The Institute for Perception

ASTM Fall 2015
Power and Precision in Sensory Difference Testing

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Sensory Difference Testing

- Sensory difference testing is as important as ever:
  - Compliance with health initiatives
  - Cost reductions
  - Changes to ingredients, processes, packaging, handling, etc.
  - Quality control
- Three challenges:
  1. Identify sensitive methods for unspecified testing
  2. Measurement:
     a) Quantify sensory differences
     b) Understand precision in measurement
  3. Determine size of meaningful difference

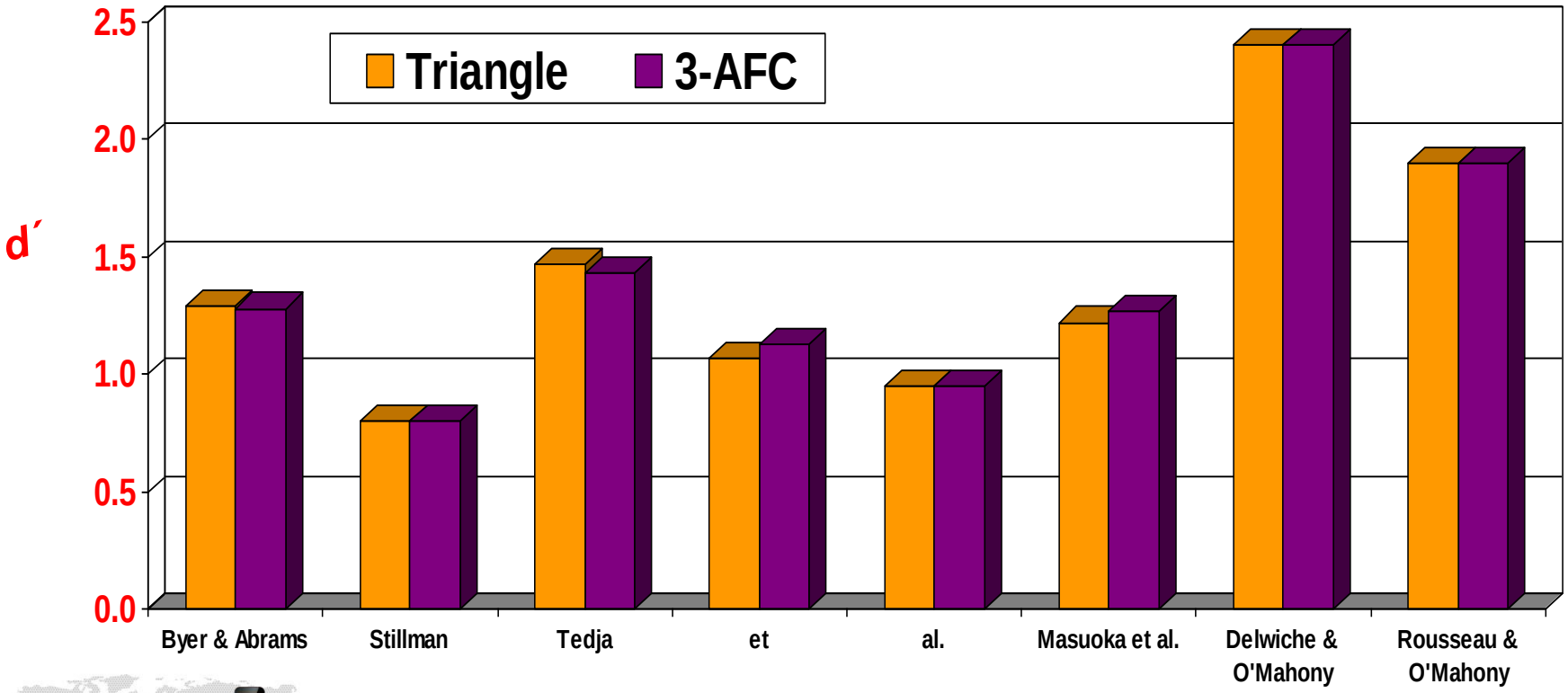
Gridgeman's Paradox

- Difference testing methods do not perform identically
  - Gridgeman (1970)

