



Supertasters, winemakers, & other freaks:

the taste genetics of alcoholic beverage behaviour

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Outline

- Taste, olfaction, flavour: concepts & definitions
- Why taste phenotypes might matter
 - General research interest and research questions
- PROP – taste & alcohol perception
- PROP – alcohol liking
- PROP and winemakers
- Conclusions & ongoing research

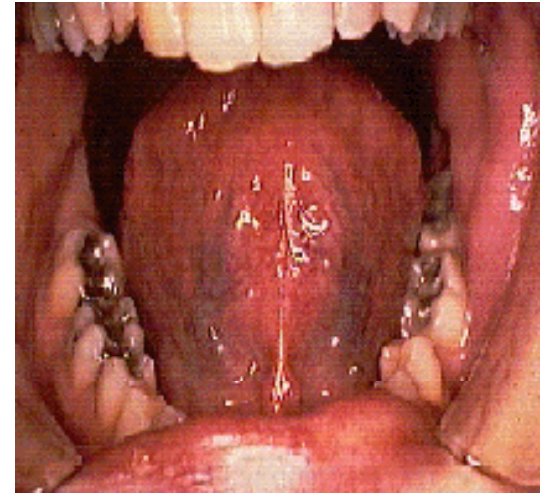


Acknowledgements

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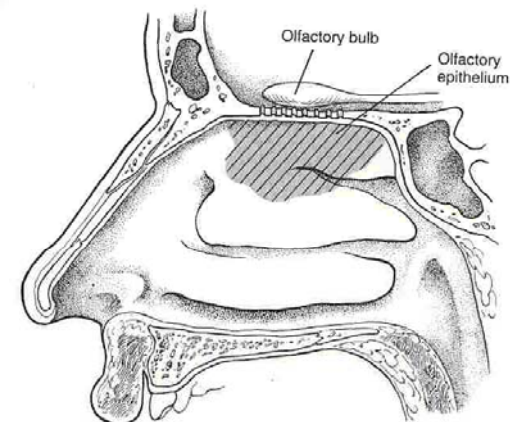
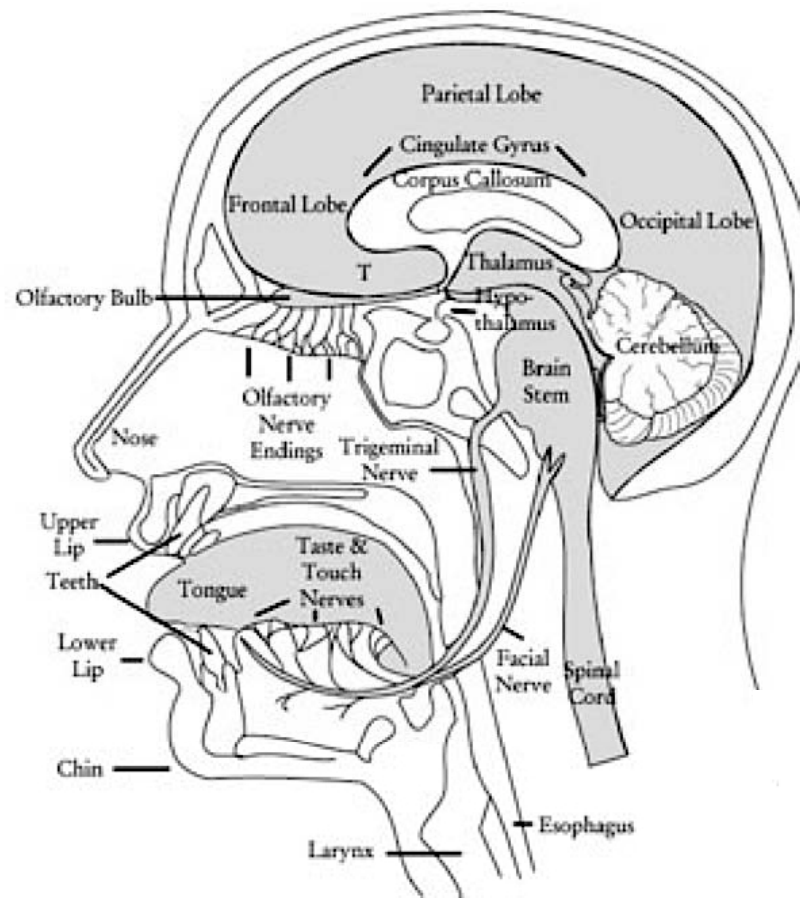
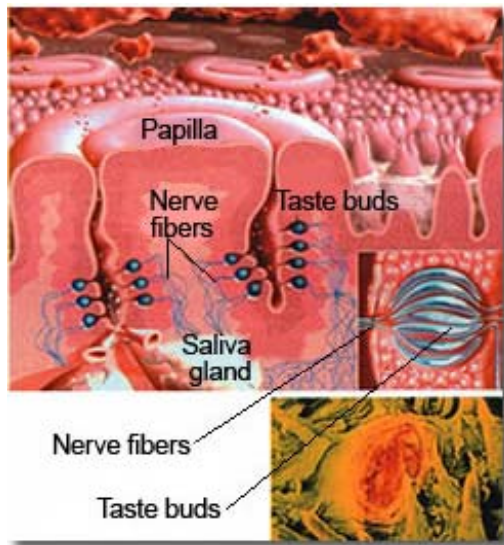
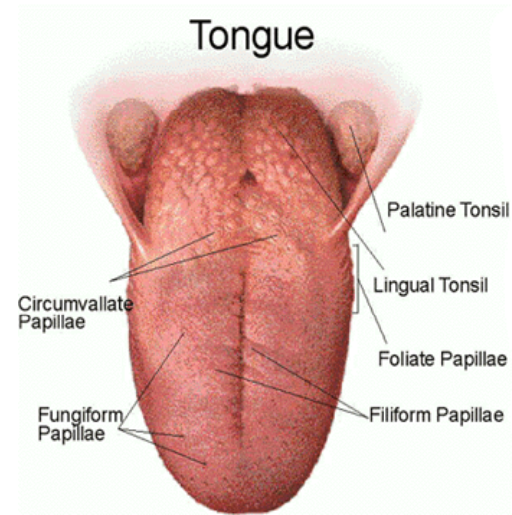
Flavour

