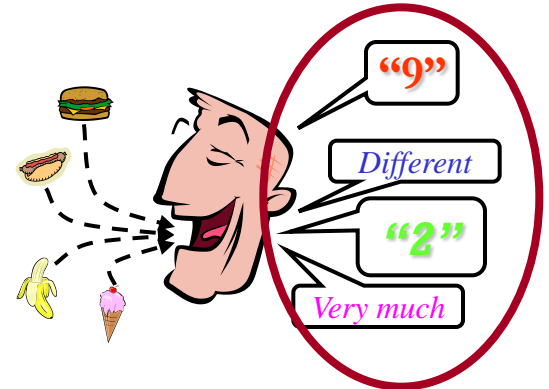


Thurstonian Theory

Methods of analysis

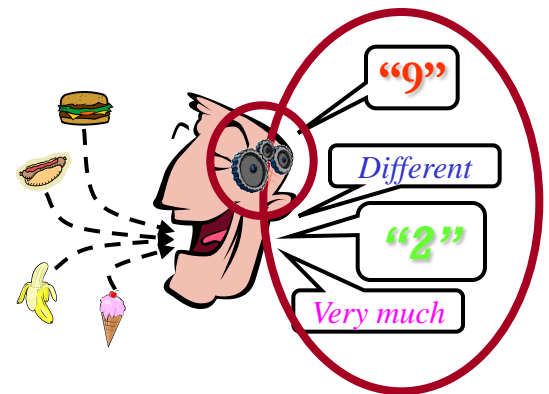
➤ Response based analysis

- ❖ Binomial
- ❖ Analysis of variance
- ❖ ...

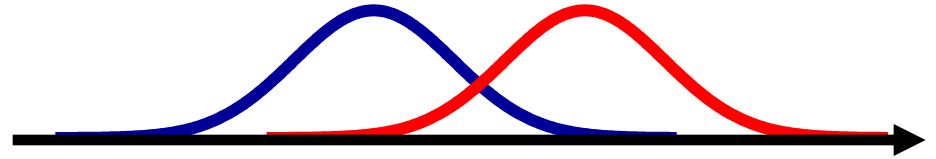


➤ Thurstonian, decision rule based analysis

- ❖ Models the mental process



Thurstonian Models



Two main assumptions :