Study	Product	# Tests	P_C Triangle	P_C 3-AFC
Byer and Abrams, 1953	Bitter solutions	45	47%	71%
Stillman, 1993	Party onion dip	108	39%	57%
Tedja *et al.*, 1994	Salt Solutions	720	50%	75%
		240	43%	67%
		240	41%	62%
Masuoka *et al.*, 1995	Beer	108	42%	69%
Delwiche, O'Mahony, 1996	Chocolate pudding	156	68%	93%
Rousseau, O'Mahony, 1997	Yogurt	180	58%	84%

Resolution of Gridgeman's Paradox

- Using Thurstonian theory, the difference between the Triangle and 3-AFC can be explained

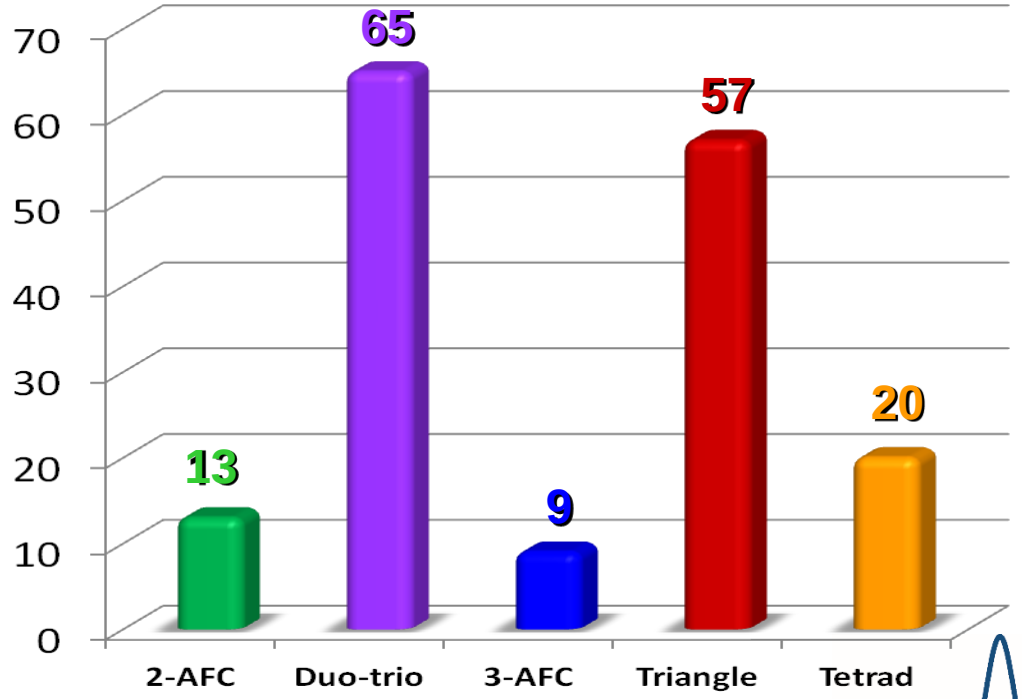


Differences in Difference Testing Methods - Consequences

- Power is the probability of finding a significant difference when two products are actually different
- Differences in methods lead to differences in power and recommended sample sizes

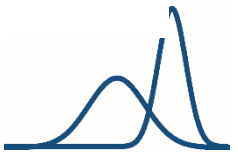
- **Size of the difference**: δ = 1.5
- **Power:** 80%
- **α level**: 5%
- ***Sample sizes needed***

