International Citrus & Beverage Conference (ICBC)
September 14-17, 2010

Hedonic gLMS: a new scale that permits valid hedonic comparisons

Linda Bartoshuk
Smell & Taste Center

UF UNIVERSITY of FLORIDA

lbartoshuk@dental.ufl.edu
352-273-5119

Outline of talk

1. Introduction to supertasters

2. Problem: Conventional scales make invalid comparisons across subjects (i.e., scales cannot “see” supertasters).

3. Solution: It’s not easy, but valid comparisons are possible.

Do we all live in the same taste worlds?

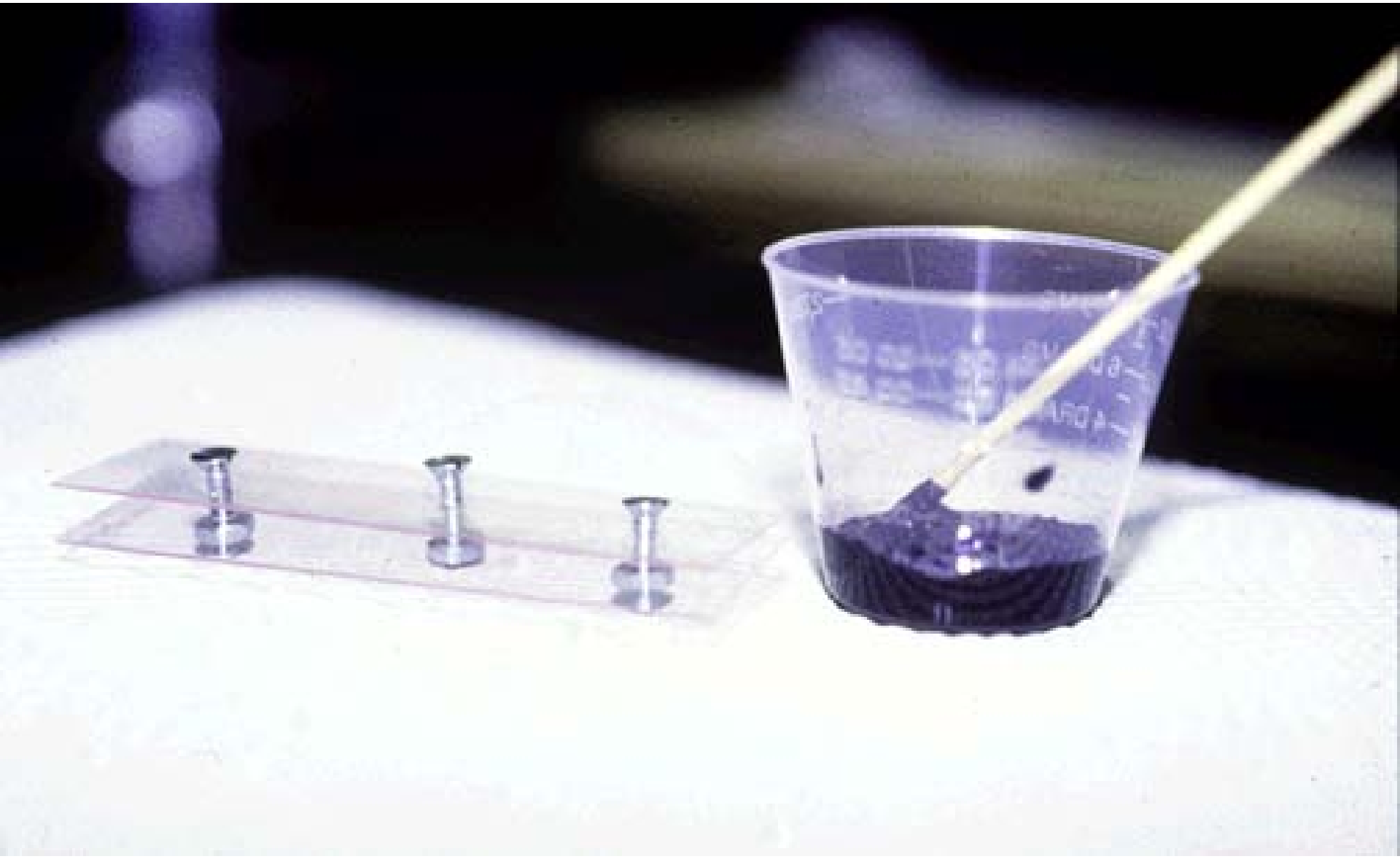
NO

Supertasters experience more intense oral sensations than the rest of us.

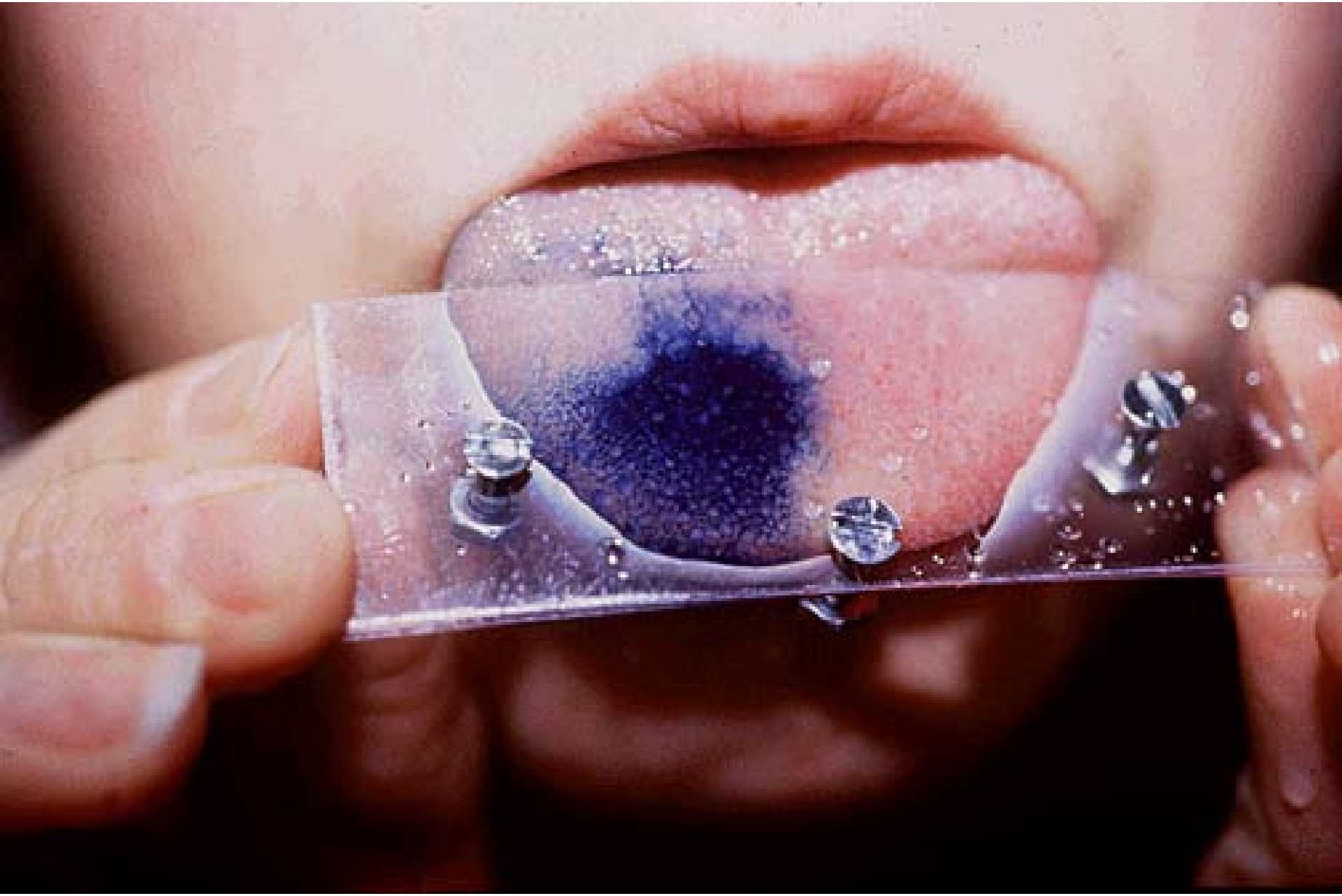
PROP DEMONSTRATION

- PROP is a medication used to suppress thyroid function in patient's with Grave's disease. Typical dose: 200 mg/day.