- **Variability**

Distribution Assumption

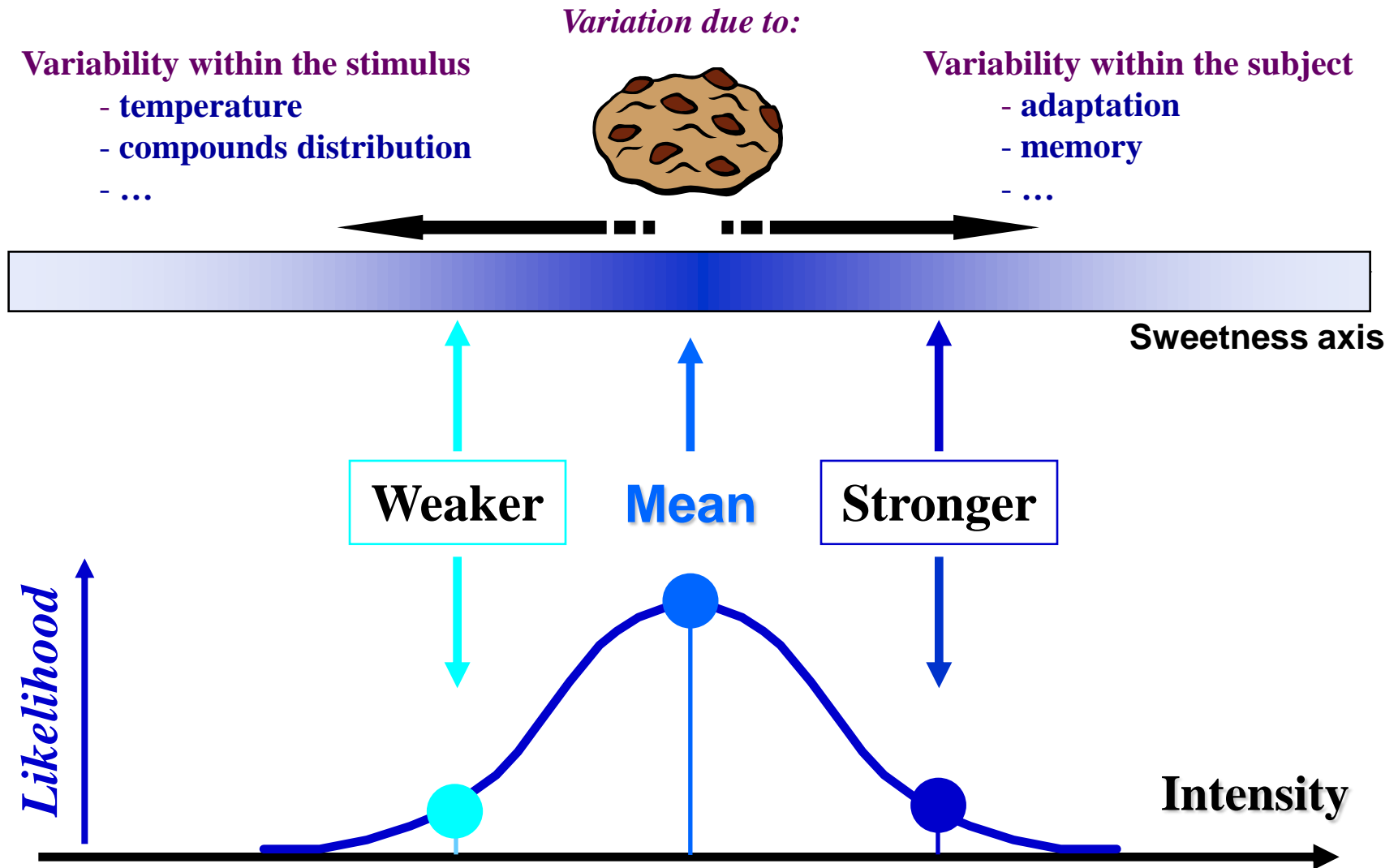
- **Behavior**

Decision Rule Assumption

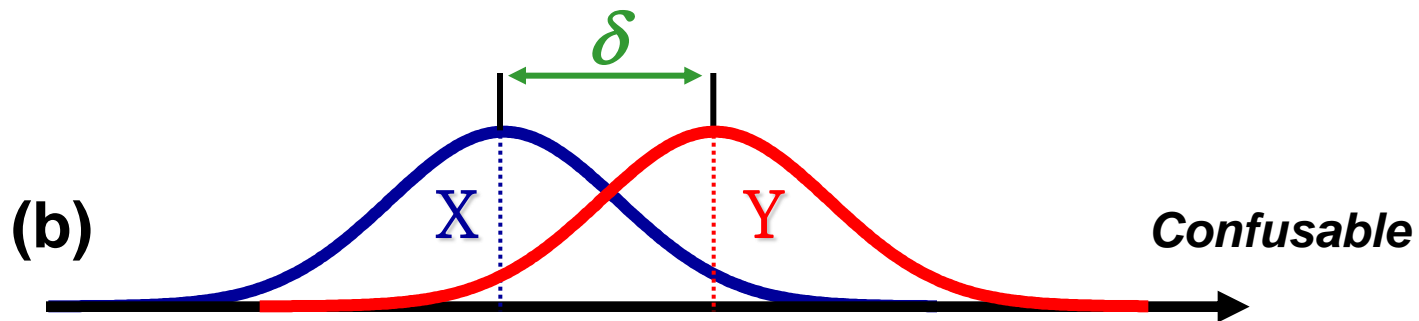
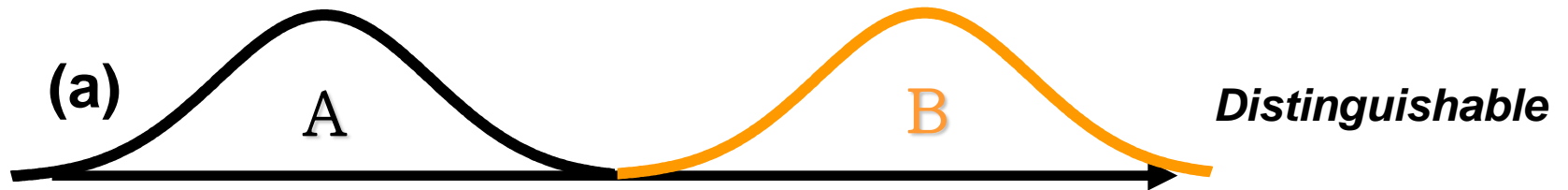
Variability