See Ennis & Jesionka (2011) for more information



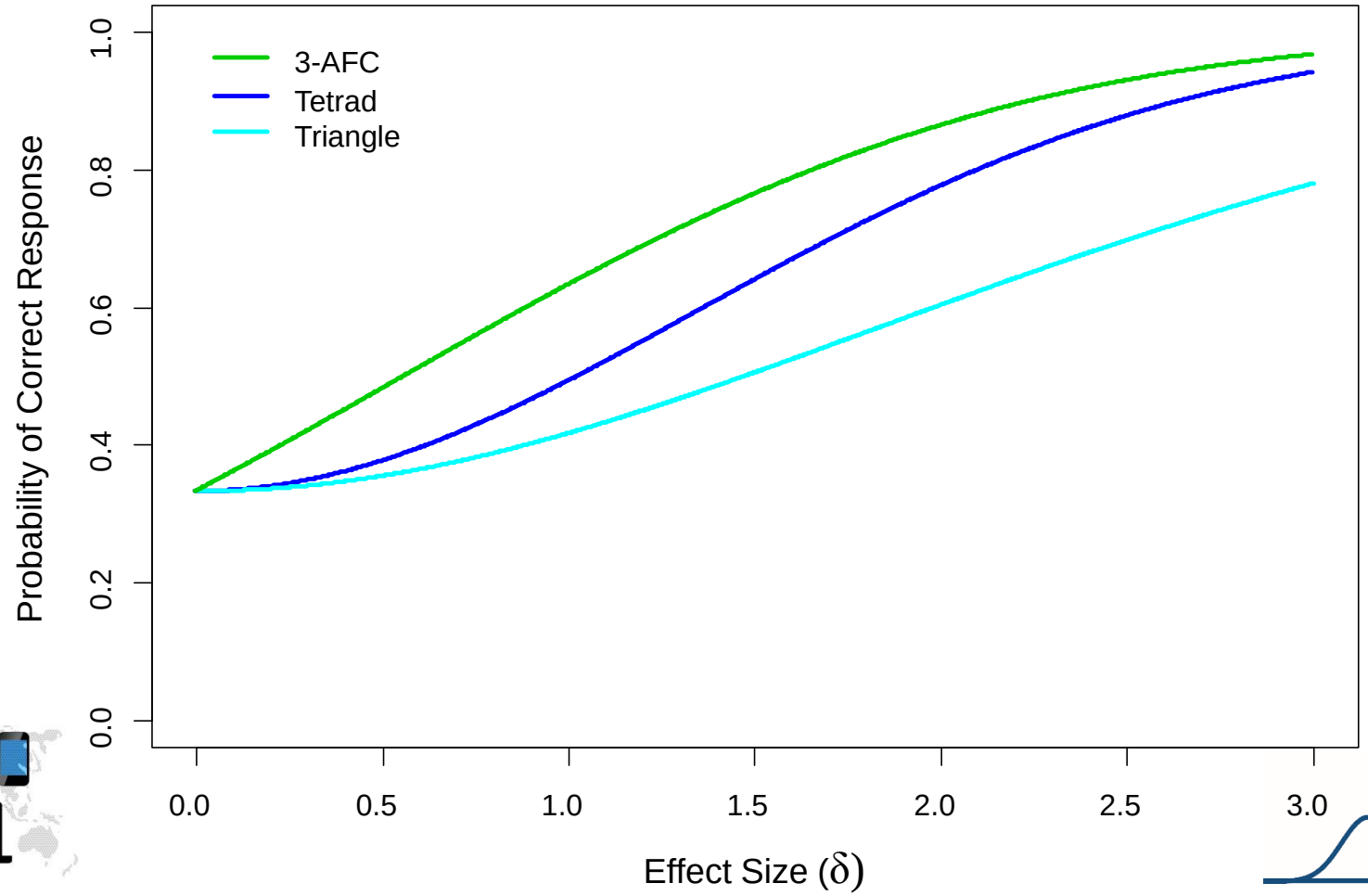
From Power to Precision

- Power has been invaluable to help understand differences in testing methods but the concept of power has limitations:
  - Any difference will be identified as significant given a large enough sample
  - Tests can be “overpowered” - they may reliably detect differences that are too small to be consumer meaningful
- Instead of considering results to be either “significant” or “not significant”, we can instead ask:
  - How large do we estimate the difference to be?
  - How sure are we about our estimate?
  - Is the difference meaningful to consumers?