Flavor = taste + olfaction + tactile



- 5 (ish) tastes - sweet, acid, bitter, salt, umami
- Olfaction (smell)
 - humans very sensitive sense of smell:
detect > 10 000 odors
 - orthonasal vs retronasal
- Tactile (chemesthesis)
 - astringency, heat, cold, irritation/pain

Physiology of flavour



Early evidence of variation in taste

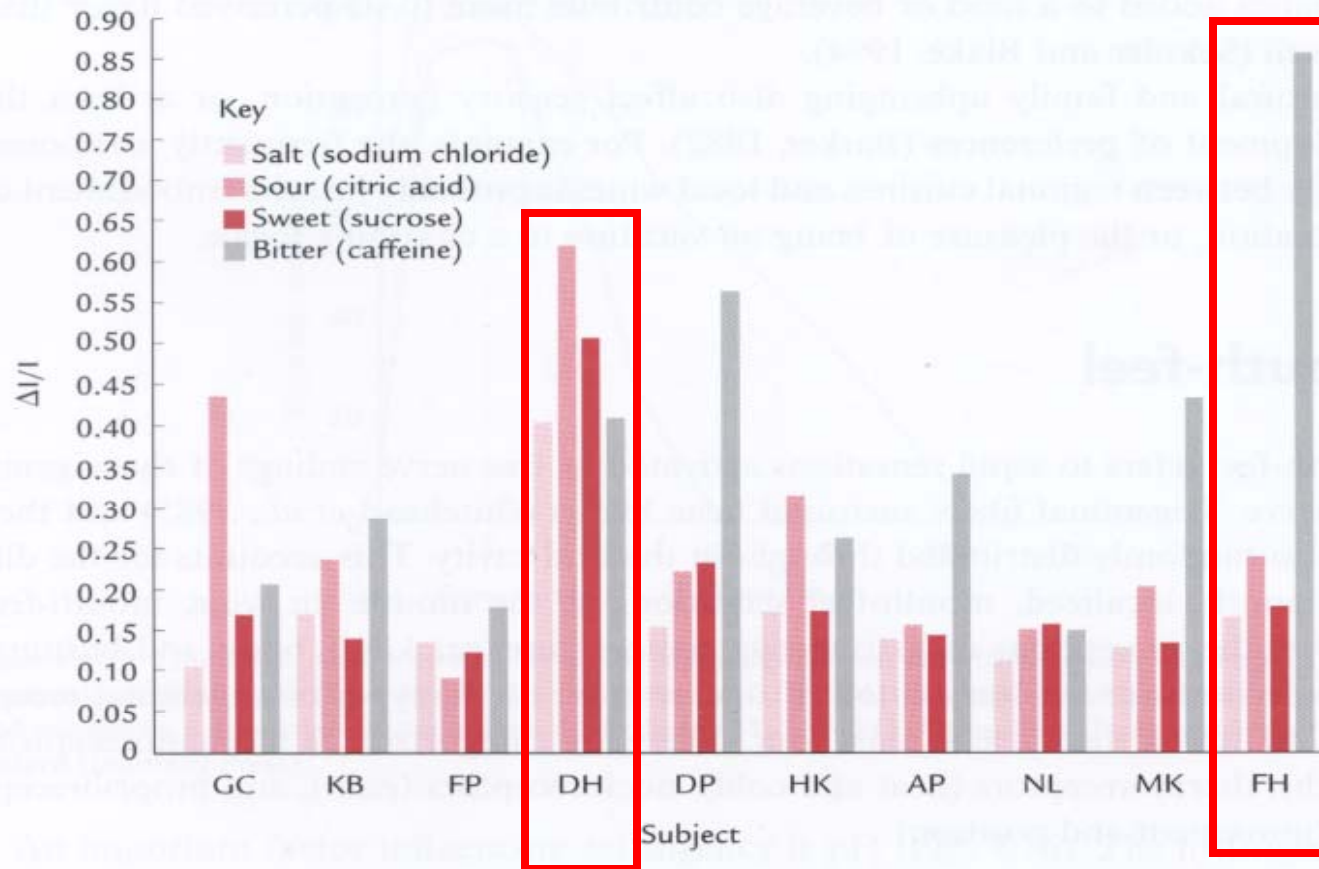


Figure 4.12 Illustration of the variability in the differential sensitivity ($\Delta I/I$) the principal taste qualities in each of 10 subjects (from Schutz and Pilgrim, 1957, reproduced with permission).

Reviewed in: Jackson, 2002



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The taste phenotype:behaviour idea



The central idea (i)

- Perceived flavour of food & beverages strongly affects liking
- Liking strongly influences food & beverage consumption
- Food & beverage consumption linked to a range of diet-related nutritional outcomes & disease risk
- Therefore

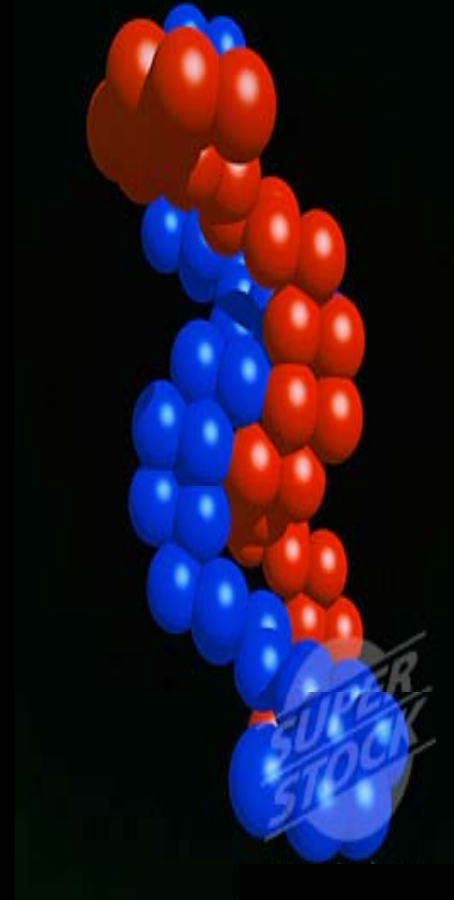
differences between individuals in perception of flavour associate with diet-related nutritional outcomes & disease risk

and

psychologists, nutritionists, epidemiologists & food/beverage producers have an interest in determining the differences between individuals in perception of flavour

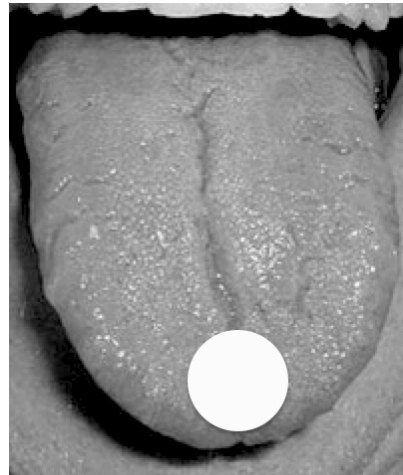
The central idea (ii)

- Biological and genetic-based differences in flavour perception are important sources of individual variation
- The PROP taster phenotype looks cool and worth pursuing
 - wine/alcoholic beverage perception ?





