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ELSEVIER

# Sensory Discrimination Testing and Consumer Relevance

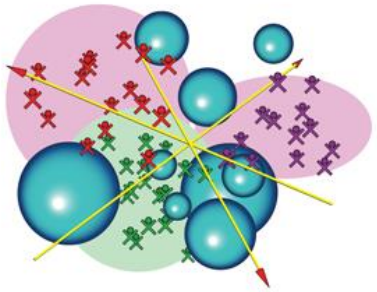
**Benoît Rousseau, Ph.D.**

The Institute for Perception

**Richmond, USA**

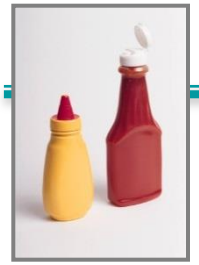
*Benoit.Rousseau@IFPress.com*

***www.ifpress.com***



## Sensory Discrimination Testing and Consumer Relevance

# Background

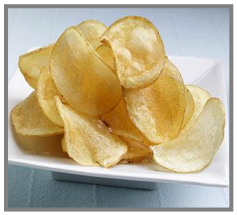


# Why Discrimination Testing?

- Measure the size of the difference between products

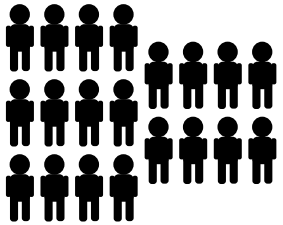
- Two main objectives
  - Prove products are different
    - “New and improved”, “Fresher, crisper taste”

  - Prove products are similar
    - Ingredient change, new supplier, government regulation (e.g., salt or sugar reduction)

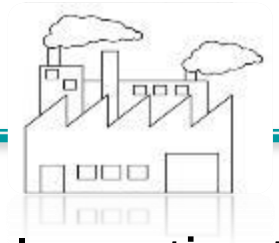


# Case Illustration 1

- A company manufactures lemon based beverages 
- A change of sweetener supplier requires an investigation using discrimination testing (triangle test) 
- 

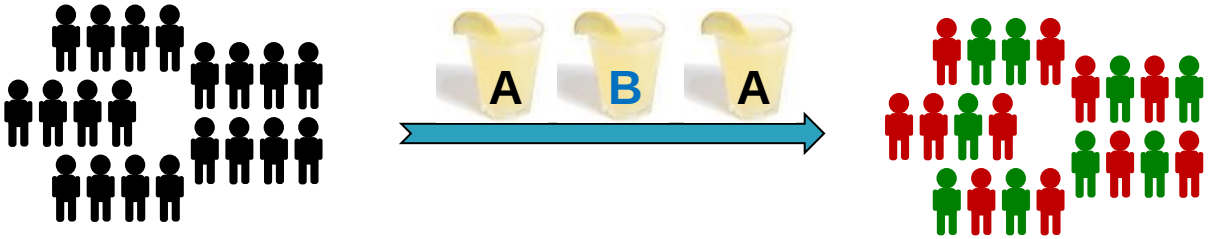
"Which one is different?"
- 20 panelists each performing one triangle test 
- **Binomial test: 11 correct** out of 20 needed to be significant at $p$=0.05

# Case Illustration 1 *(Cont.)*

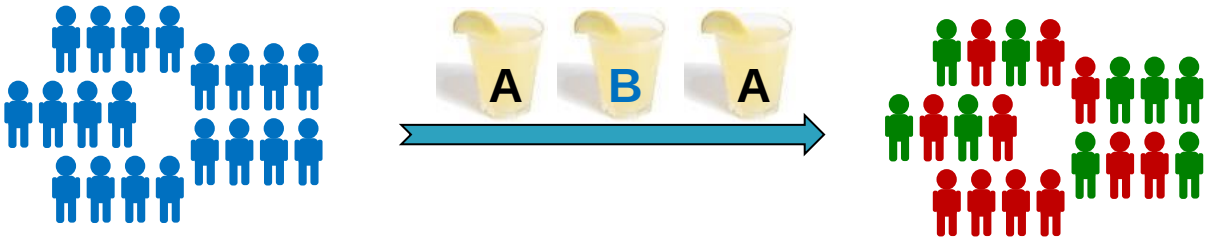


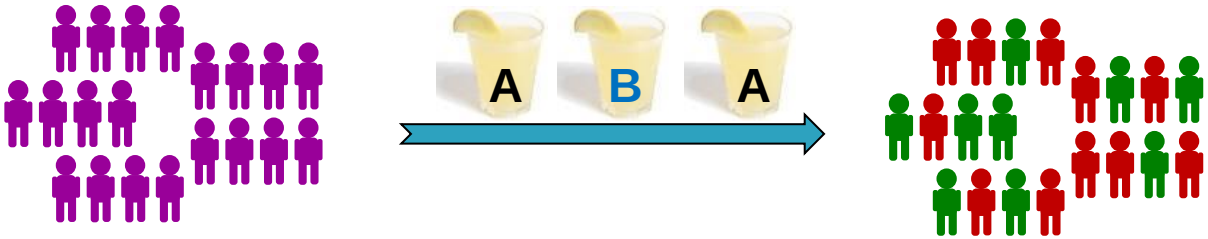
**11 correct / 20 needed**

- Investigation results




- Important project → Repeat the research two more times



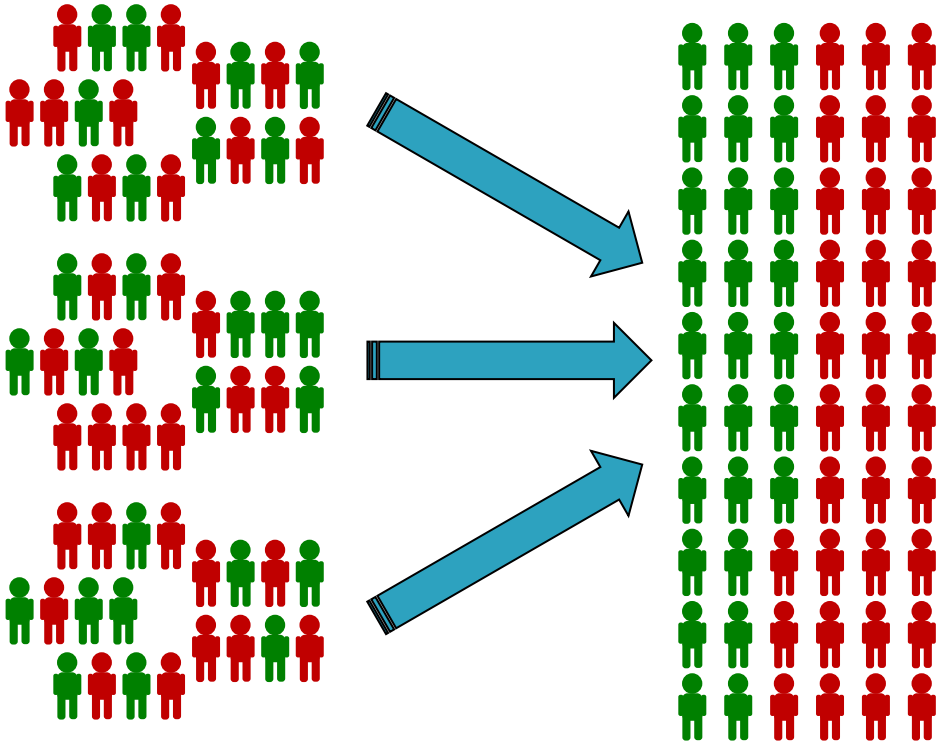




- More confidence that no difference exists

**However…**

# Case Illustration 1 *(Cont.)*

- If results are combined



**27 correct out of 60** → ***p* = 0.04 !**

- Can the team recommend the change?