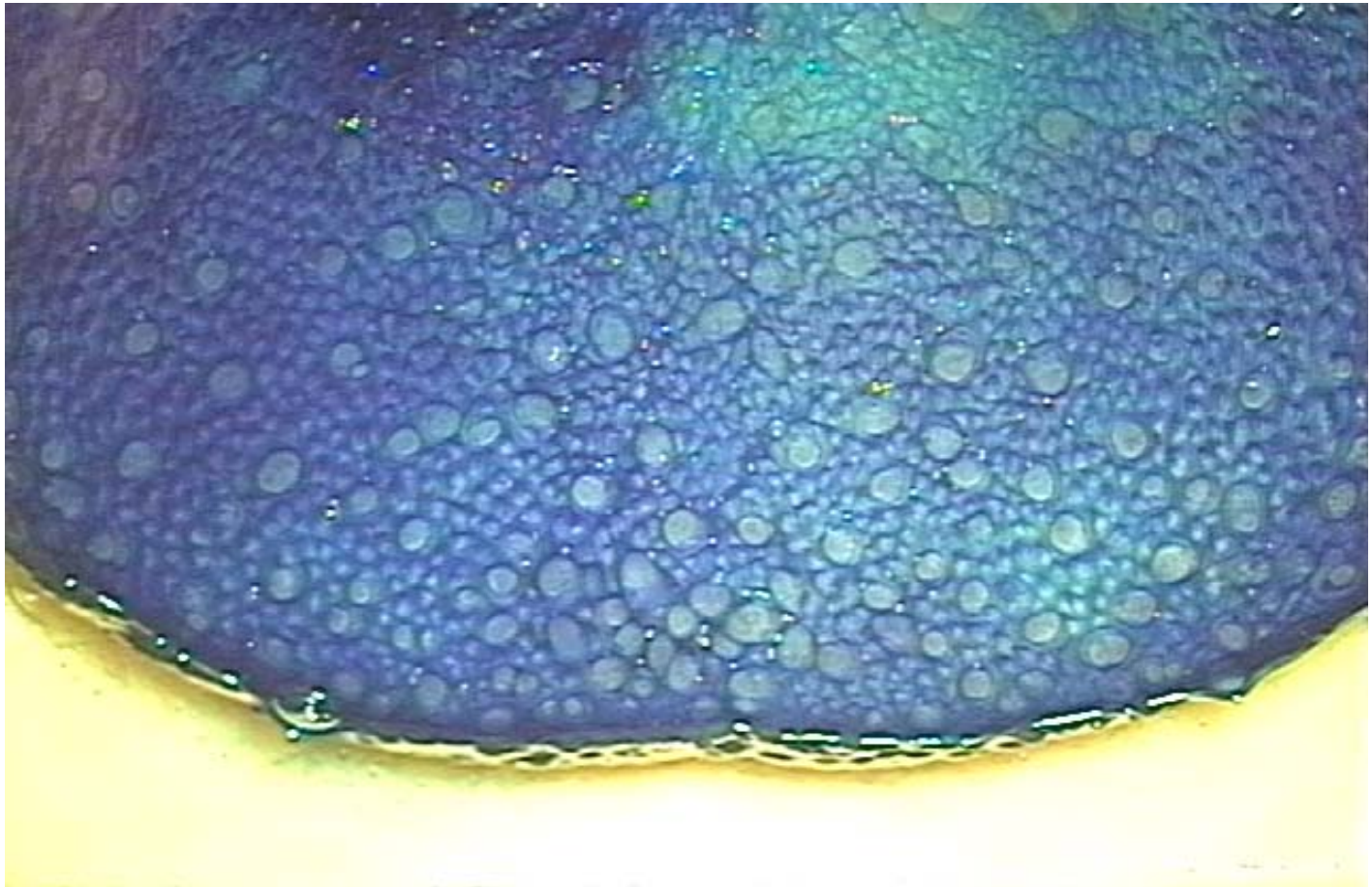
- PROP paper: about 1.6 mg of PROP



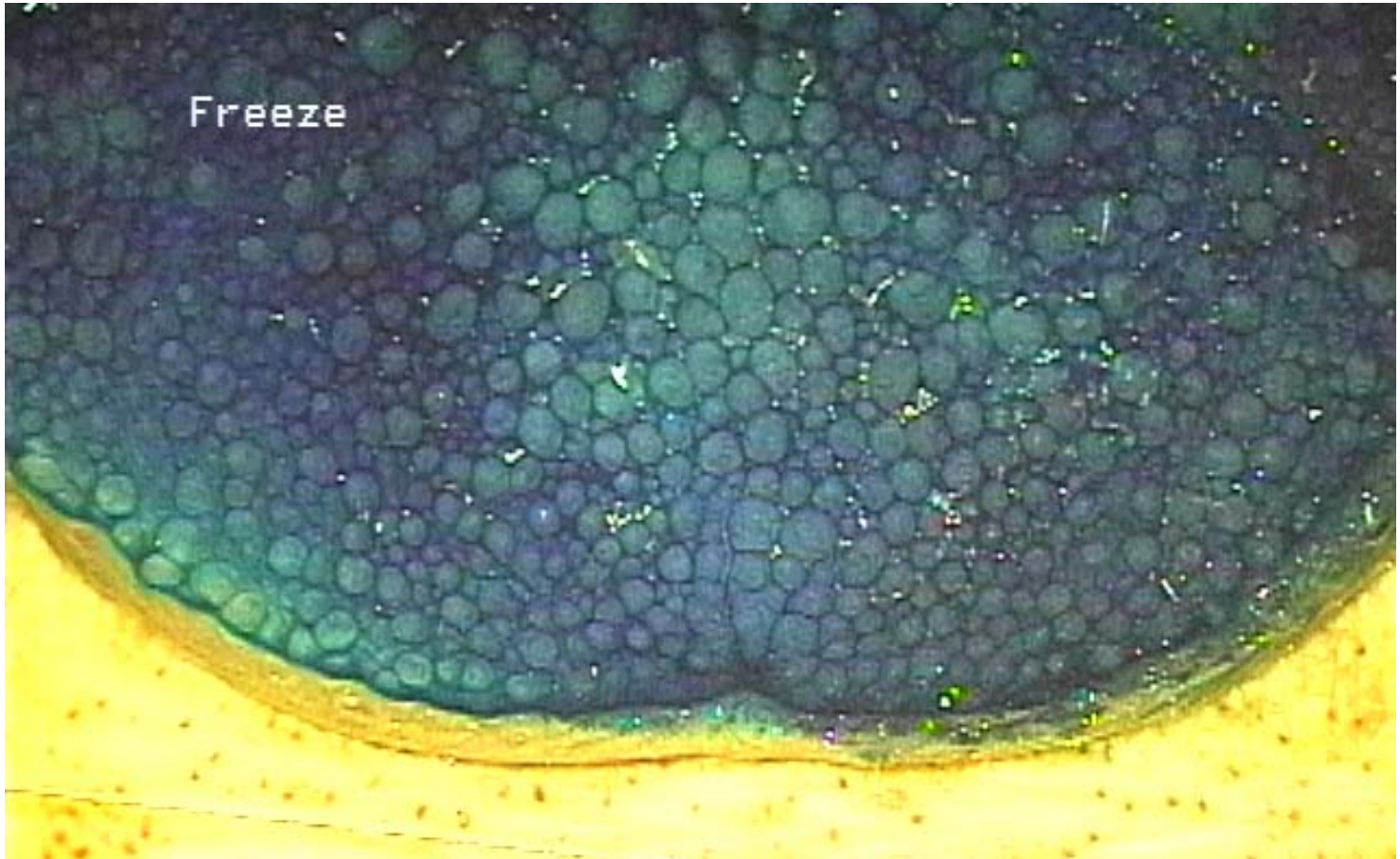

3M

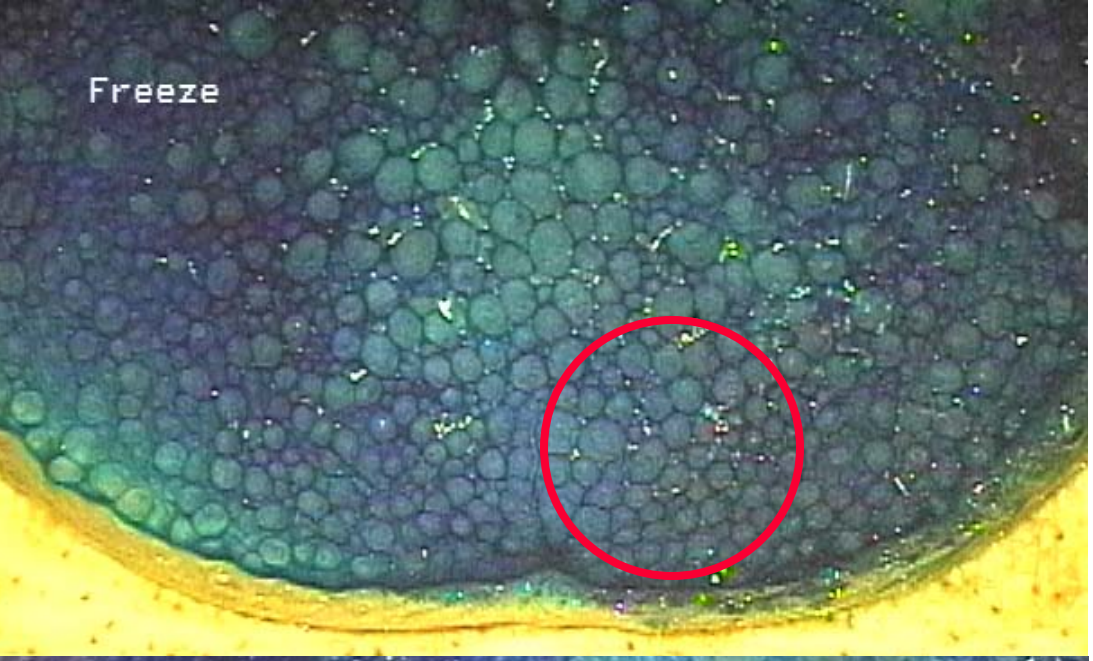


This tongue has been swabbed with blue food coloring. The structures that house taste buds (fungiform papillae do not stain as well as the rest of the tongue so they appear lighter. Keep a mental picture of this tongue.