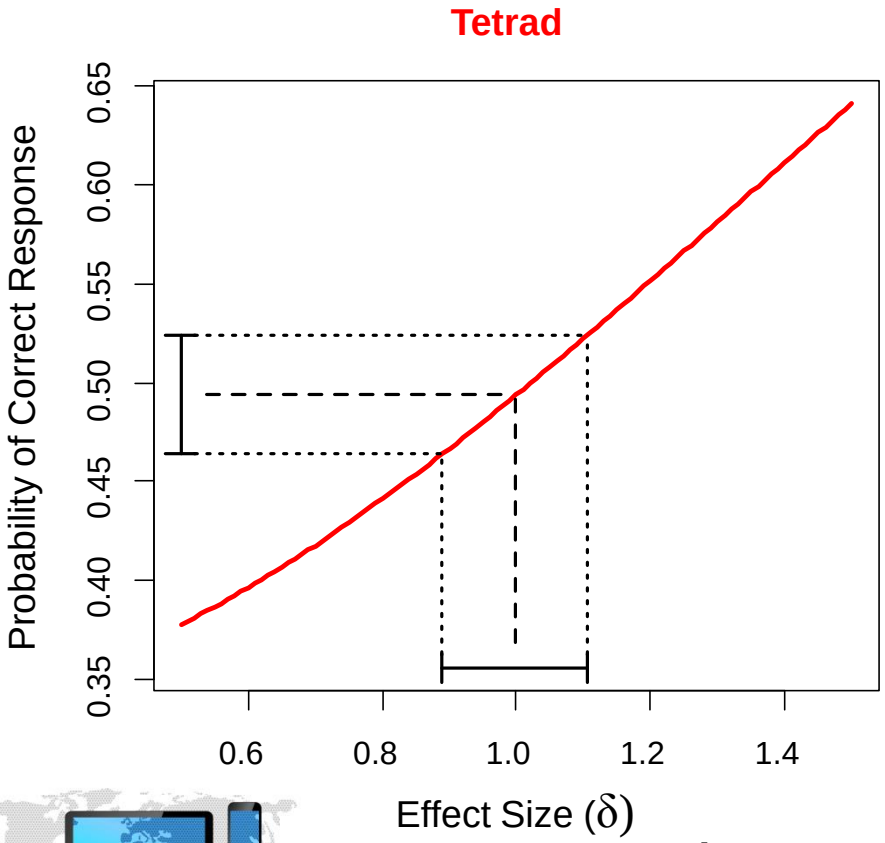
Psychometric Functions

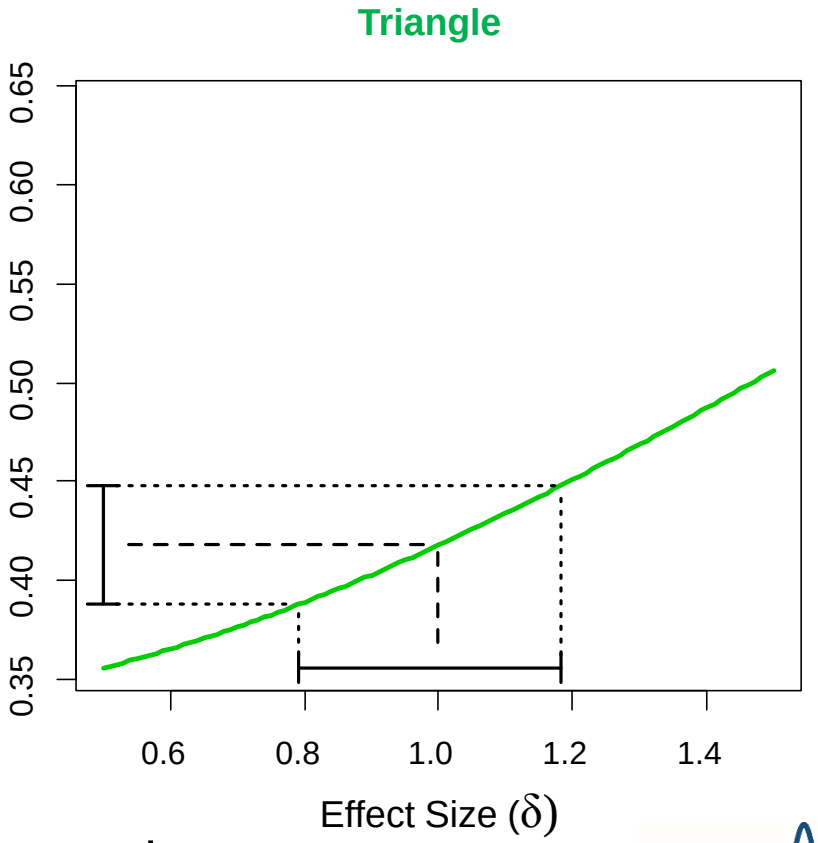
- The relationship between δ and proportion correct is called the psychometric function



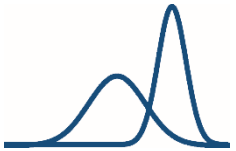
Why Some Methods are More Precise

- The precision of the estimate depends on the shape of the psychometric function