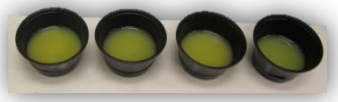
# Case Illustration 2

Ishii, O'Mahony, Rousseau (2014)

- Comparison of apple juices of different concentration
  -  vs. 

    **A** **B**
- Two experimental protocols
  - Discrimination: Tetrad (N=228)

    **A B A B**

    **"Group the four samples into two groups of two identical samples"**
  - Hedonic: Paired preference (N=104)

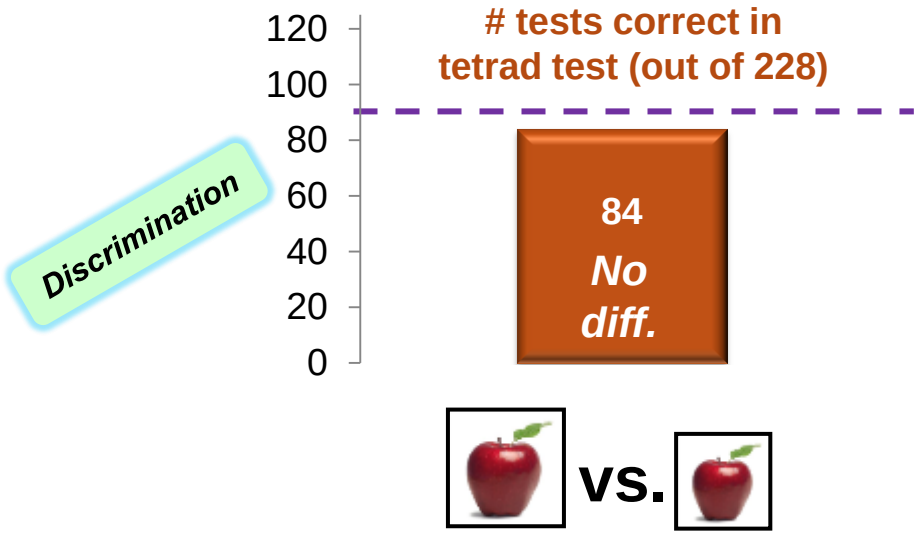
    **A B**

    **"Which sample do you prefer?"**

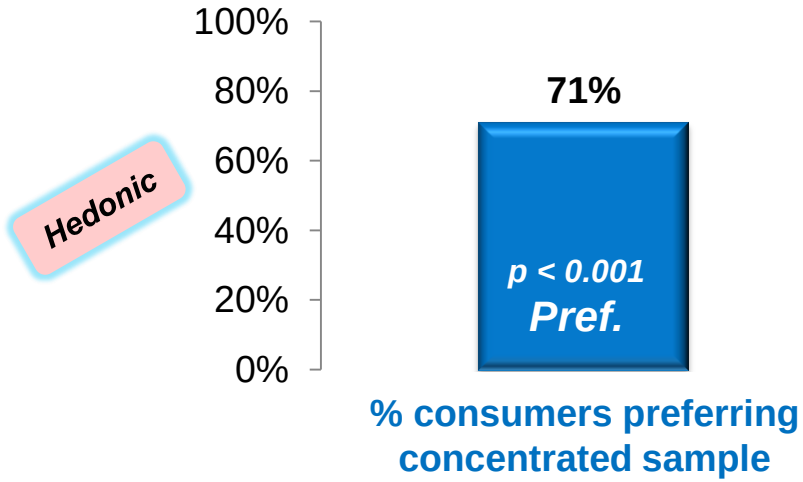
# Case Illustration 2 *(Cont.)*

Ishii, O'Mahony, Rousseau (2014)

- **Results**




*Number of tests correct needed for significance at 5%: 89/228*

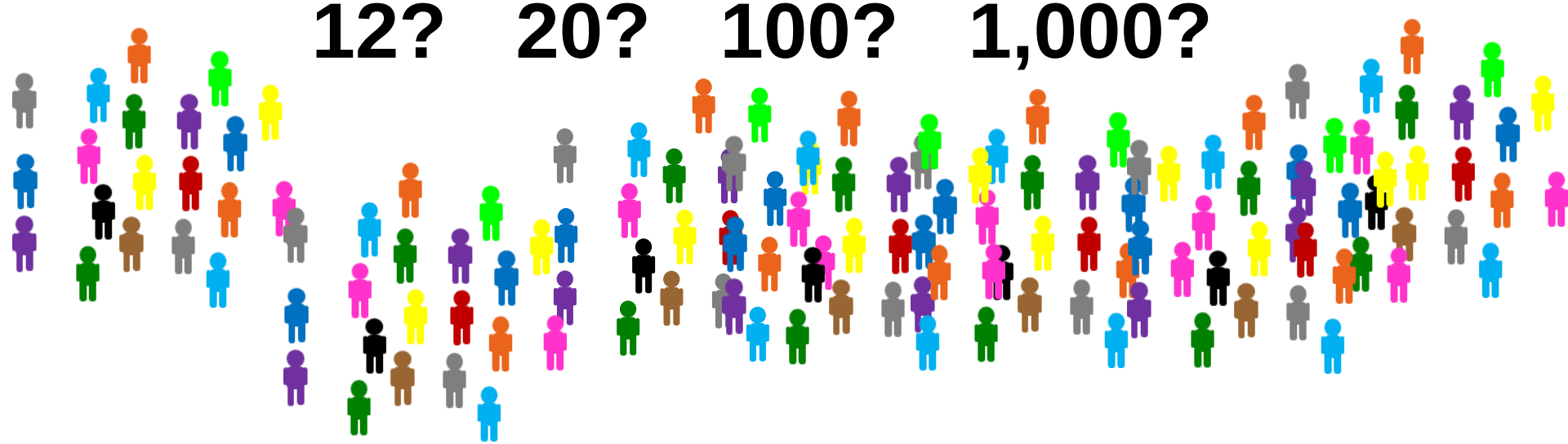



- **How can consumers be unable to discriminate the samples but yet have a preference?**
- **This very common situation is linked to sample size and size of the underlying difference**