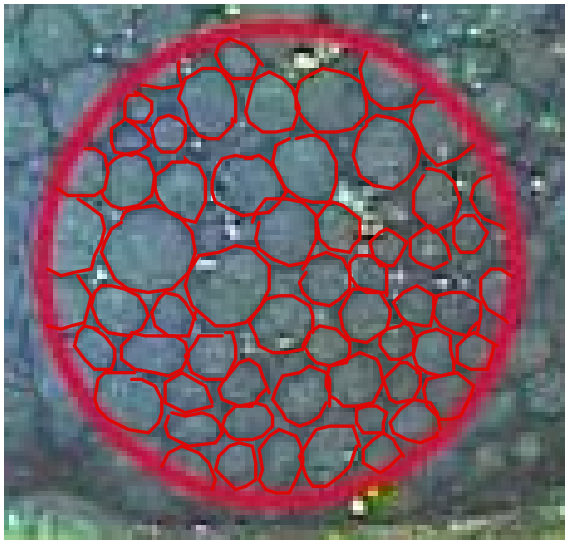


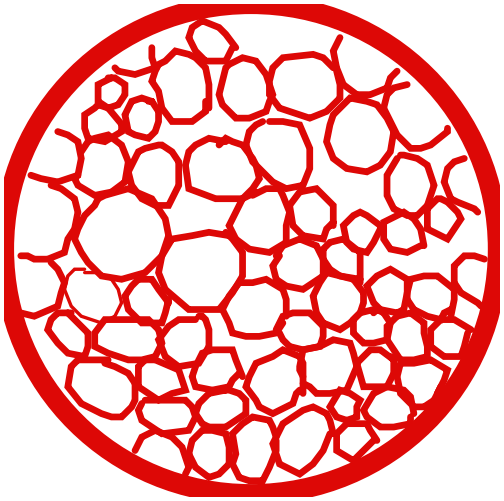
This is the tongue of a **supertaster**:
a person born with an unusually large number of fungiform papillae.



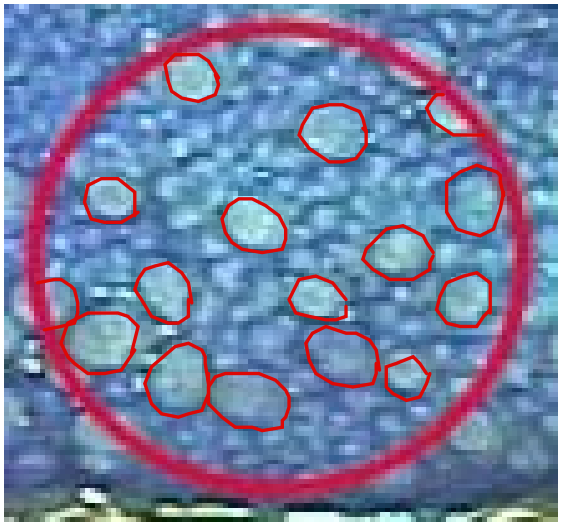


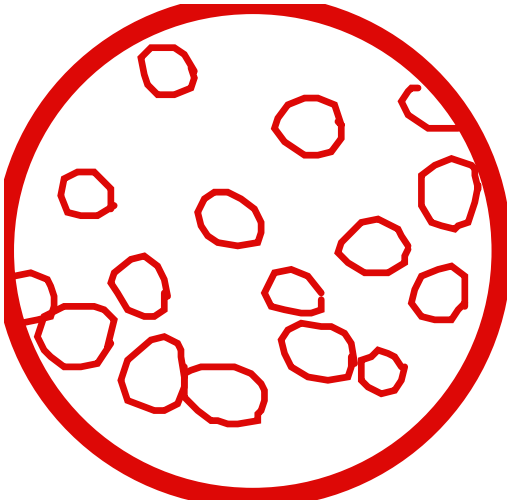
- We count the papillae in a circular template 6 mm in diameter just to the side of the midline.





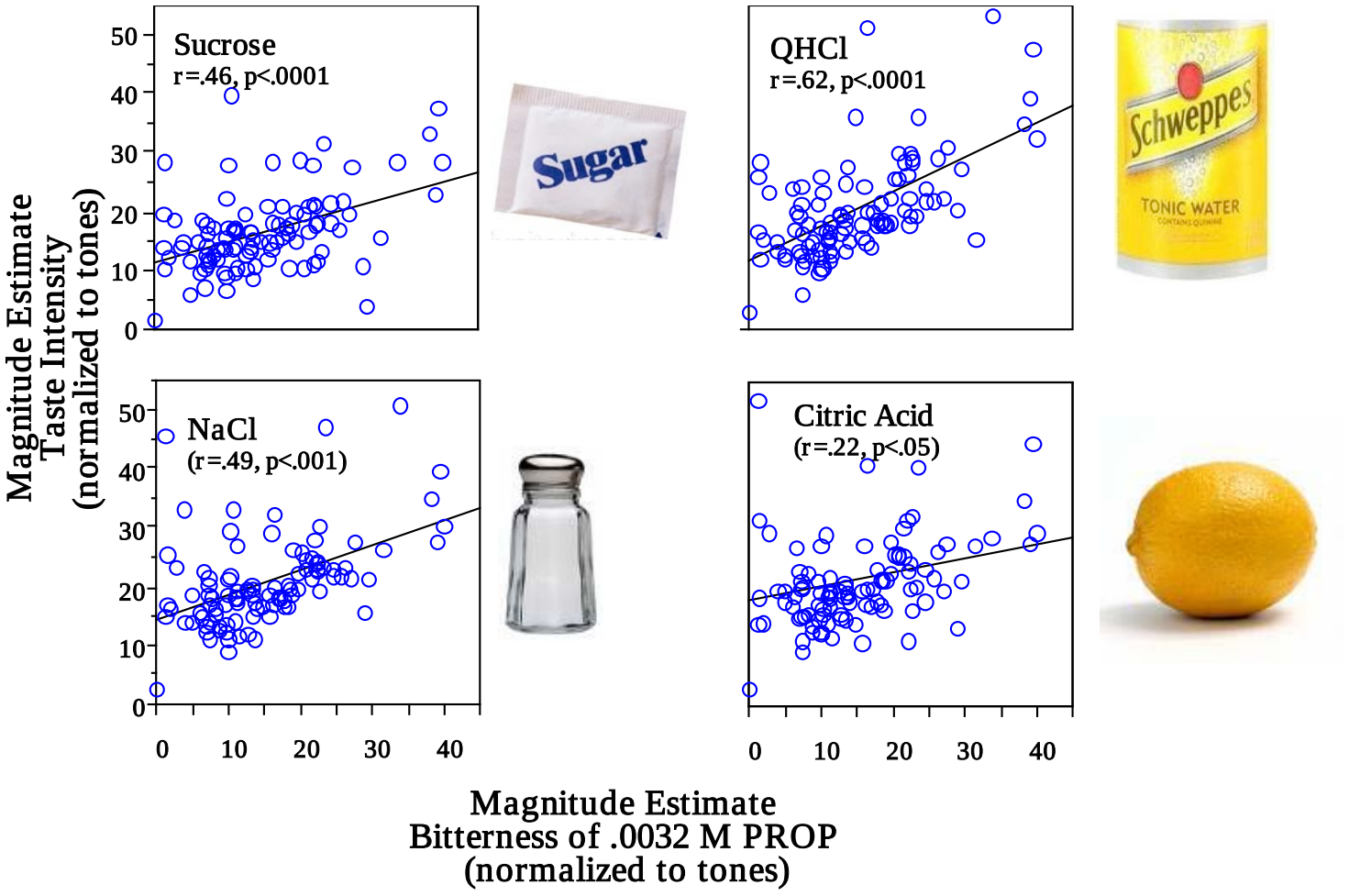
Supertasters can have up to about 60 fungiform papillae in the template area.



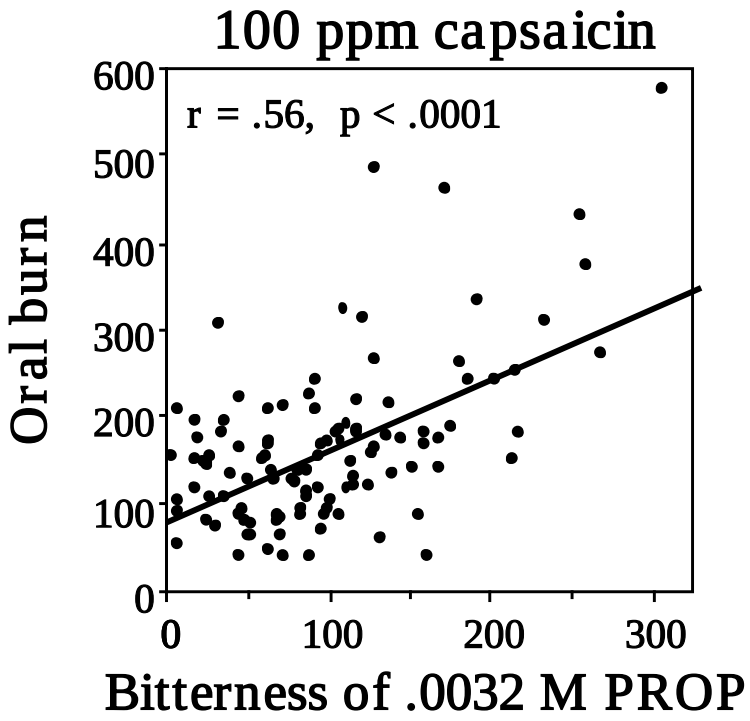


Most individuals have far fewer. This individual has 16 fungiform papillae in the template area. Values as low as 5 are normal.