Distribution Assumption

Distribution Assumption



Distribution Assumption



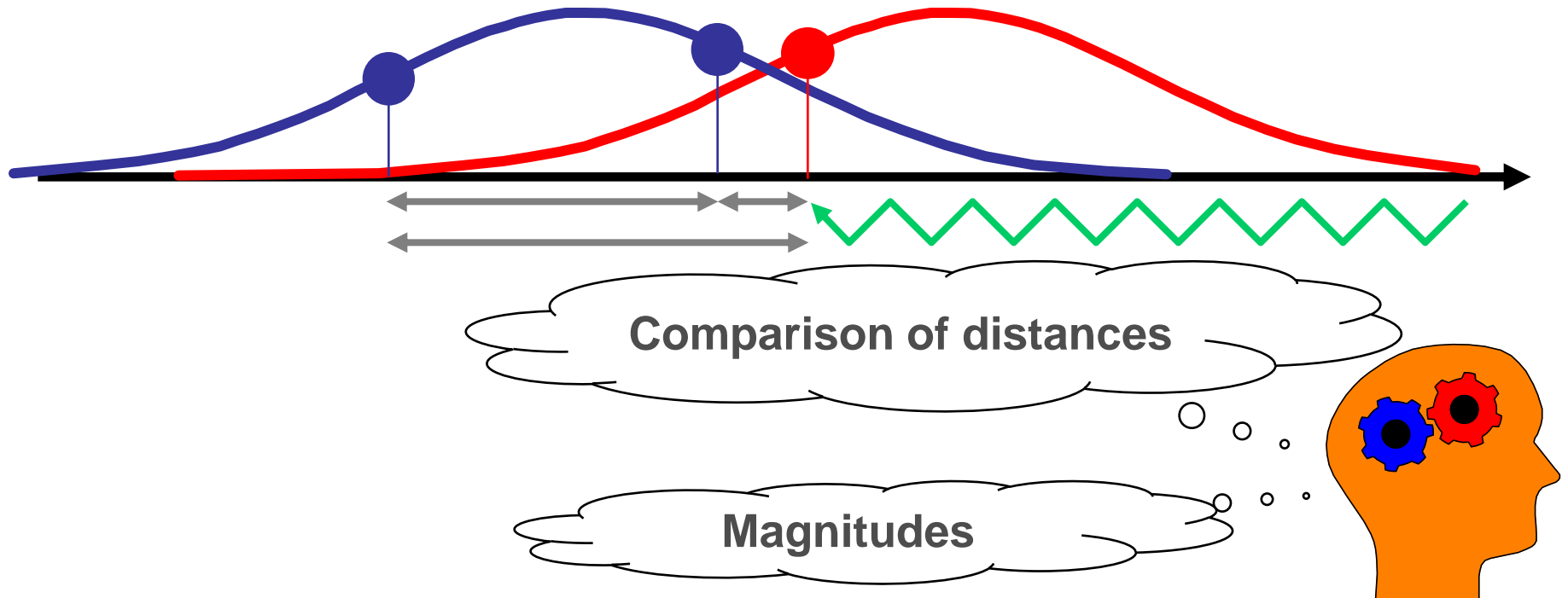
δ = Distance between the means

d' = Experimental estimate of δ

Behavior

Decision Rule Assumption

Decision Rules



Comparison of distances	Magnitudes
Triangle, Duo-trio, Unspecified tetrads, ...	2-AFC, 3-AFC, Specified tetrads, ...