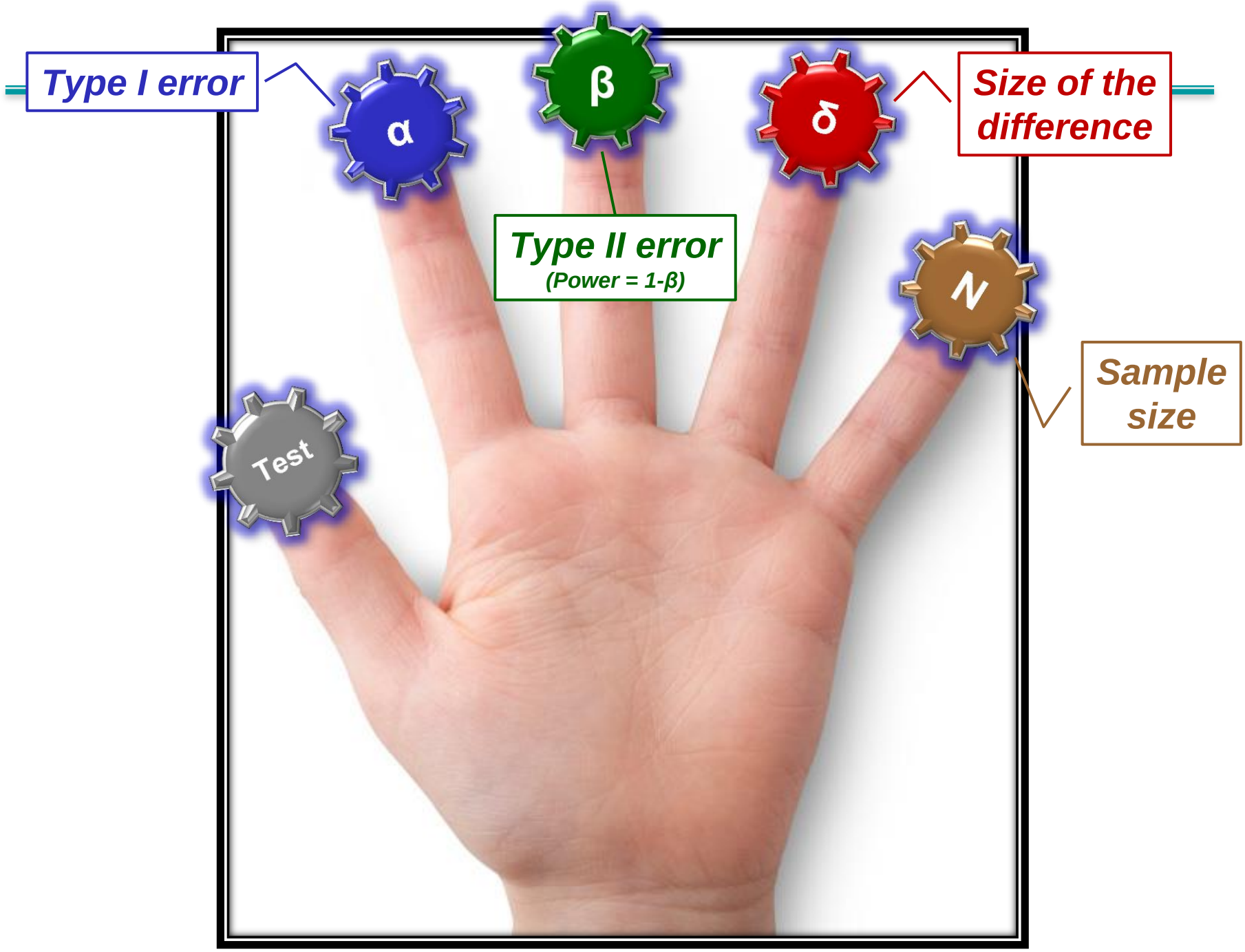
# The Need for Information on Consumer Relevance

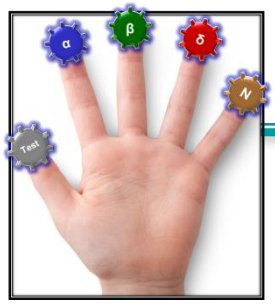
- When studying the similarity of two products, provided that the sample size is large enough, ***a significant result will always be found when using a discrimination test***
- What is the optimal sample size?

**12? 20? 100? 1,000?**



- Optimal sample size can only be set if ***the size of the relevant difference*** is known

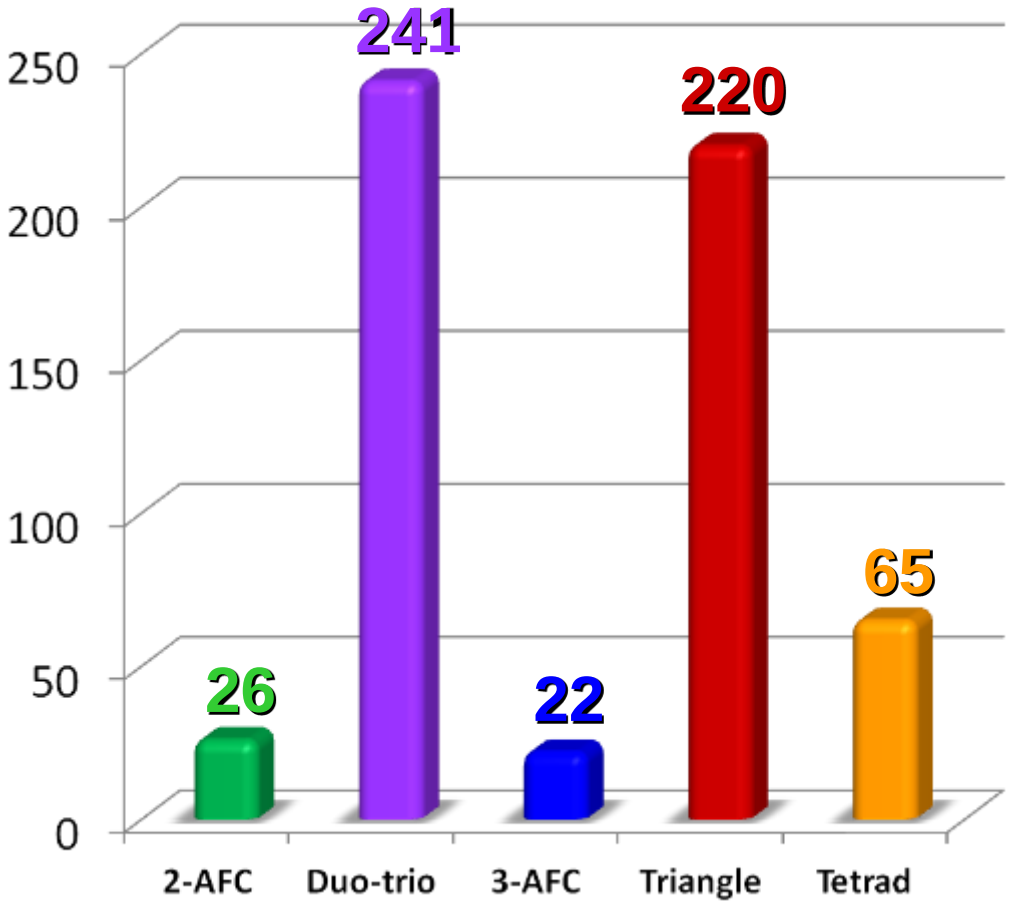

Type I error
α
β
σ
Size of the difference
Type II error
(Power = 1-β)
N
Sample size
Test