TASTE: Supertasters have the most fungiform papillae (the structures that house tastebuds) so they have the most tastebuds and thus perceive the most intense tastes.



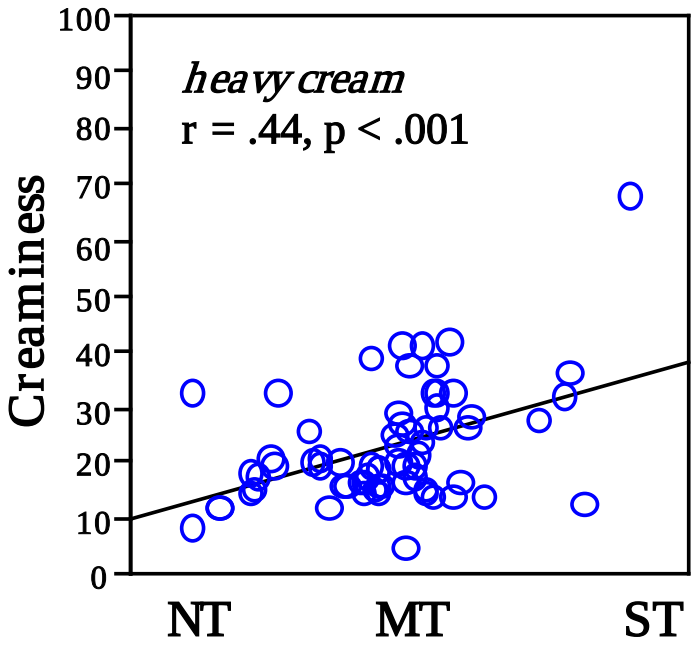
ORAL BURN: Tastebuds are surrounded by fibers thought to mediate oral burn; thus supertasters perceive greater burn from oral irritants like chilis.



Jalapeno peppers contain about 100 ppm capsaicin.

Snyder Senior Essay, Yale University, 1996

ORAL TOUCH: Fungiform papillae are innervated by fibers mediating touch; thus supertasters perceive more intense touch sensations (e.g., creaminess) from fats



Duffy, Bartoshuk, Lucchina, Snyder &, Tym, 1996.

In addition, there is a connection between supertasting and flavor

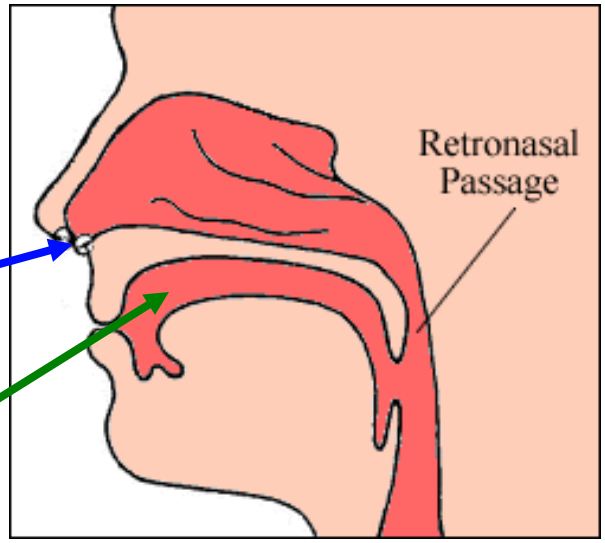
(flavor is taste plus RETRONASAL OLFACTION)

Food and Beverage Industry

- Has long known that adding a taste to a beverage (e.g., adding sugar) will intensify the perception of the flavor (e.g., orange) of the beverage.

- Similarly, experiencing greater taste (as do **supertasters**) will intensify the perception of flavor.

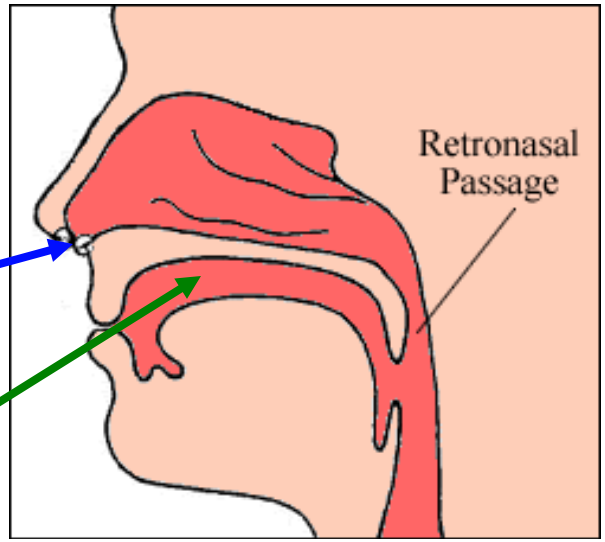
Nontasters



Orthonasal

Retronasal

Supertasters



Orthonasal

Retronasal

- Supertasters live in a *neon* food world.

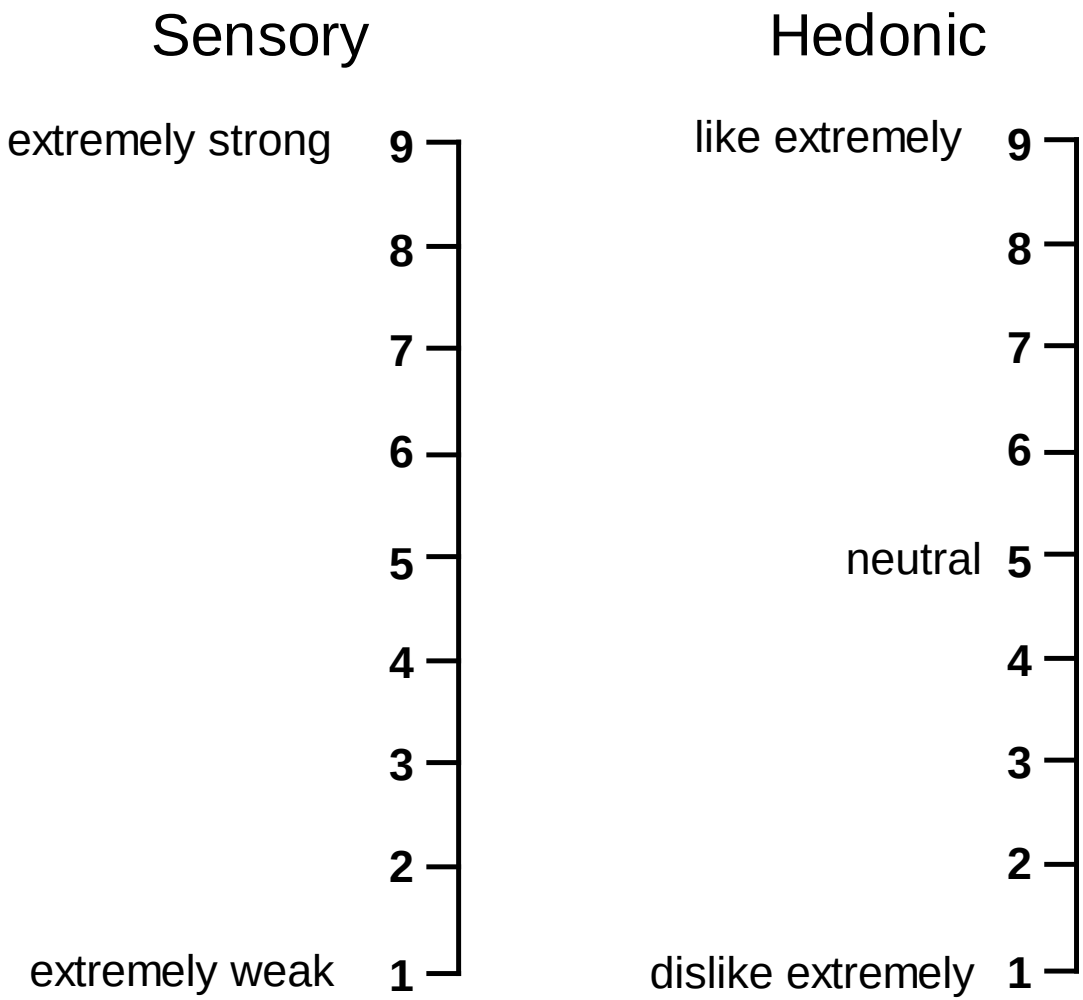
- Those with the fewest taste buds live in a *pastel* food world.

I’ve compared supertasters to others with regard to how they perceive the food world. But we cannot share each other’s experiences directly.

How did I make comparisons between supertasters and others?

I did **not** use the classic Natick 9-point scales (or any similar scales like VAS).

Natick 9-point scales



The problem.

- What does "**extremely** strong" mean?
- What does "like **extremely**" mean?
- Let me begin with the sensory descriptor: "**extremely** strong."

- In ordinary conversation, we use intensity descriptors to communicate with each other and compare experiences. “That lemonade tastes ***extremely strong*** to me. Does it taste ***extremely strong*** to you?”

- Labeled scales use those same descriptors to denote perceived intensities.

- We seem to be communicating, but are we?

- No! ***“extremely strong ”*** may denote different perceived taste intensities to each of us.