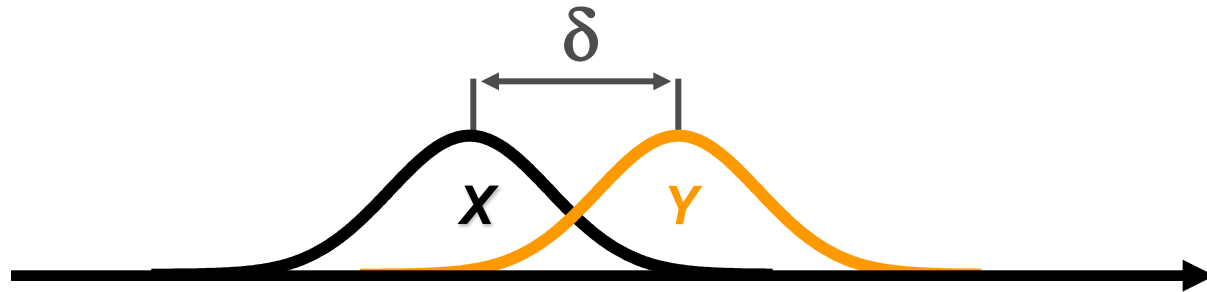
2-Alternative Forced Choice (2-AFC) Method



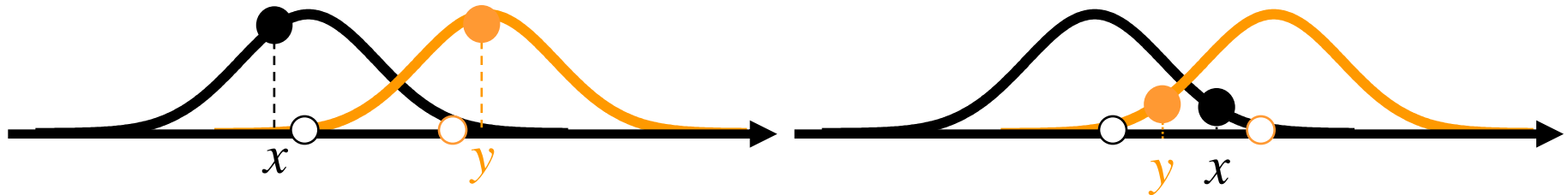
Total: 2 presentation orders
AB, BA

“Choose the stimulus with the stronger (or weaker) sensory magnitude”