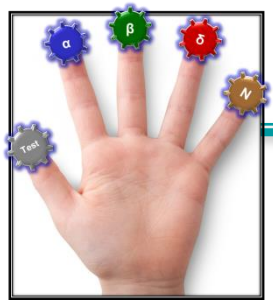



# 5 Factors Relationship (1)

**Scenario 1**

- **Size of the difference**: 76% correct in a 2-AFC *(d' of 1)*
- **Power**: 80% chance of detecting the difference
- **α level**: 5%
- ***Sample size needed*** ➡

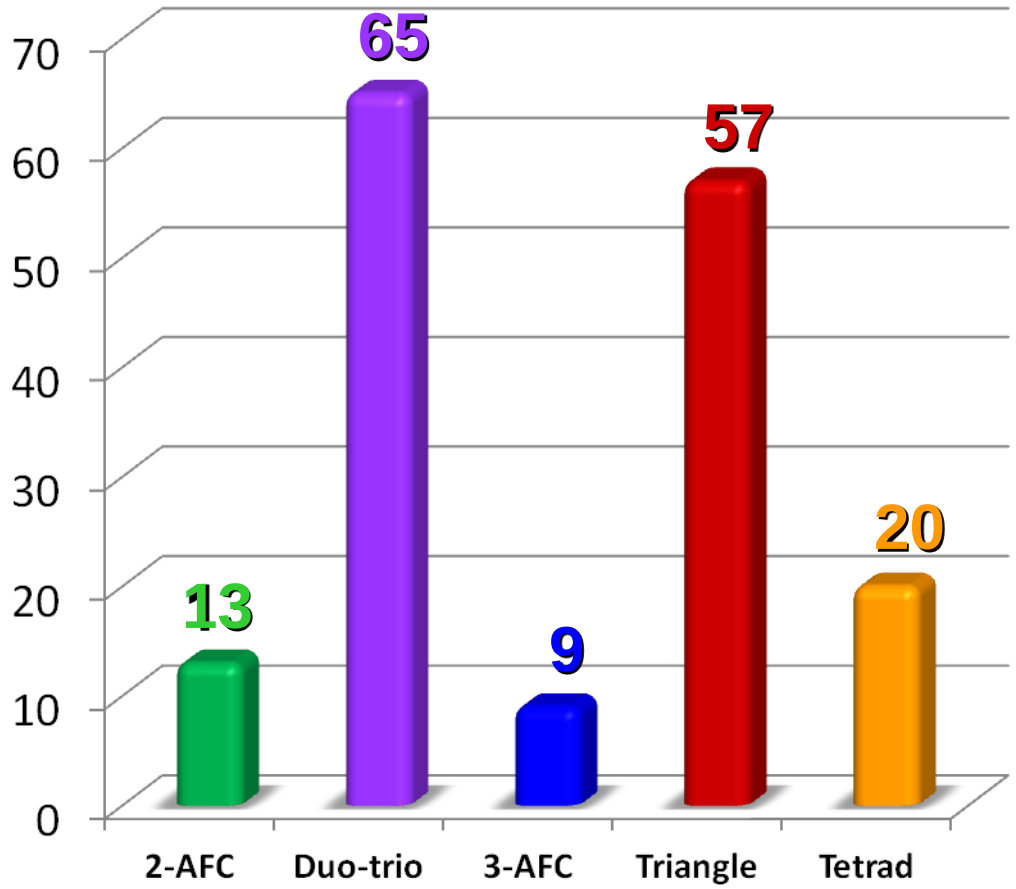





# 5 Factors Relationship (2)

**Scenario 2**

- **Size of the difference**: 86% correct in a 2-AFC *(d' of 1.5)*
- **Power**: 80% chance of detecting the difference
- **α level**: 5%
- ***Sample size needed*** ➡

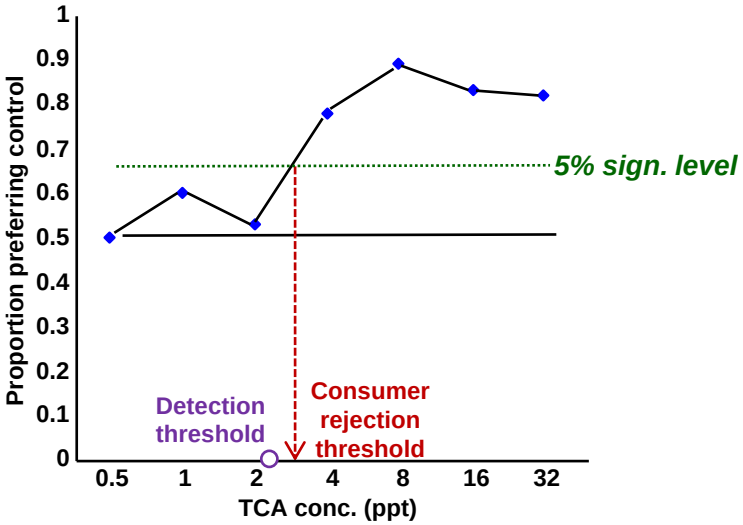


## Sensory Discrimination Testing and Consumer Relevance

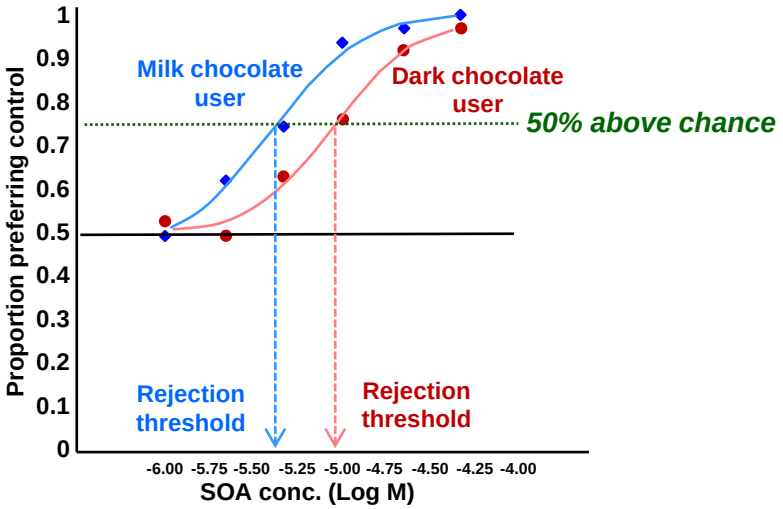
# Consumer Rejection Threshold

# Consumer Rejection Threshold

- Measuring ‘Consumer rejection threshold’ is a way at getting at the relevant **δ**
- Concept introduced by Prescott *et al.* (2005) for cork taint in white wine