- How do our subjects interpret "***extremely strong"*** on the 9-point scale?

- Do they tend to interpret "***extremely strong***" as referring only to foods when they are in a food experiment?

- Let's ask them.

We asked our subjects to rate their favorite and least favorite foods.

- The median for favorite food was “9.”
- The median for least favorite food was “1.”
- This tells us that the Natick 9-point scale was interpreted as referring to food preferences only.

But consider how easily we switch contexts for ratings.

Example: elastic intensity scale

- A woman who has just experienced childbirth may describe her pain as **“very strong.”**
- Given a cup of tea, she may also describe the flavor of the tea as **“very strong.”**

Elastic Intensity Scale

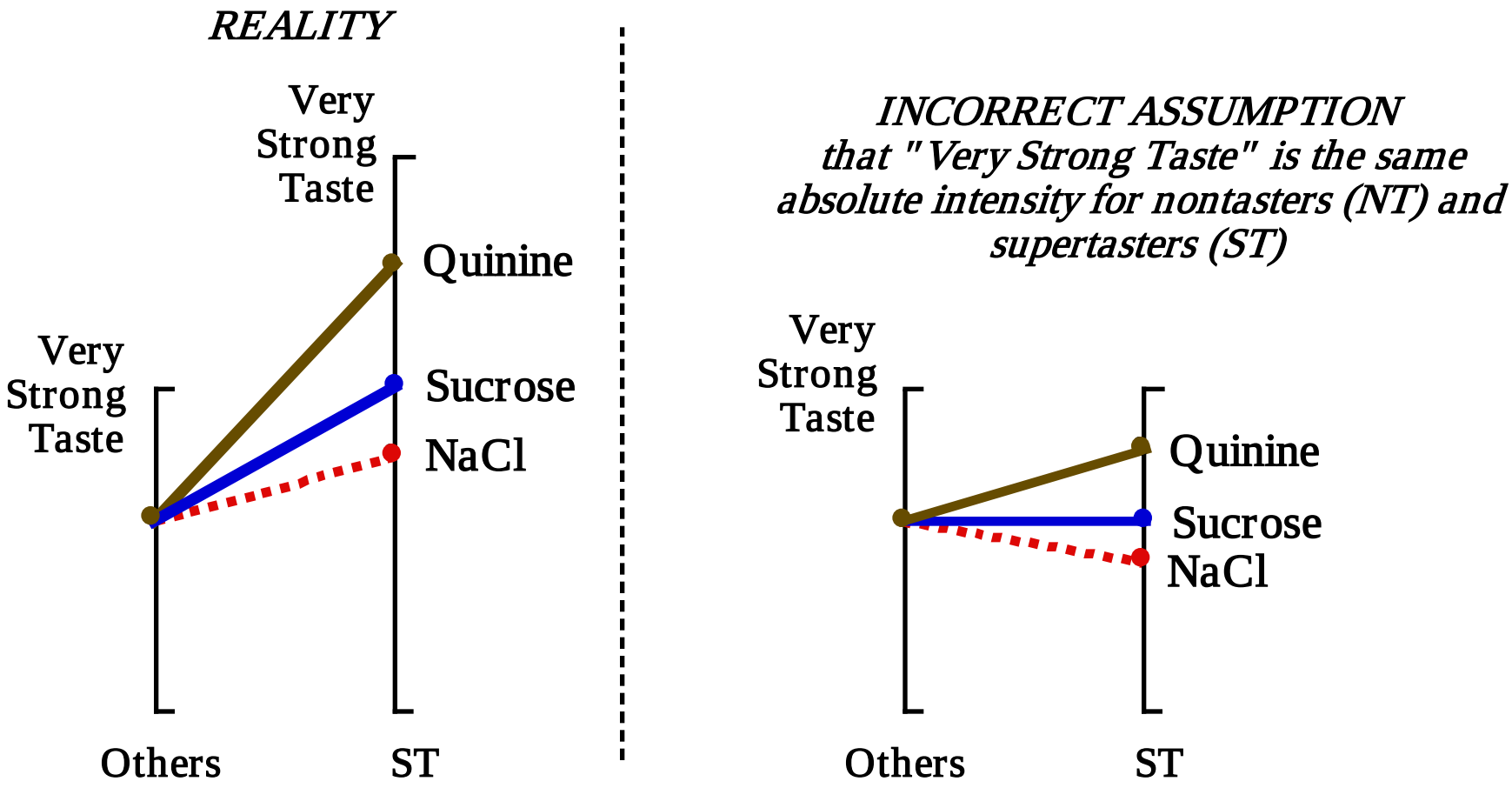
We understand that she does not mean to suggest that her pain and the intensity of the tea flavor are the same. She means her pain was “very strong” in the context of all pains she has experienced and the tea flavor was “very strong” in the context of all teas she has sampled.

Comparison errors caused by elasticity of our intensity scale

- What happens when we treat our elastic scale as if it is absolute?

- We first encountered this kind of error in our taste studies involving supertasters.

REVERAL ARTIFACT
(shown by red dashed lines)



We are not the first to note this error.

- Aitken, R. C. B. (1969). Measurement of feelings using visual analogue scales. *Proceedings of the Royal Society of Medicine, 62*, 989-993.

- Narens, L., & Luce, R. D. (1983). How we may have been misled into believing in the interpersonal comparability of utility. *Theory and Decision, 15*, 247-260.

- Biernat, M., & Manis, M. (1994). Shifting standards and stereotype-based judgements. *Journal of Personality and Social Psychology, 66*, 5-20.

- Birnbaum, M. H. (1999). How to show that 9>221: Collect judgements in a between-subjects design. *Psychological Methods, 4*, 243-249.

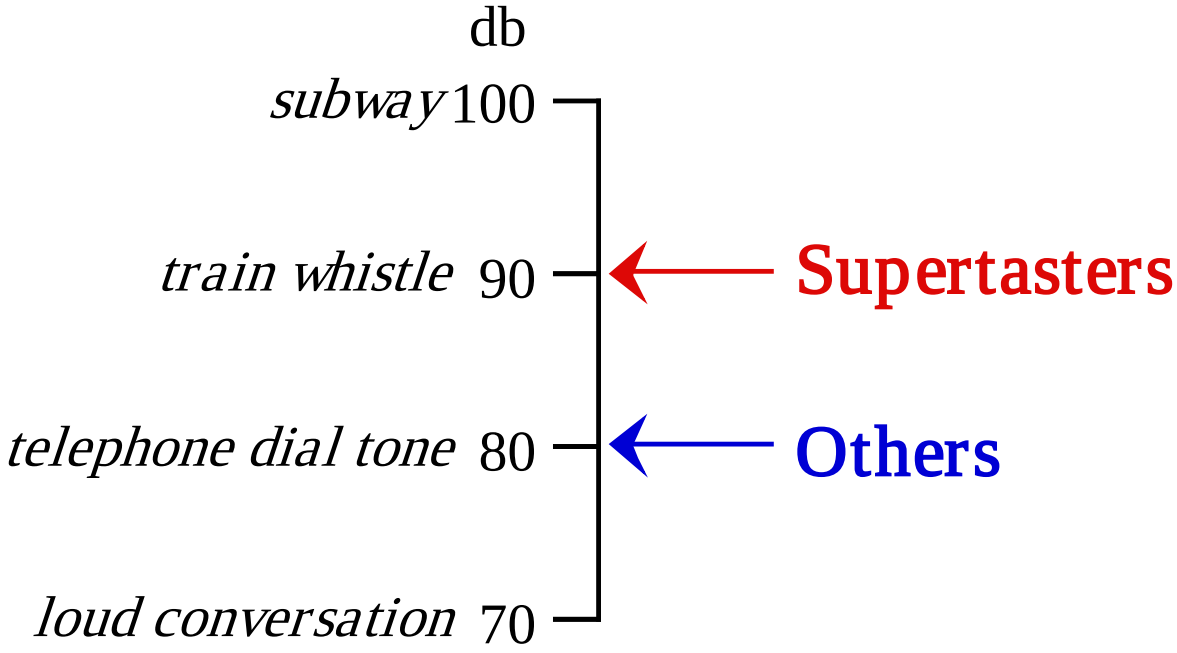
Illustration: PROBLEM and SOLUTION

- Select two groups
  - people with many fungiform papillae: **supertasters**
  - people with few fungiform papillae

- Ask both groups to describe the sweetness of a coke
  - Both groups rate the sweetness to be about 2/3 of the distance from no sweet (0) to the strongest sweet they have ever tasted (100%).
  - Thus both groups seem to be experiencing the same sweetness.

- Now ask both groups to match the sweetness to the loudness of a tone.

Sweetness of a coke



Each 10 db doubles loudness

Correct conclusion: **Supertasters** perceive twice as much sweetness as do **Others**.

Summary of Magnitude Matching

- Select a standard that is independent of the sensation we want to compare and ask subjects to rate the sensation of interest relative to the standard.

- If the standard is roughly equal, on average, to two groups, then we can make an absolute comparison of the sensation of interest across the two groups.