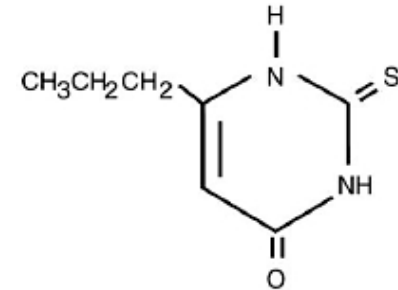
The PROP taster phenotype



Background – PROP taster phenotype

- 6-n-propylthiouracil (PROP)

- Different bitterness response
- PTS: pST > pMT > pNT



- Proxy for general taste responsiveness

(Gent & Bartoshuk, '83; Bartoshuk et al., '98; Prescott et al., '01; Karrer et al., '91; Bartoshuk et al., '93; Prescott & Swain-Campbell, '00; Tepper & Nurse, '97; Essick et al., '03).

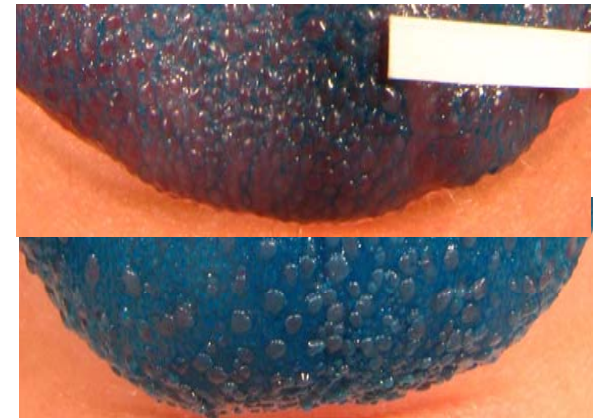
- Genetics & physiology

- *TAS2R38* (AVI/AVI, PAV/AVI, PAV/PAV)

- + other genes (Duffy et al., '04; Hayes et al., '08; Bering, '10)

- Fungiform papillae density

- (Reedy et al., '93; Bartoshuk et al., '94; Tepper & Nurse, '97; Essick et al., '03; Hayes et al., '08)



Background – PROP taster phenotype

implications for...

- **food preference** e.g. - $\uparrow \text{PROP} = \uparrow \text{☹}$ cruciferous vegetables, citrus fruit, fat (Tepper, '08; Duffy, '07)

- **alcohol intake & alcoholism ?**

Literature equivocal – more later



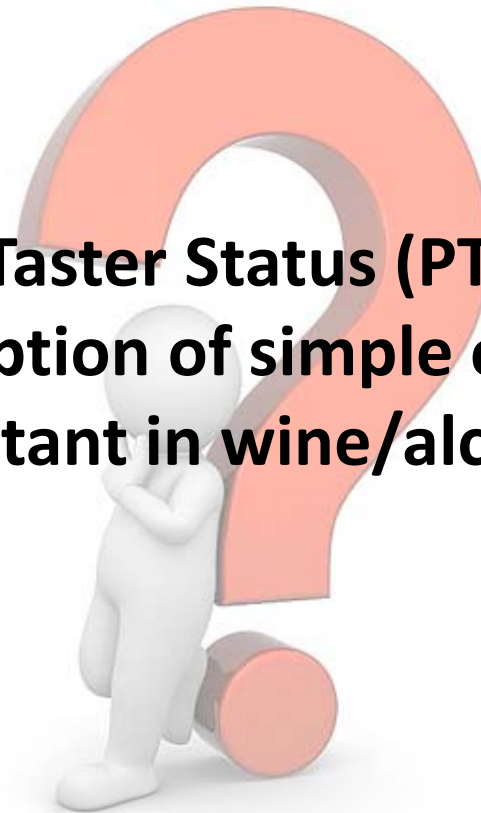
- **other health consequences**

☐PROP = ☐some cancers, body mass index (BMI), cardiovascular disease, smoking (Enoch et al., '01; DiCarlo & Schade, '98; Miluncova et al., '69; Duffy et al., '04; Tepper & Nurse, '98; Tepper & Ulrich, '02)



The PROP taster phenotype

Does PROP Taster Status (PTS) associate with perception of simple oral stimuli important in wine/alcohol?