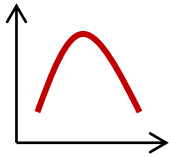



*Adapted from Prescott et al. (2005)*
**Estimating a “consumer rejection threshold” for cork taint in white wine.**
*Food Quality and Preference, 16, 345-349*




*Adapted from Harwood et al. (2012)*
**Rejection thresholds in chocolate milk: Evidence for segmentation.**
*Food Quality and Preference, 26, 128-133*

- This approach requires a way to increase systematically a product defect
- More difficult to use in case of attribute exhibiting satiety

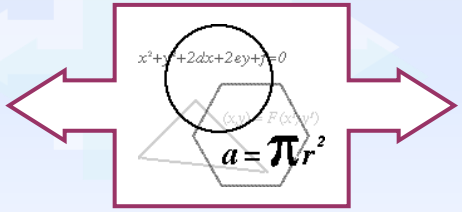


## Sensory Discrimination Testing and Consumer Relevance

# Approaches to set δ

## Sensory Discrimination Testing and Consumer Relevance

# Relating Trained Panel and Consumers' Sensitivities

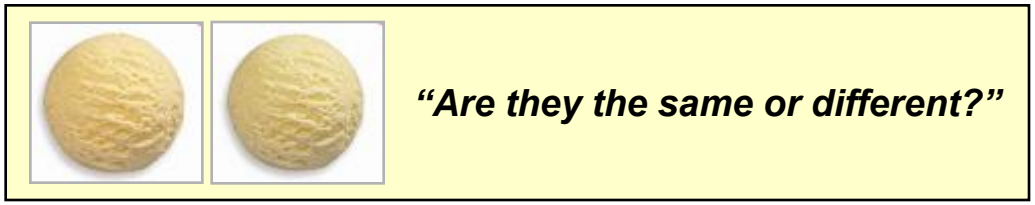



# Relating Trained and Naïve Subjects Sensitivities

- Trained panel testing more efficient and cost effective than consumer panel testing
- Through training, subjects' sensitivity can improve
- Higher sensitivity increases power

# Illustration with Ice Cream Products

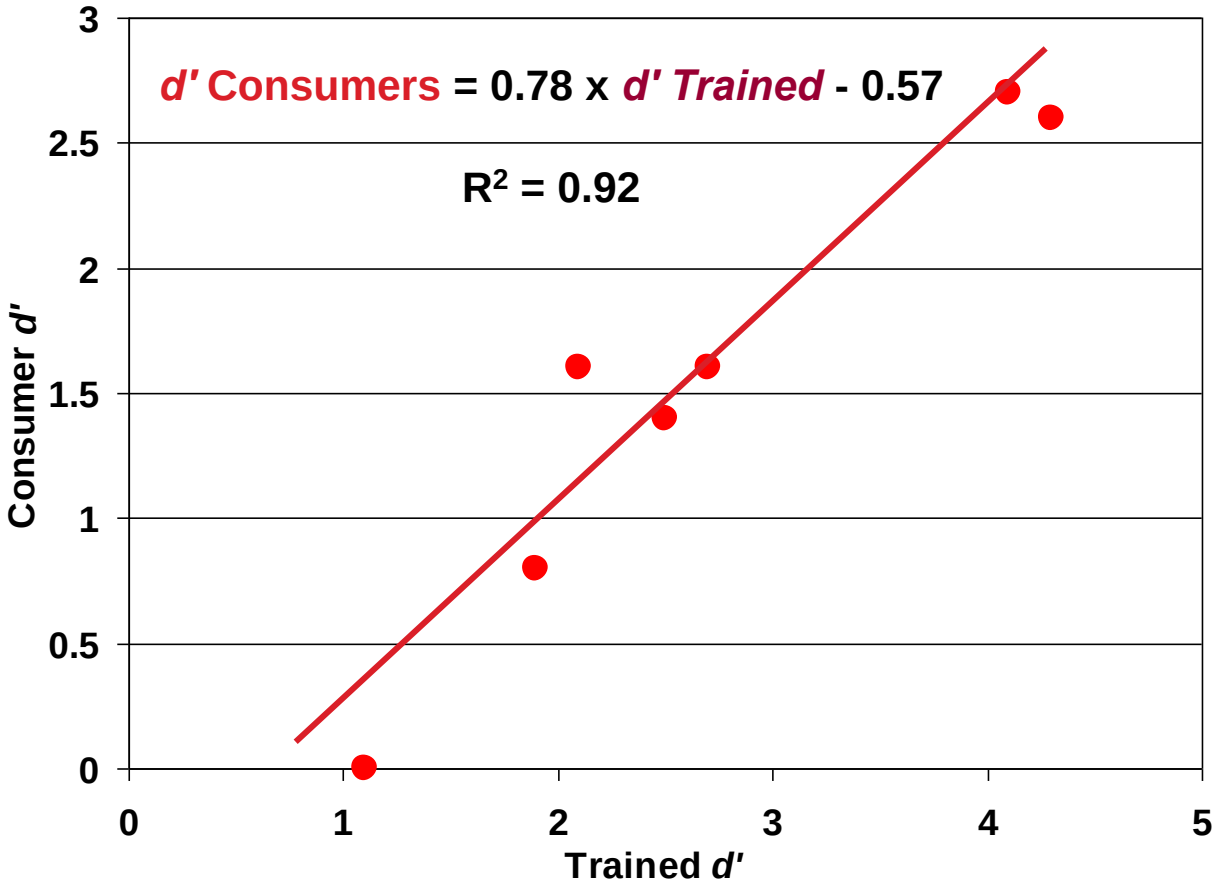
- Study by Ishii, Kawaguchi, O'Mahony and Rousseau (2007)
- Conducted with seven different pairs of vanilla ice cream samples varying on various dimensions (flavor, fat content, texture, …)
- Sample pairs evaluated both by the trained and consumer panels
- Protocol used: same-different test for both panels