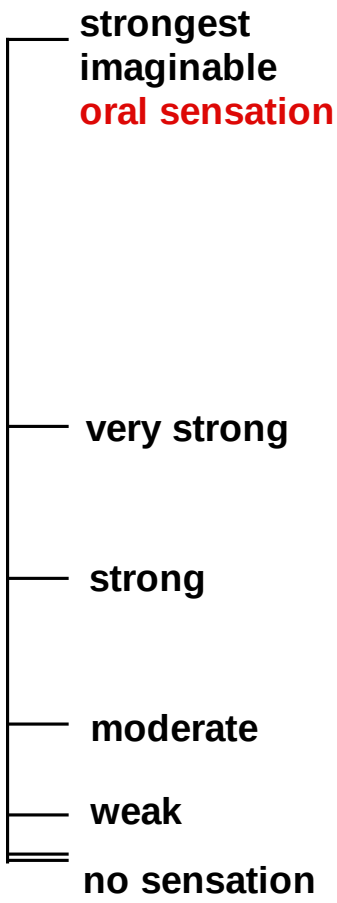
- This method was first used in taste (1975) and was formalized as “magnitude matching” in 1980 (Marks & Stevens).

Let’s make this user friendly.

- Let’s take the labeled magnitude scales we are used to (e.g., Natick 9-point scale).

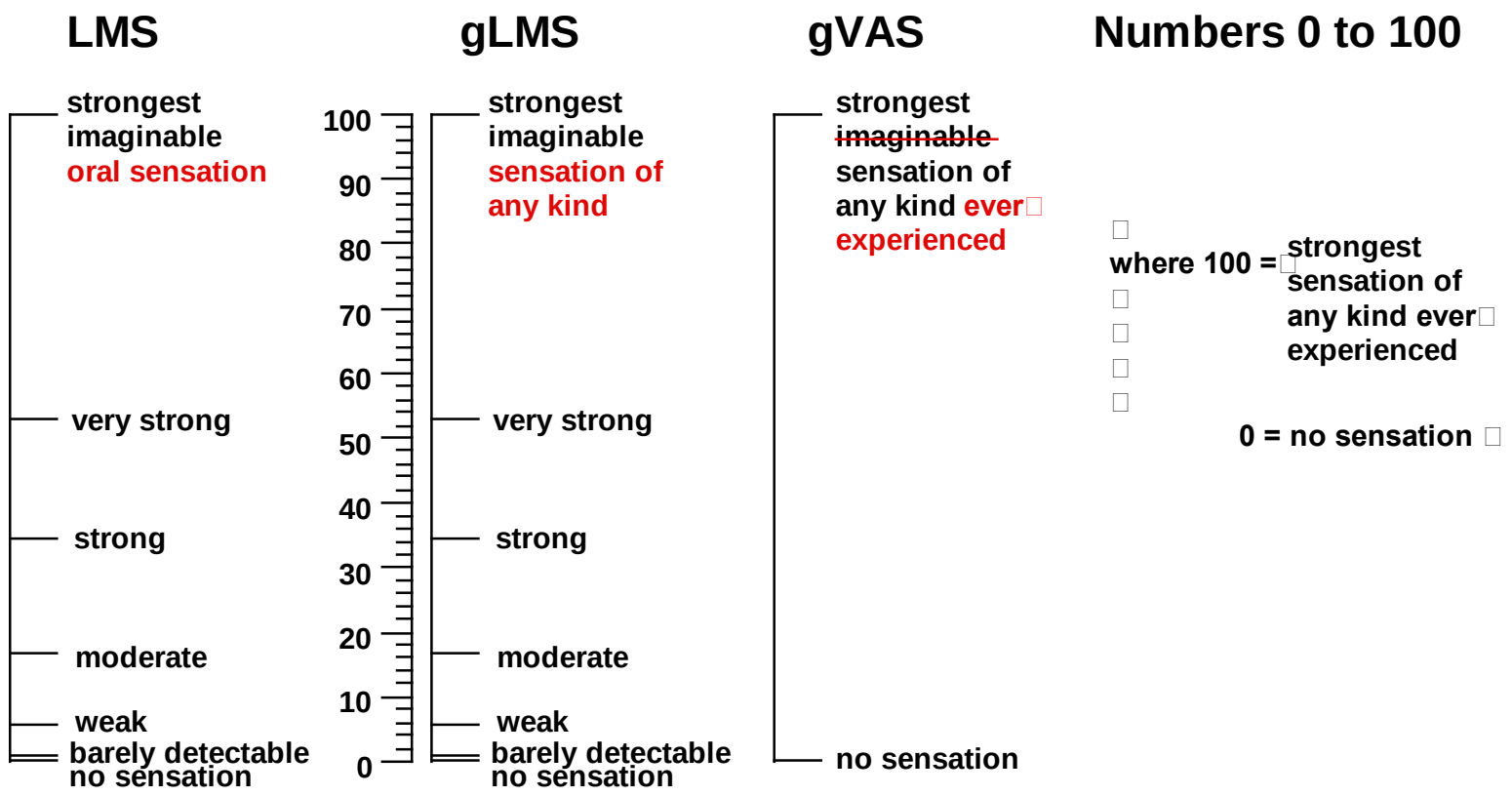
- Respace the intensity descriptors so that the scale has ratio properties (i.e., “8” denotes an intensity twice that of “4”).

LMS



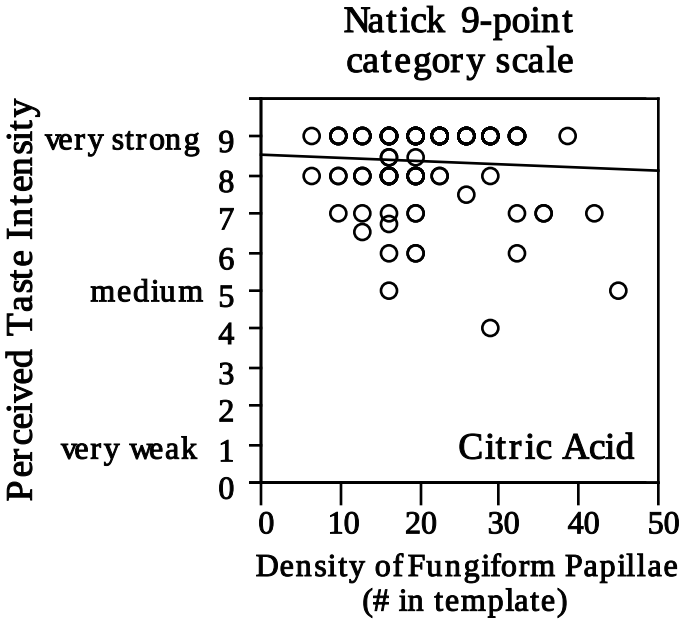
- This is essentially the LMS (Labeled Magnitude Scale) devised by Barry Green and his colleagues to be used with oral sensations (Green et al, 1993).
- Green and his colleagues empirically re-spaced the intensity descriptors to give this scale ratio properties
- Turns out that we don't even really need all of those descriptors.

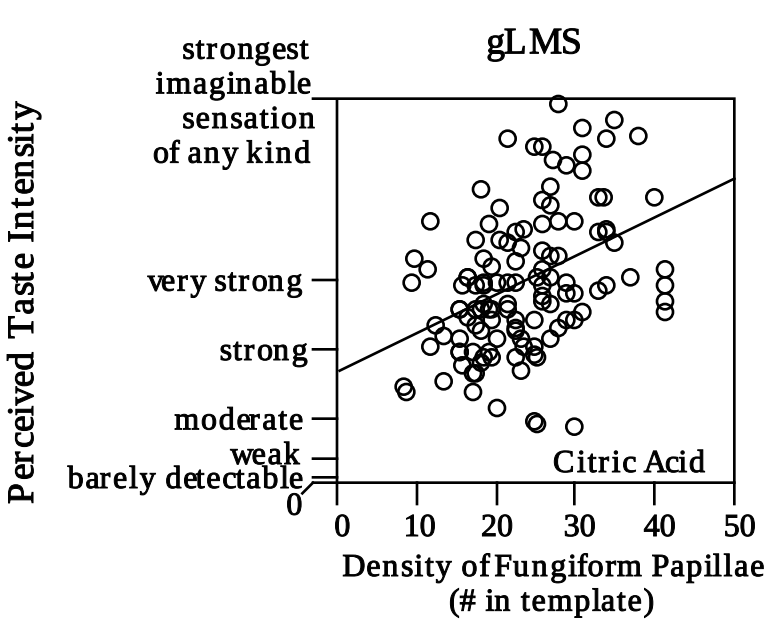
Evolution of the general Labeled Magnitude scale (gLMS)



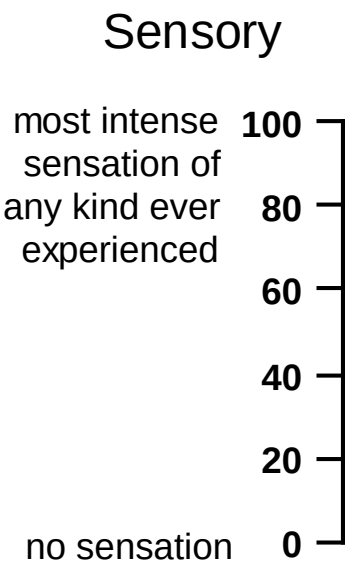
Bartoshuk, Puentes, Snyder & Sims, unpublished data

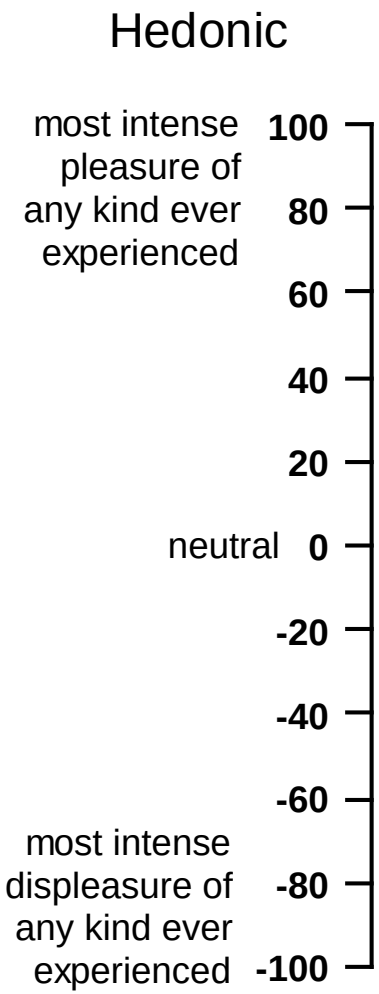
Density of fungiform papillae gives us a way to check how good our scales are.