Decision Rule: 2-AFC



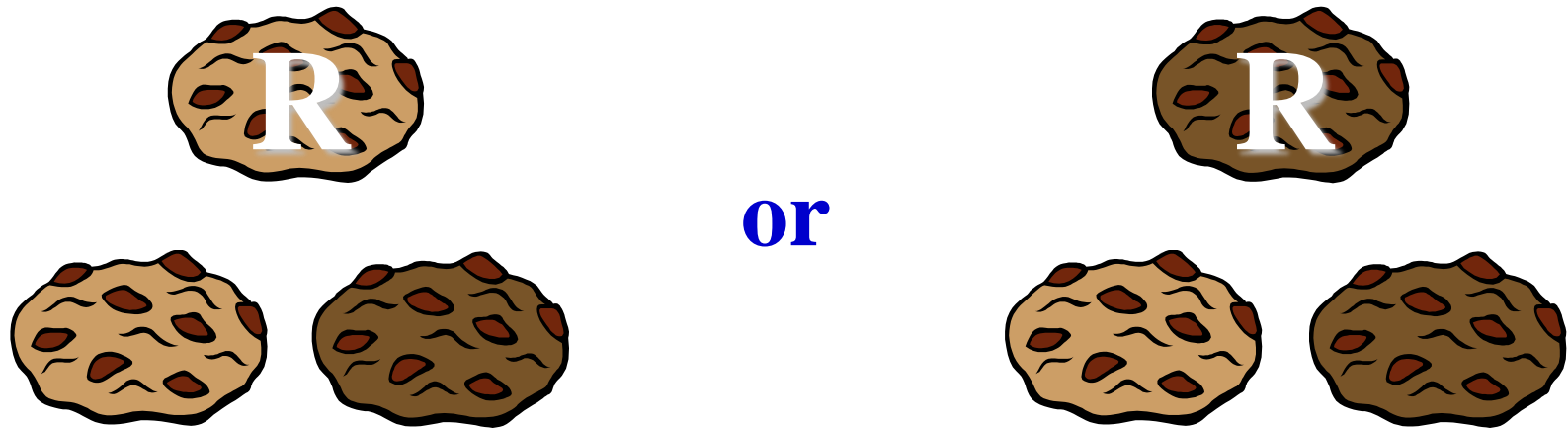
2-AFC method



$y > x$
Correct

$y < x$
Incorrect

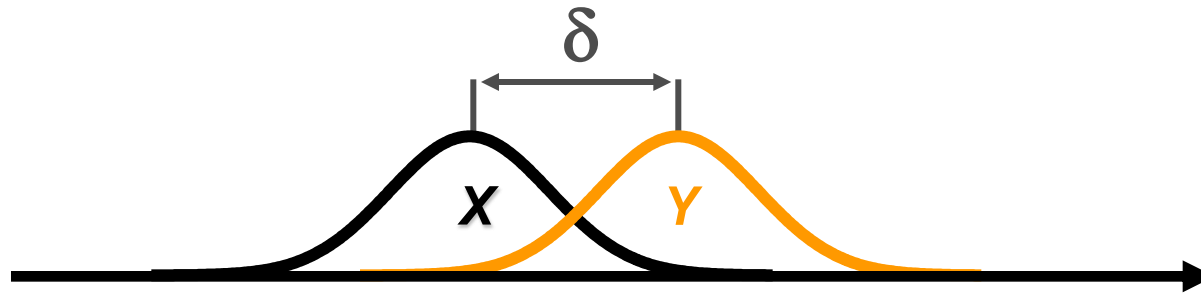
Duo-Trio Method



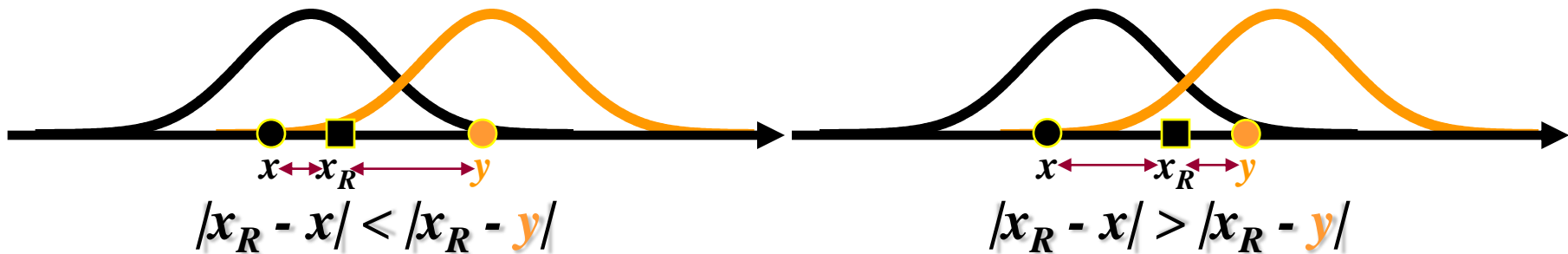
Total: 4 presentation orders
 $A_R AB, A_R BA, B_R AB, B_R BA$

“Choose the one (of two) stimuli more similar to the reference”