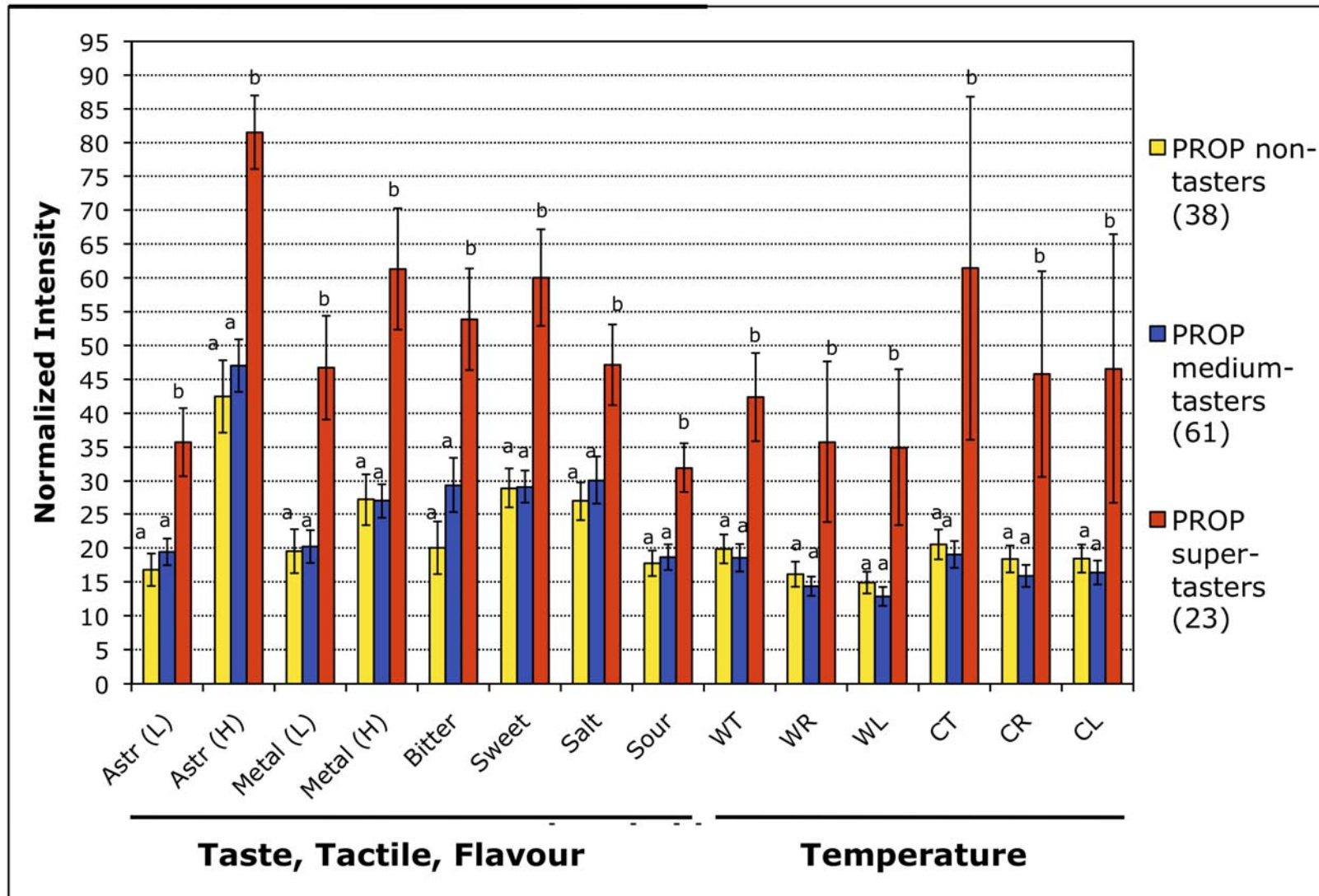


Experimental

Strongest Imaginable
—
Very Strong
—
Strong
—
Moderate
—
Weak
—
Barely Detectable
—
No Sensation

- 126 participants
- Stimuli: chemical tastants, metallic flavour, astringent (all aqueous slns), temperature
- Scale: gLMS (intensity ratings)
- PTS determined (duplicate) with 0.32 mM PROP
 - bitterness cut-offs (Porubcan & Vickers, '05)
- Data treatment & analysis:
 - standardization against a non-oral standard (brightness of the sun)
 - log10 transformation
 - Pearson's r
 - ANOVA

PTS and intensity of oral sensations





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Thermal taste, PROP responsiveness, and perception of oral sensations

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The PROP taster phenotype

Does PTS associate with perception of wine-relevant odorants presented retronasally?

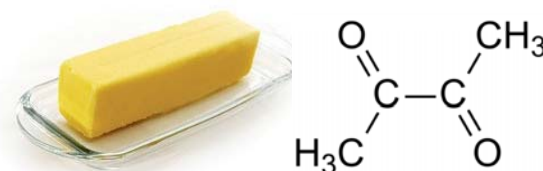


Expectation: in the presence of concurrent taste or tactile stimuli, intensity ratings for retronasally presented odorants will vary with PTS

Experimental

15 NT, 15 MT, 15 ST assessed intensity of 3 odorants (diacetyl, linalool, acetaldehyde) in aqueous solution at 3 concs in duplicate using LMS under 3 conditions:

- **Condition 1:** Orthonasally
- **Condition 2:** Retronasally
- **Condition 3:** Retronasally + an astringent (0.25g/L alum sulfate)
- **Condition 4:** Retronasally + a bitterant (0.4g/L epicatechin)