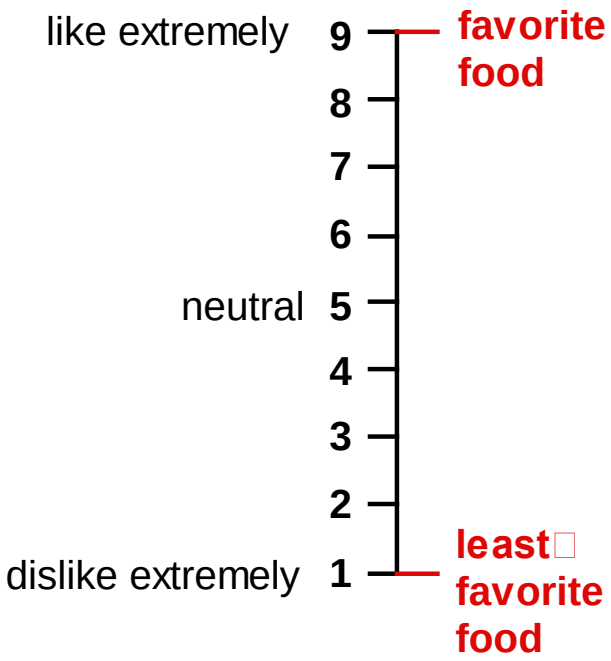


Let’s create a hedonic version of the gLMS

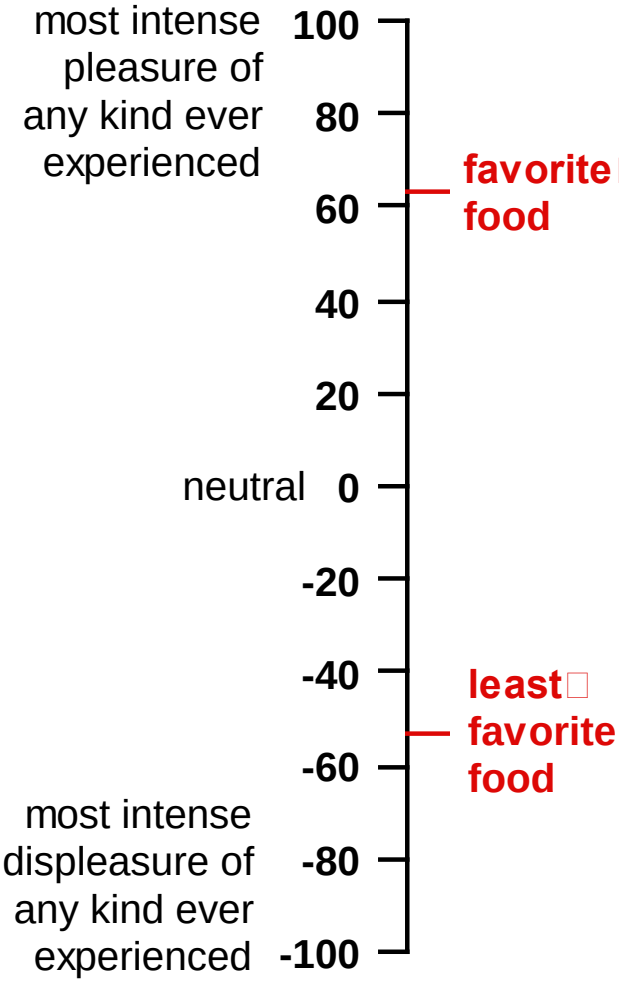




Natick 9-point scale

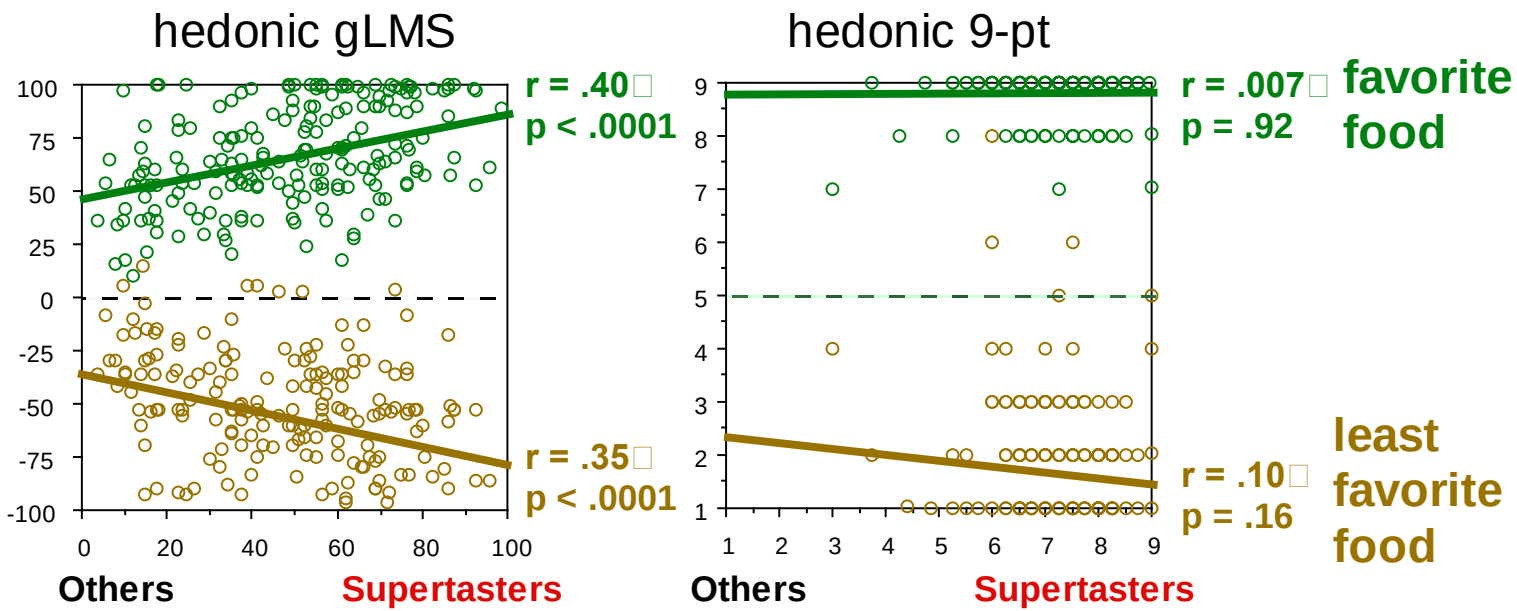


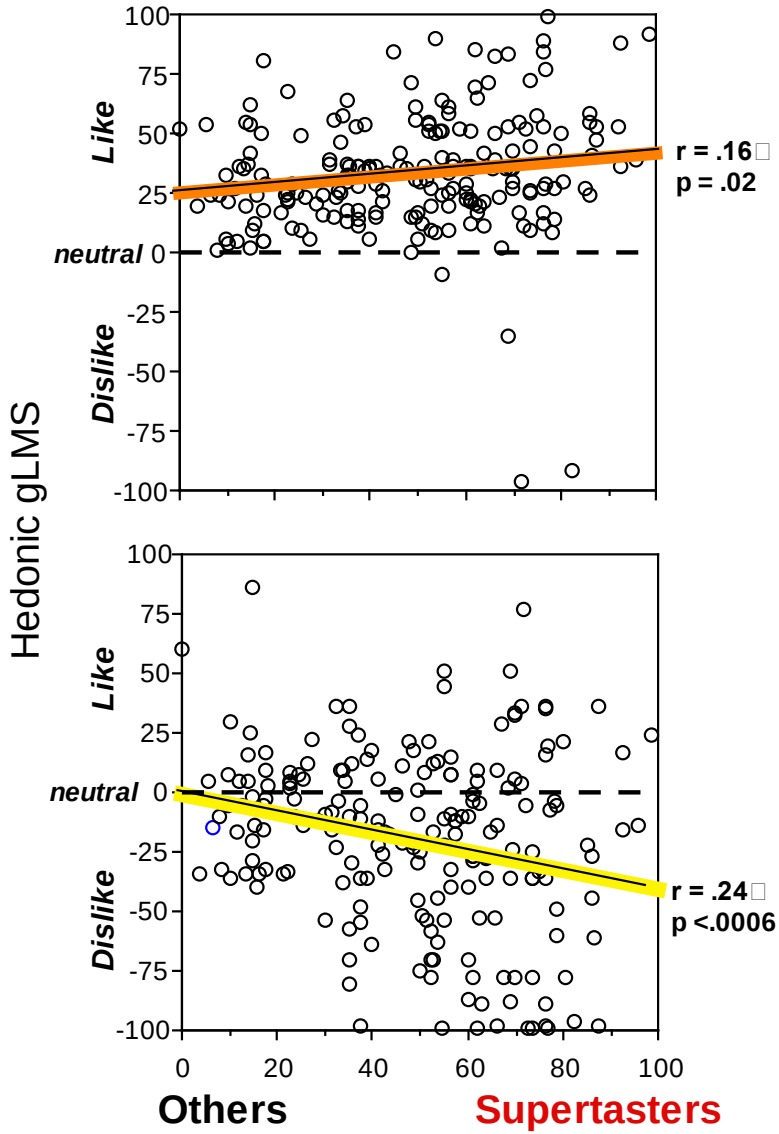
Hedonic gLMS



Examples of what the hedonic gLMS can do

Note that the hedonic gLMS reveals that supertasters have more extreme food likes and dislikes.