Decision Rule: Duo-Trio



Duo-trio method



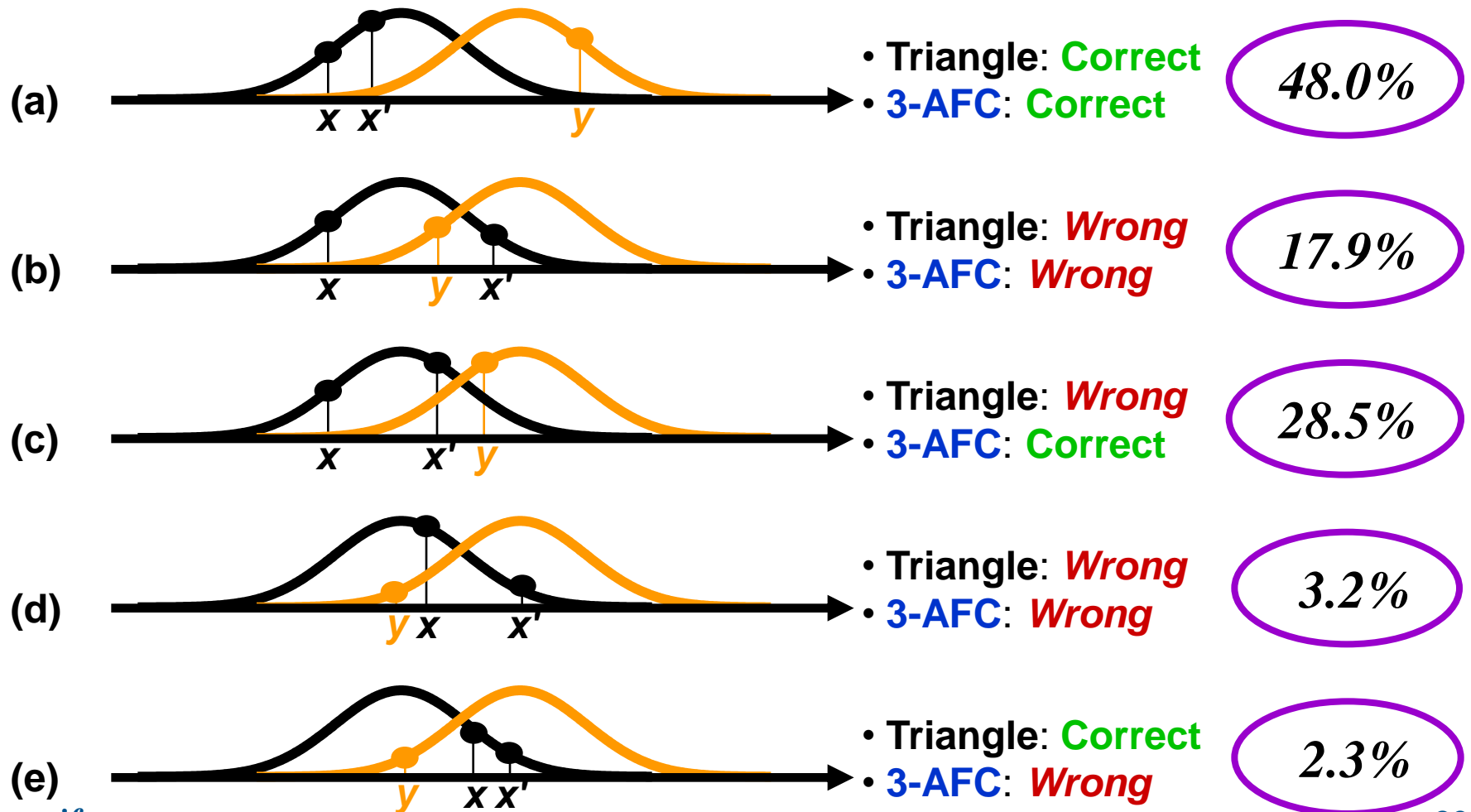
Correct

Incorrect

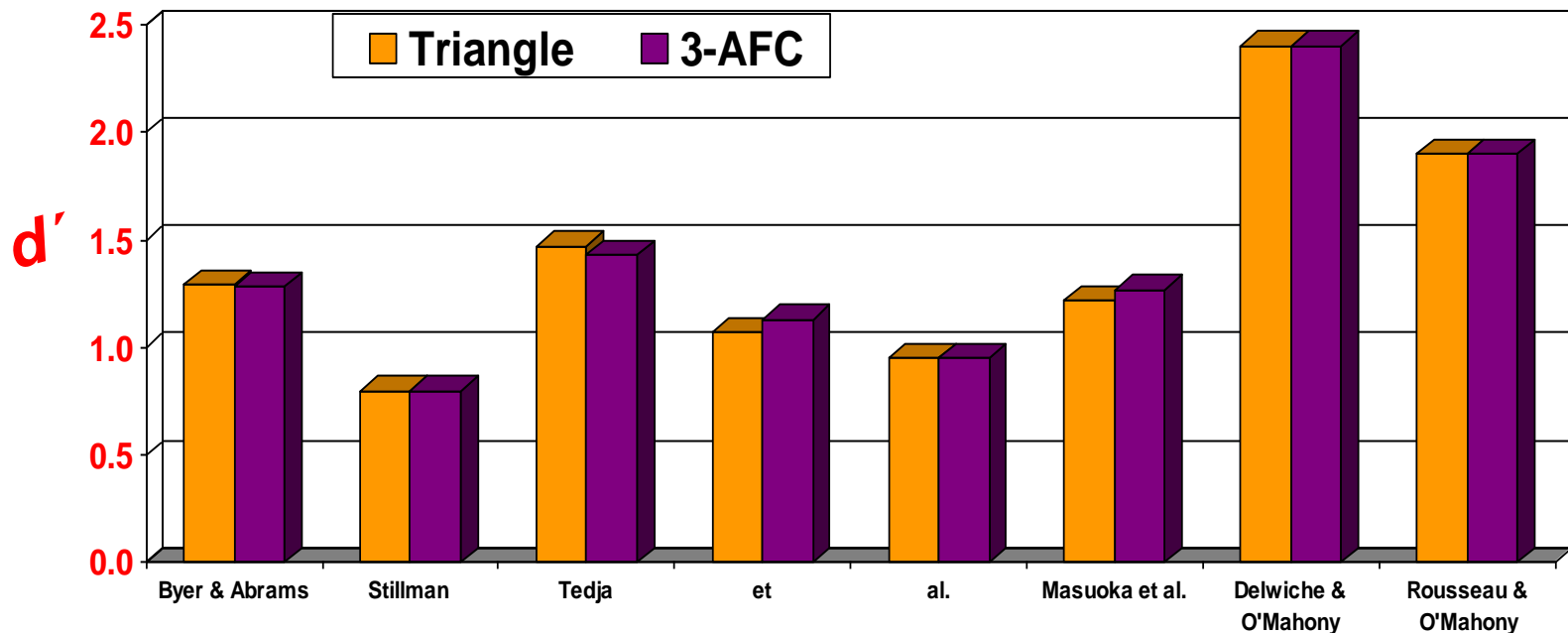
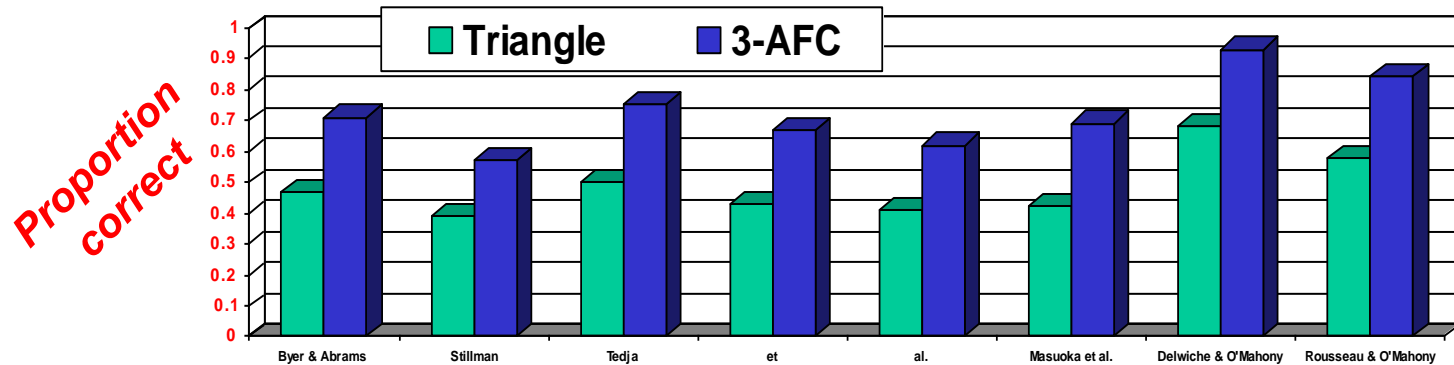
- Each sensory protocol (duo-trio, triangle, 2-AFC, ratings, preference, ...) has its own specific decision rule

Gridgeman's Paradox Revisited

Discrepancy between Triangle Test and 3-AFC?