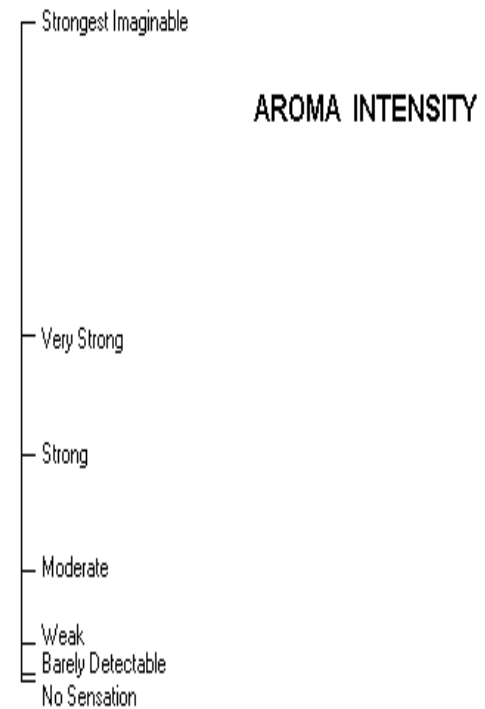


Orthonasal Aroma Evaluation



Using the protocol for assessing ortho-nasal aroma intensity, evaluate the intensity of the aroma. For example, 'Strongest Imaginable' refers to the strongest imaginable aroma.