- *d'* values calculated for each panel and for each pair of samples

# Experimental Results

| | Trained | | Consumers | |
|---|---|---|---|---|
| Pair # | *N* | *d'* | *N* | *d'* |
| 1 | 18 | 1.1 | 133 | 0 |
| 2 | 17 | 1.9 | 124 | 0.8 |
| 3 | 14 | 2.5 | 77 | 1.4 |
| 4 | 16 | 2.1 | 122 | 1.6 |
| 5 | 17 | 2.7 | 120 | 1.6 |
| 6 | 12 | 4.3 | 137 | 2.6 |
| 7 | 13 | 4.1 | 232 | 2.7 |




- This relationship allows the estimation of the discrimination level that will be exhibited by consumers based on trained panel data

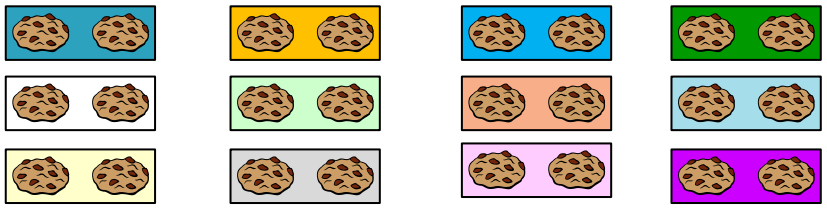
## Sensory Discrimination Testing and Consumer Relevance