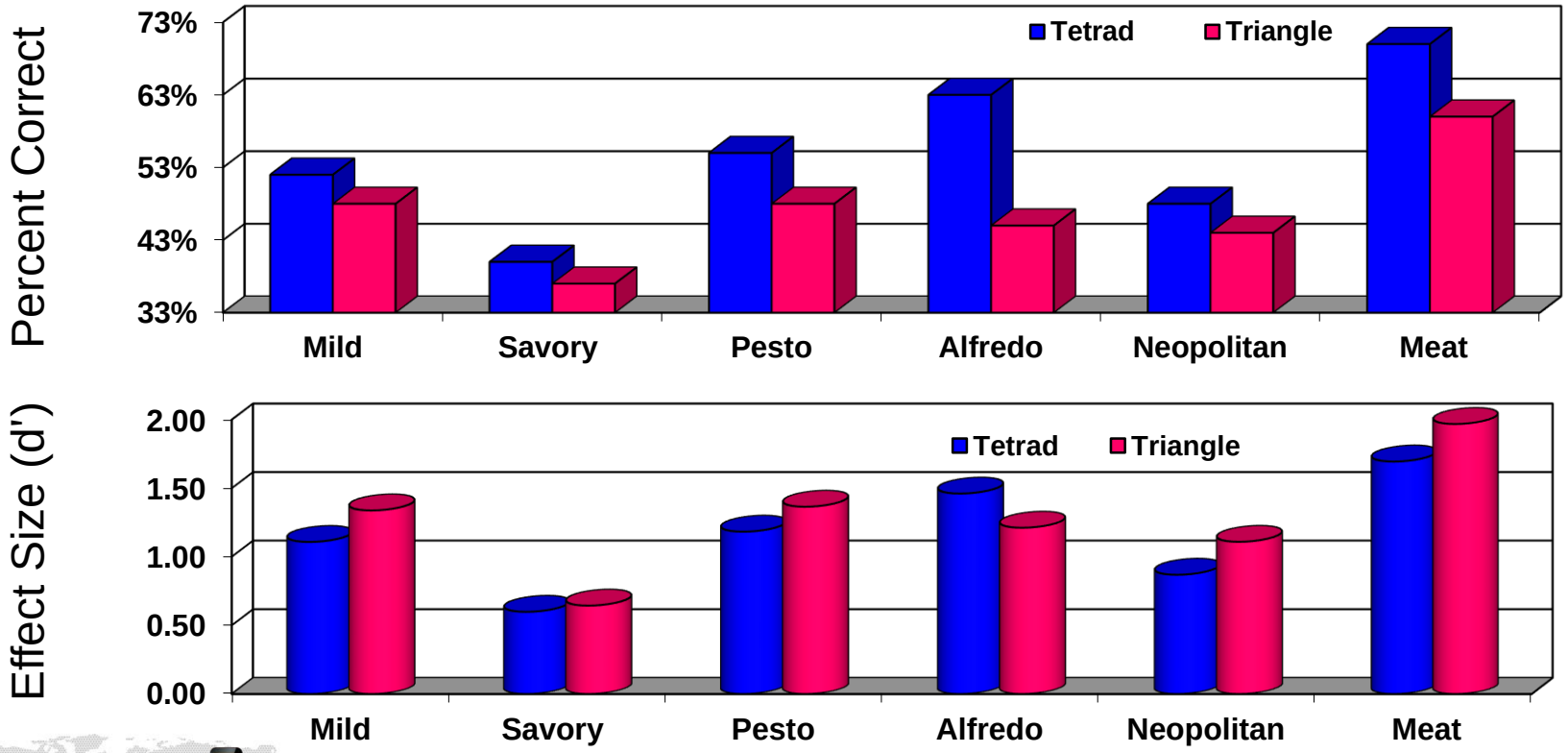


A steeper curve gives greater precision



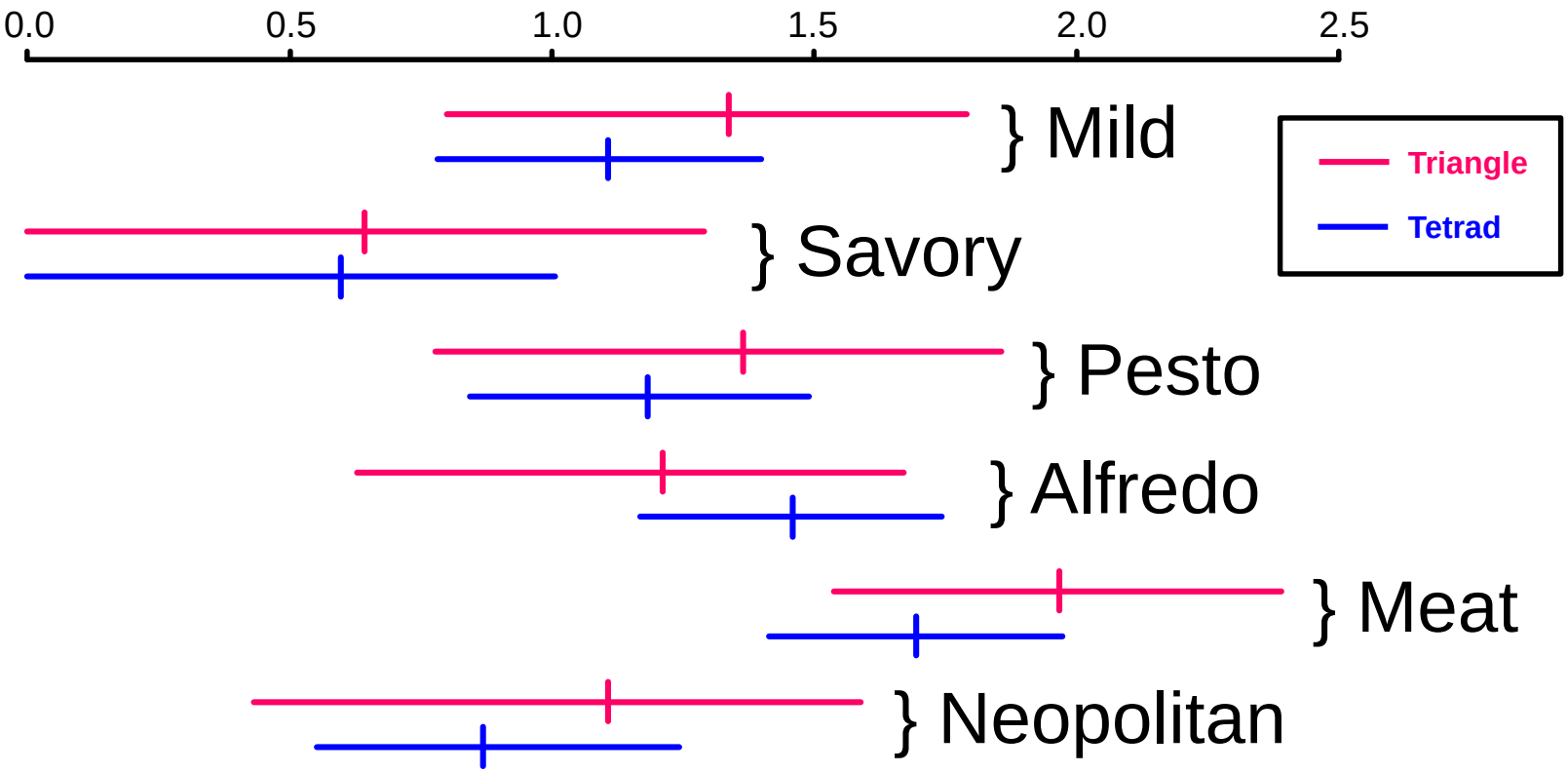
Tetrad vs Triangle Example (1/2)

- Triangle testing currently used for a line of pasta sauces
- Research conducted to compare Triangle and Tetrad tests



Tetrad vs Triangle Example (2/2)

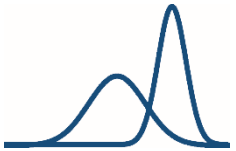
- Confidence intervals for δ:



Tetrad test gives more precise estimate of sensory difference in each case

Summary

- Sensory differences can be measured instead of determined to be simply “significant” or “not significant”
  - Thurstonian scaling provides technology to support measurement
- Once differences are measured, the precision in the measurements must be considered
  - Some methods are more precise than others
- Using a measurement perspective:
  - Difference and equivalence testing can be unified
  - The risk associated with action (or inaction) can be quantified



Thank you for attending!

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