Sample 111

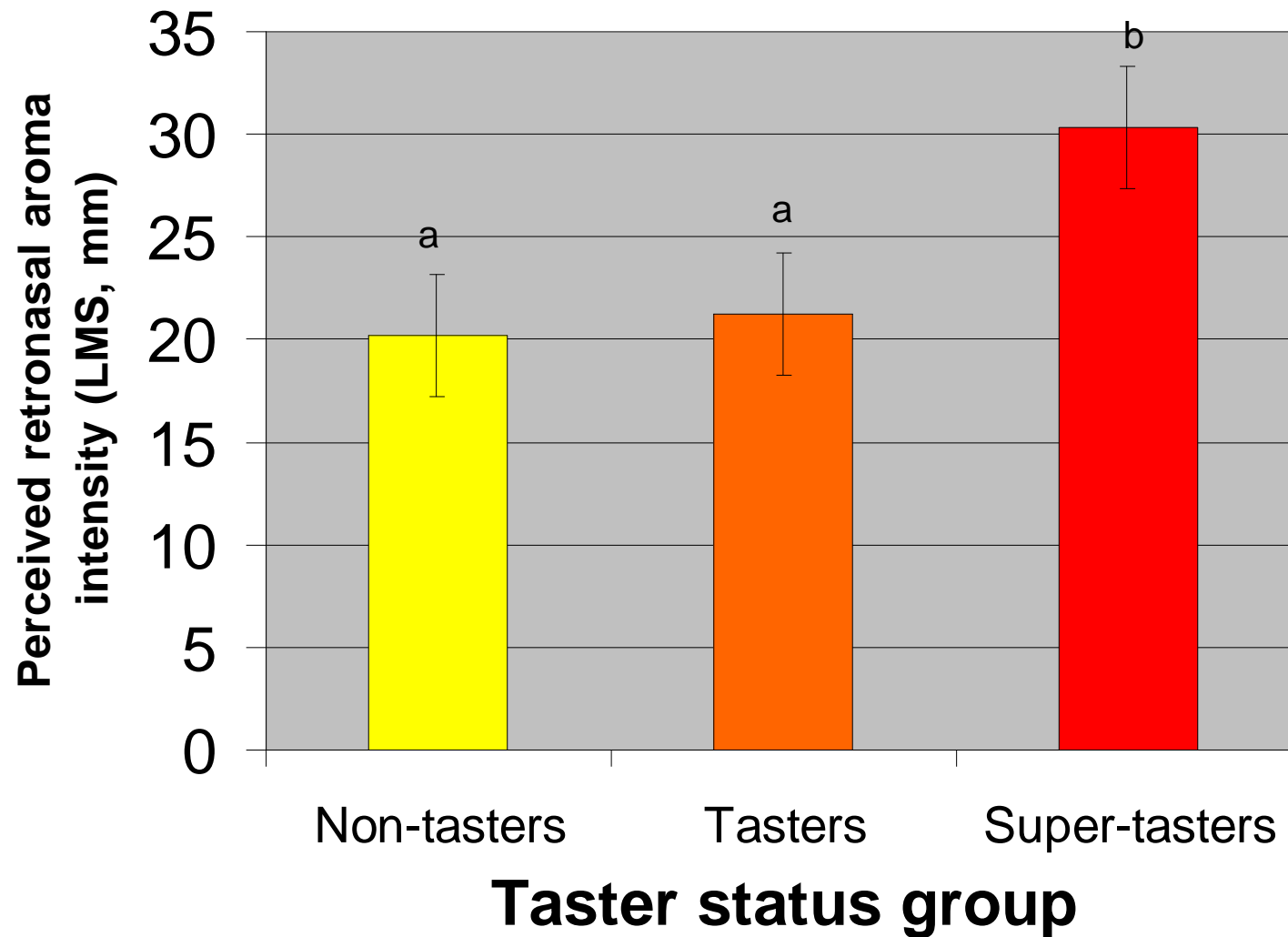


Display
Instructions

Done

Retronasal aroma intensity vs PROP-taster status