# Using Preference Tests

# Preference Test Approach Example

- 150 consumers

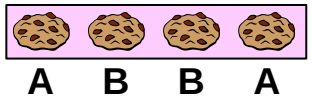
- 12 different pairs of products



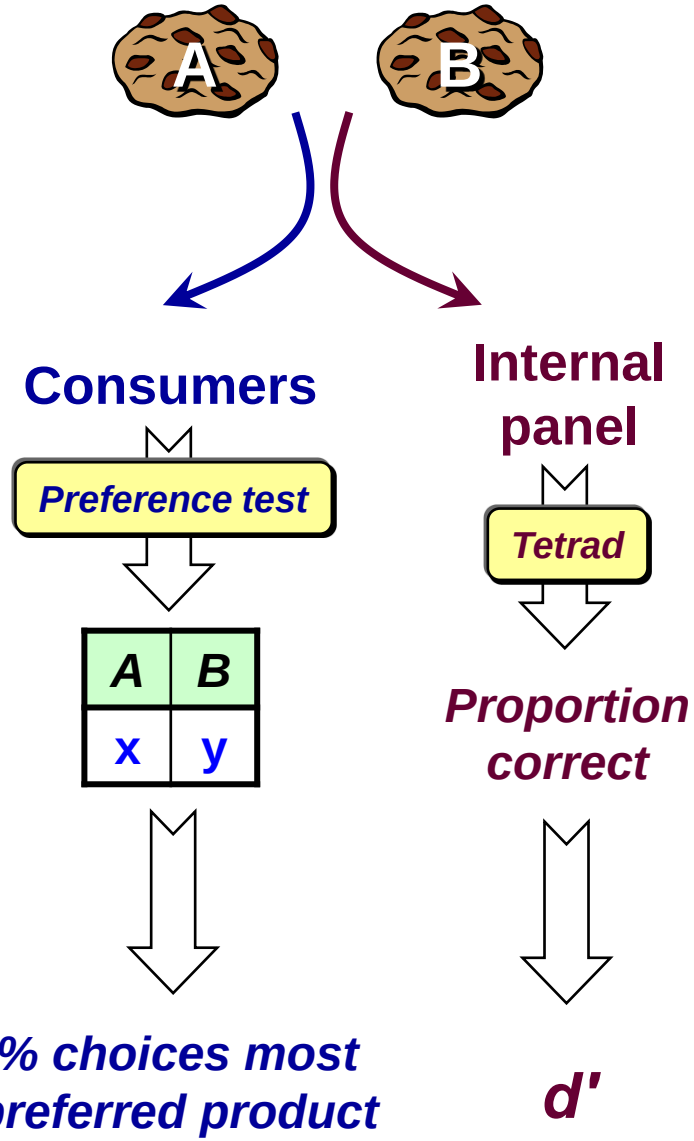
- Consumers: Paired preference

*"Which sample do you prefer?"*

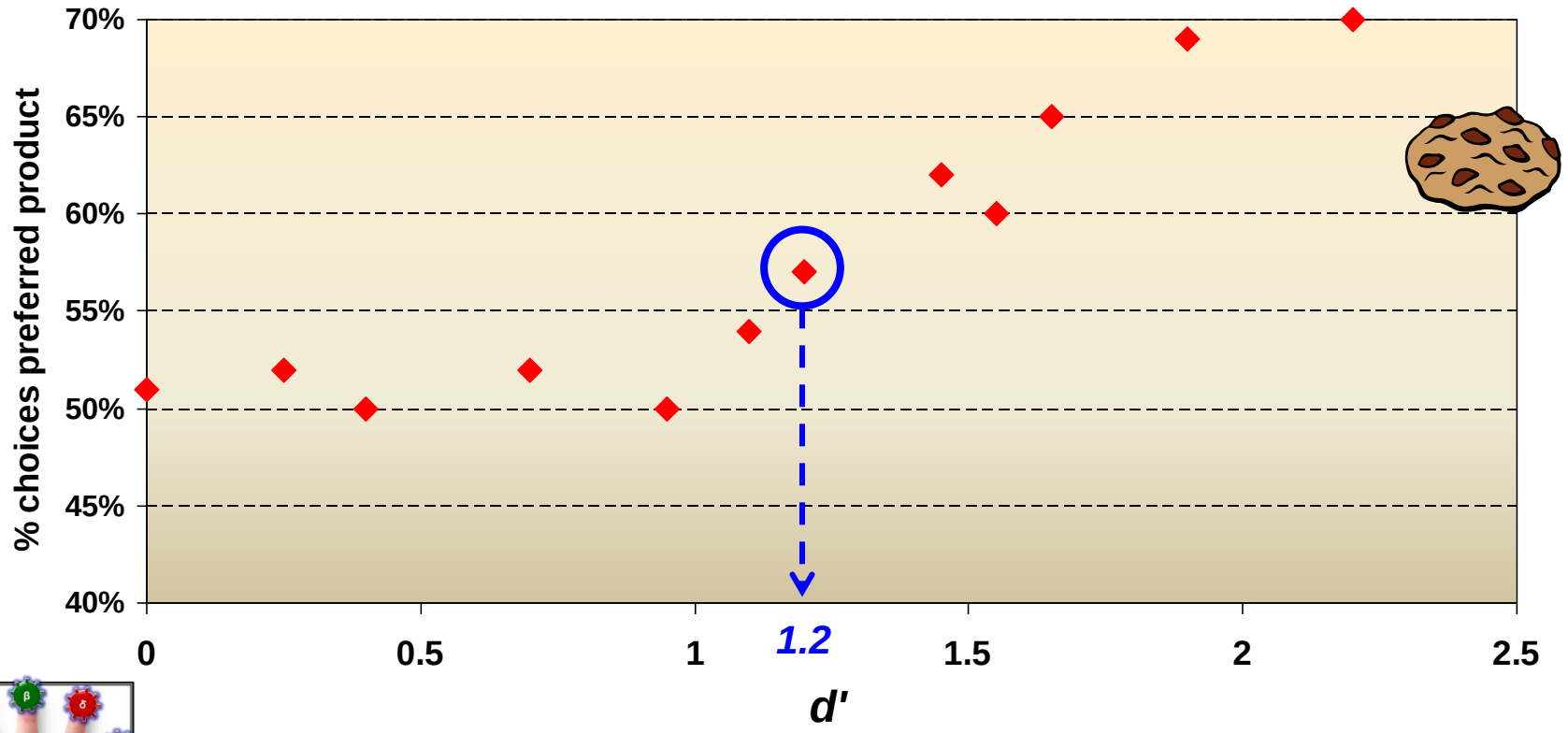
- Internal panel: Tetrad

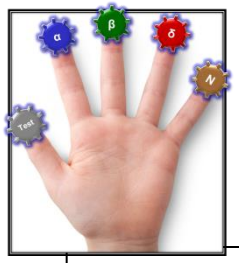



*"Put the 4 samples in two groups of 2 identical samples"*



# Internal *d'* vs. Consumers' Preference Results



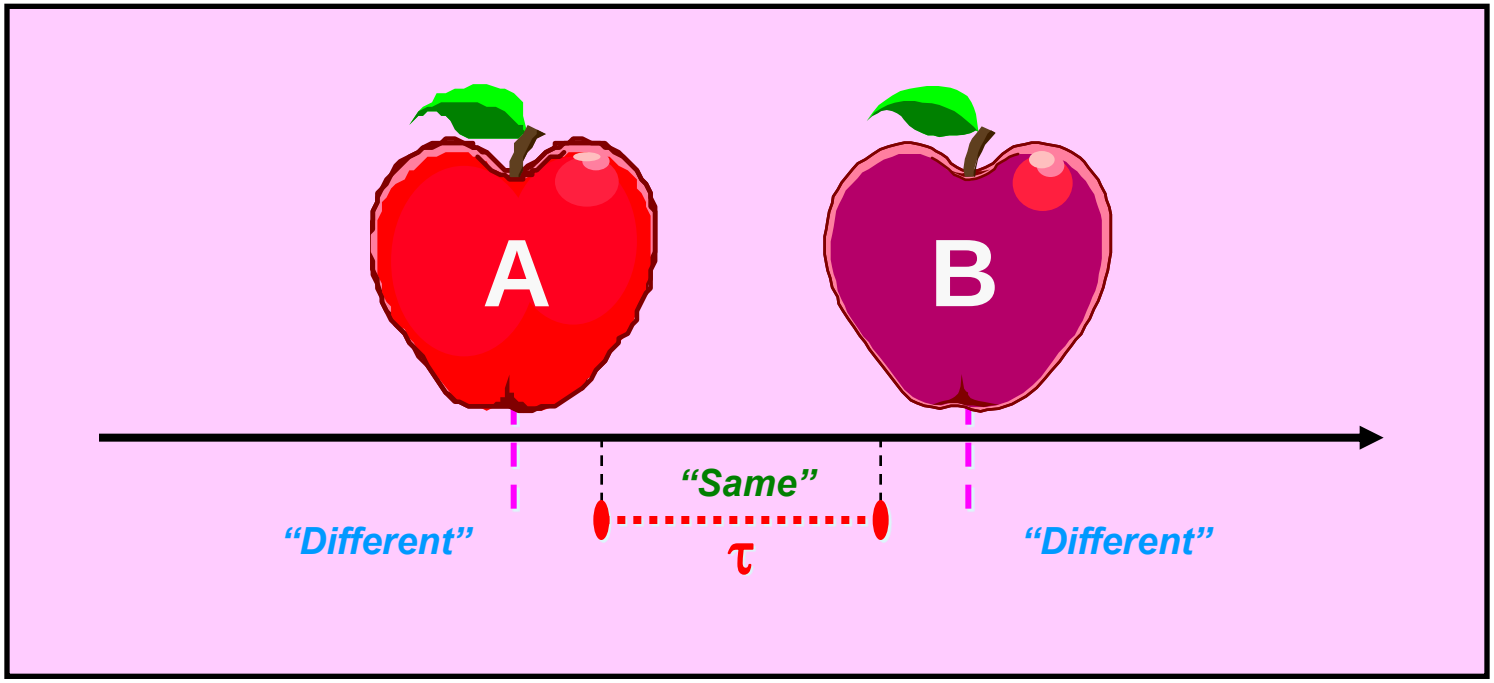
- The relevant threshold can be set at **δ**=1.2
- Using this value, the program's risk profile can be established
  - **Tetrad test**, **α**=5%, **Power**=80%, **δ**=1.2 → **N**=39

## Sensory Discrimination Testing and Consumer Relevance

# Using the Same-Different Test

# Response Bias: τ Criterion

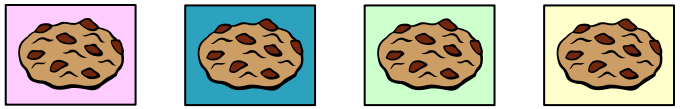
***Are the two apples the same or different?***