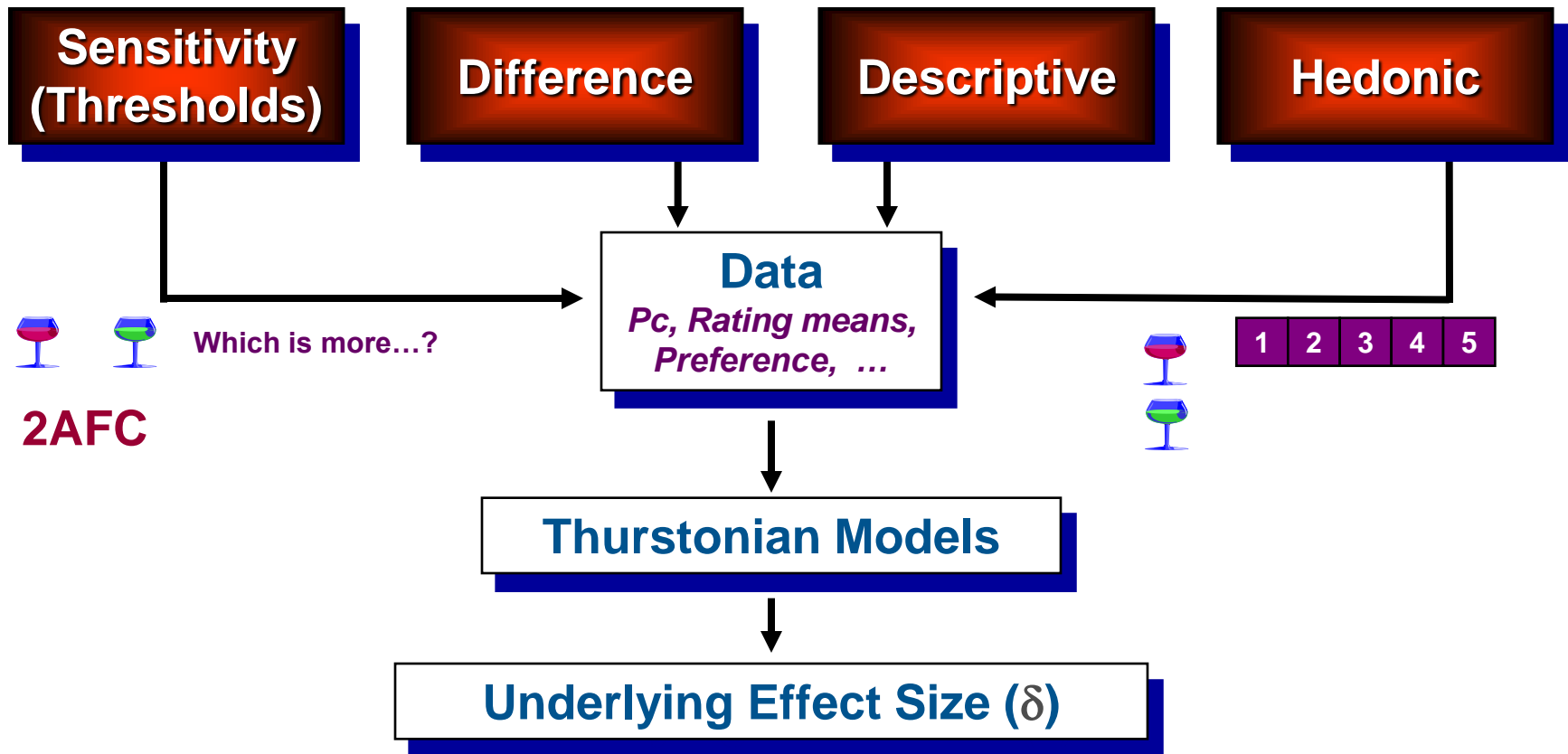


Gridgeman's Paradox Resolved



A Unifying Framework

Linking Results of Methods to Sensory Information





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