group with alum sulphate

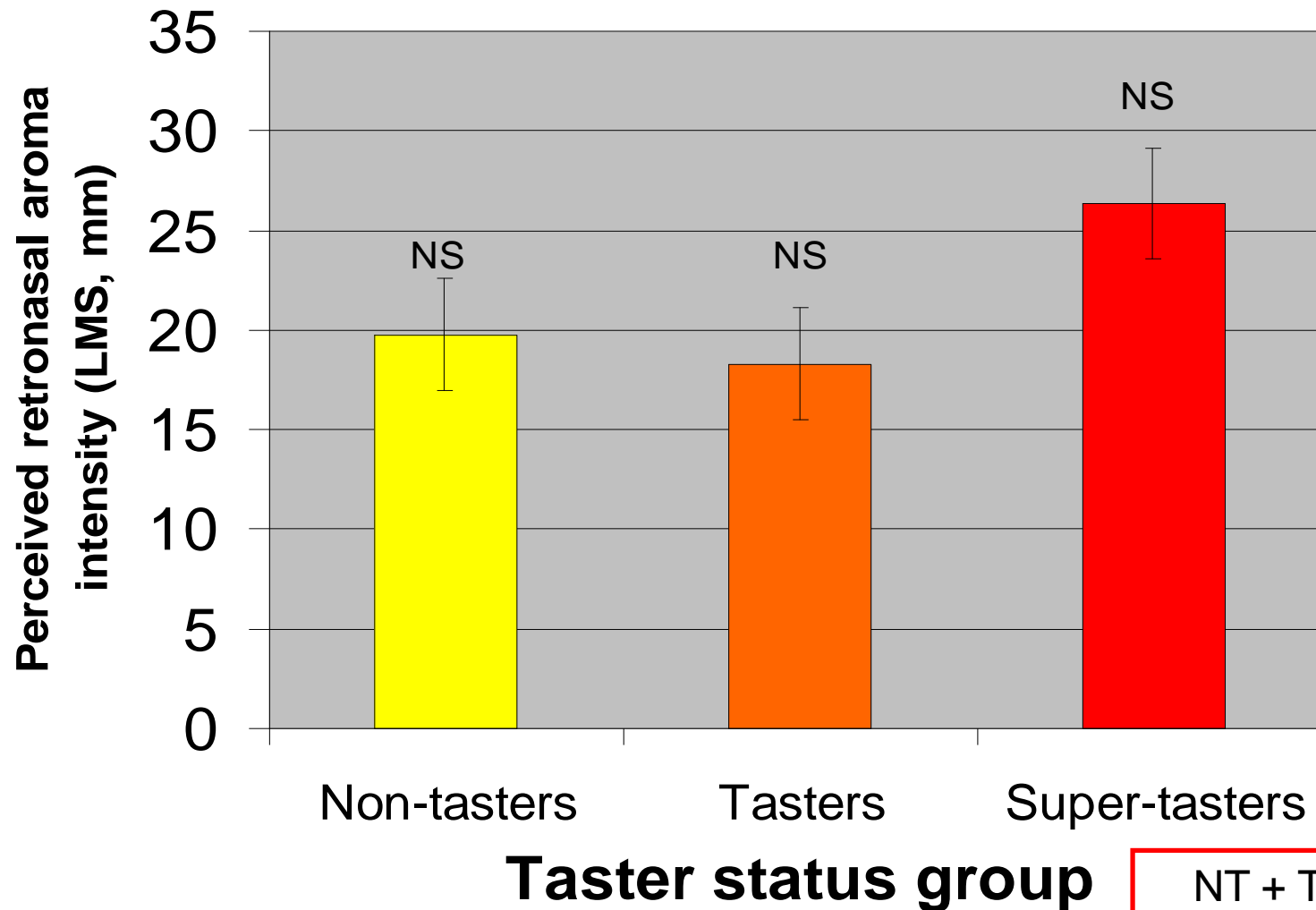
(averaged across odorants, odorant levels & replicates)