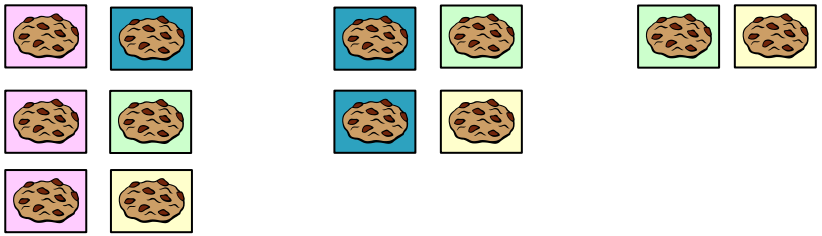

# Example

- 300 consumers

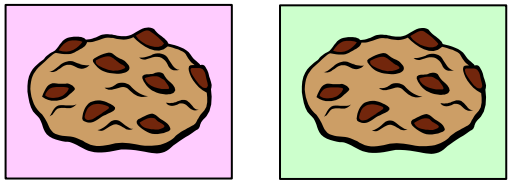
- 4 products

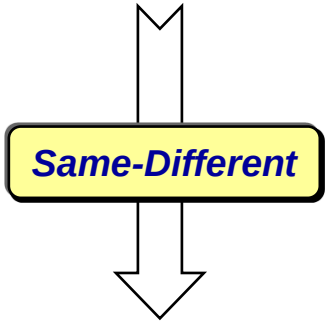


- 6 pairs

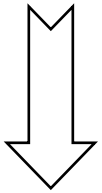


- Protocol: Same-different





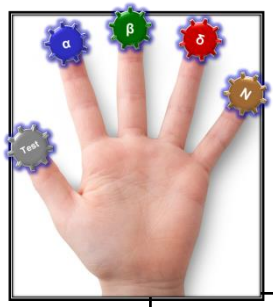

| | "Same" | "Diff." |
|---|---|---|
| Same | | |
| Diff. | | |



$d'$, $\tau$

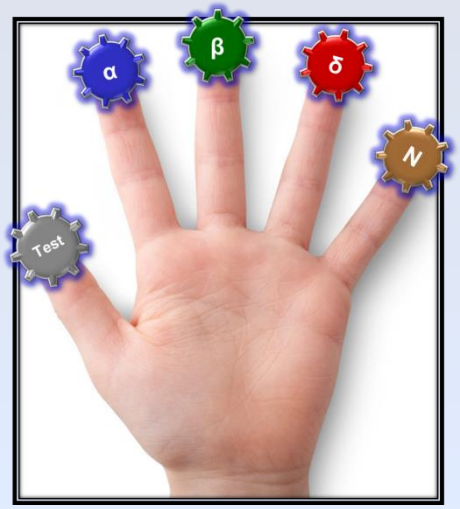
# Consumers Same-Different Data

| Pair | *"D"/S* | *"S"/S* | *"D"/D* | *"S"/D* | *d'* | τ |
|---|---|---|---|---|---|---|
| A *vs.* B | 85 | 65 | 90 | 60 | **0.60** | **0.81** |
| C *vs.* D | 87 | 63 | 89 | 61 | **0.38** | **0.78** |
| A *vs.* C | 86 | 64 | 104 | 46 | **1.21** | **0.80** |
| B *vs.* D | 87 | 63 | 99 | 51 | **0.97** | **0.78** |
| A *vs.* D | 84 | 66 | 111 | 39 | **1.54** | **0.82** |
| B *vs.* C | 86 | 64 | 92 | 58 | **0.66** | **0.80** |
| | | | | | **Average** | **0.80** |




- 0.80 corresponds to the consumer threshold for "difference"
- The program's risk profile can then be established
  - Tetrad test, **α=5%, Power=80%, δ=0.80 → N=140**

## Sensory Discrimination Testing and Consumer Relevance

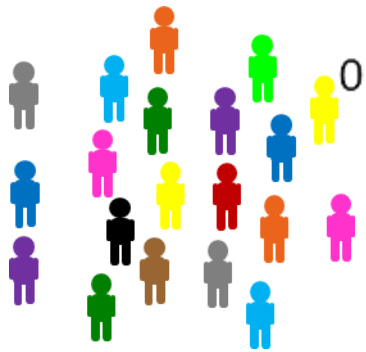


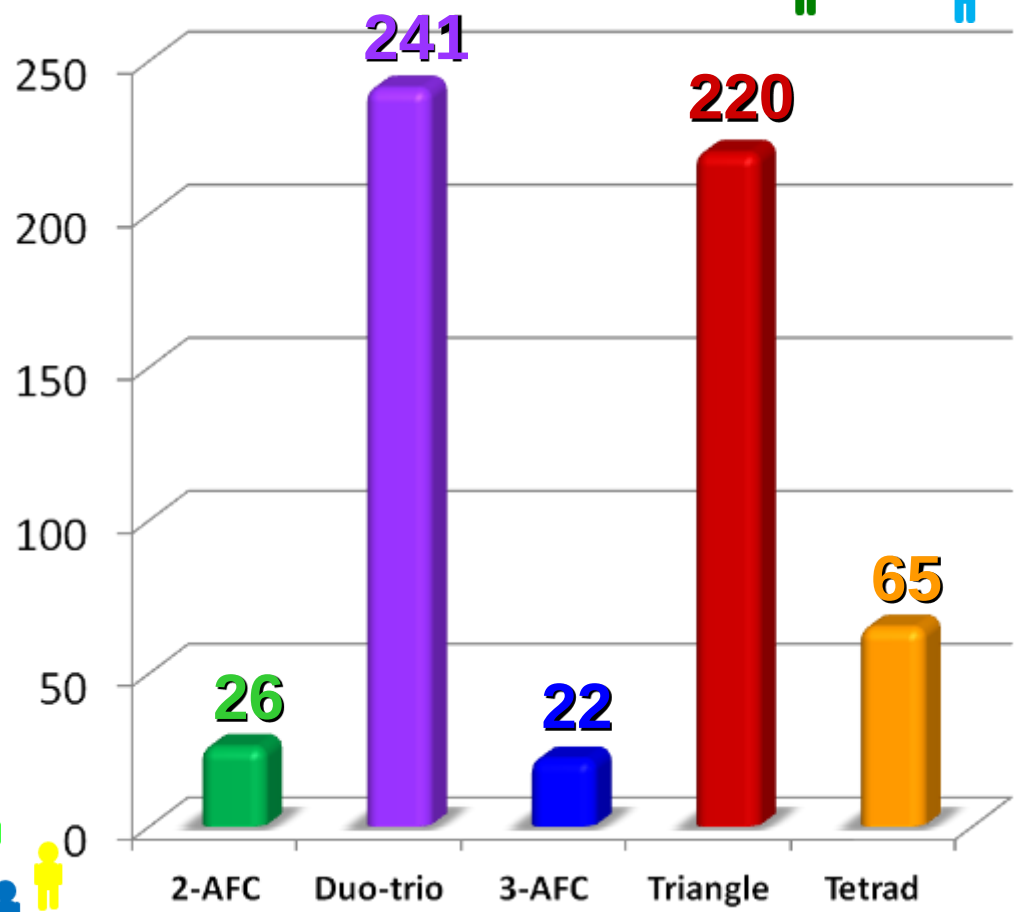

# Conclusions

# 5 Factors Relationship

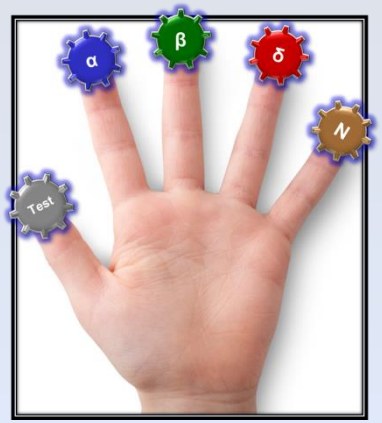
## Scenario 1

- **Size of the difference**: 76% correct in a 2-AFC *(d' of 1)*
- **Power**: 80% chance of detecting the difference
- **α level**: 5%
- ***Sample size needed*** ➡





## Sensory Discrimination Testing and Consumer Relevance




# *Thank You For Your Attention*

# Any Questions?

***www.ifpress.com***

**Benoît Rousseau, Ph.D.**
***Benoit.Rousseau@IFPress.com***
***(530) 753 2231***
The Institute for Perception