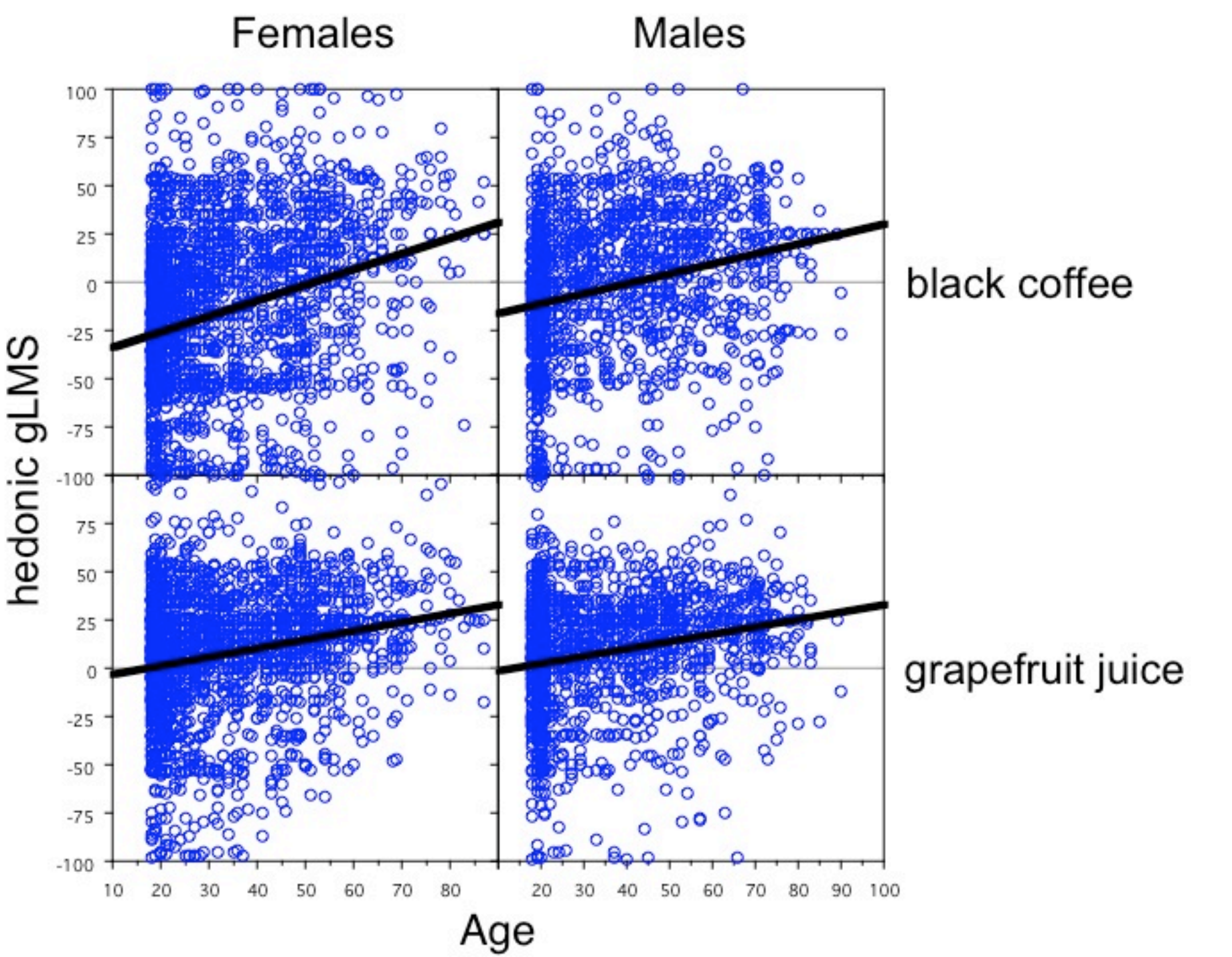


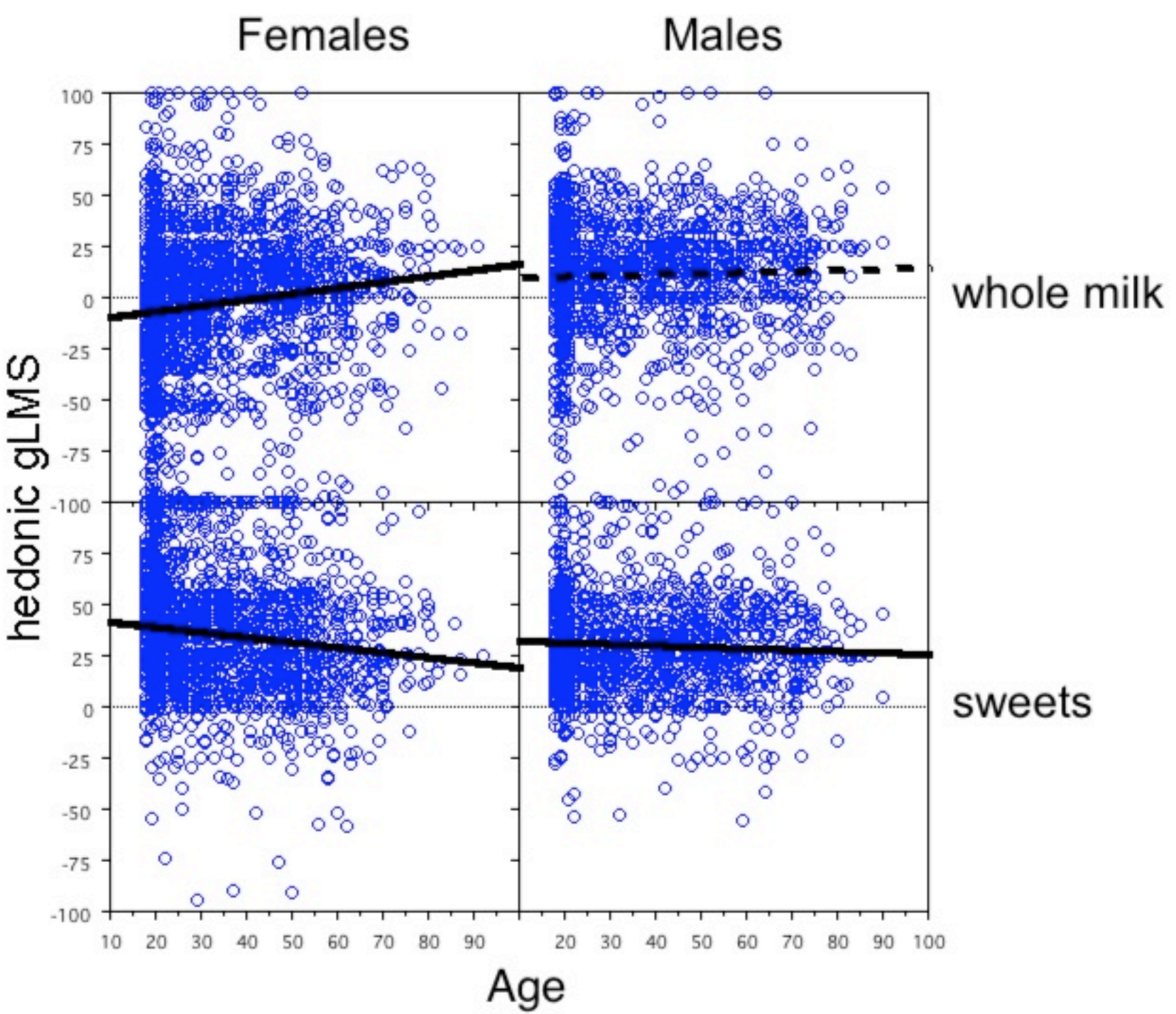


- The gLMS shows that supertasters like orange juice and dislike grapefruit juice more than do others.

- The 9-point hedonic scale cannot reveal this.

These data were collected at lectures so we could accumulate large samples.


Females
Males
hedonic gLMS
100
75
50
25
0
-25
-50
-75
-100
10
20
30
40
50
60
70
80
90
Age
black coffee
grapefruit juice


Females
Males
hedonic gLMS
100
75
50
25
0
-25
-50
-75
-100
10
20
30
40
50
60
70
80
90
Age
whole milk
sweets

When to use the hedonic gLMS

- When you compare samples, this is a within subject comparison and virtually any scales can do this.
- However, when you need to compare groups they may be quite different with regard to food perception or liking, the older scales may provide erroneous comparisons.