(Bonferroni_{0.05})

Retronasal aroma intensity vs PROP-taster status group with epicatechin

(averaged across odorants, odorant levels & replicates)

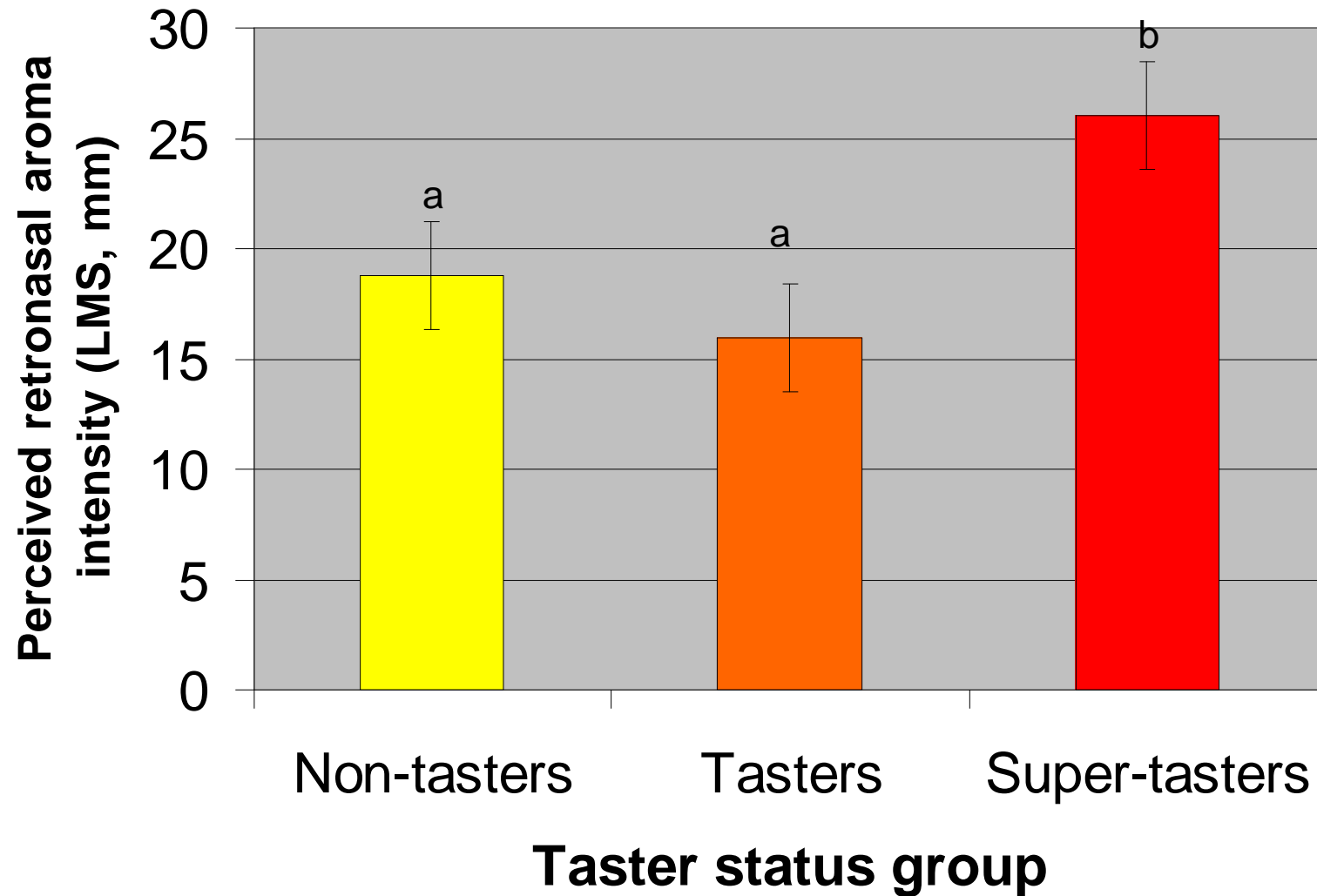


($F=2.36$, $df=2,43$,
 $p=0.107$)

NT + T vs ST is
significant (estimate
= 7.34, $p=0.036$)

Retronasal aroma intensity vs PROP-taster status group

(averaged across odorants, odorant levels & replicates)





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Food & Health

Evidence that sensitivity to 6-*n*-propylthiouracil (PROP) affects perception of retro-nasal aroma intensity

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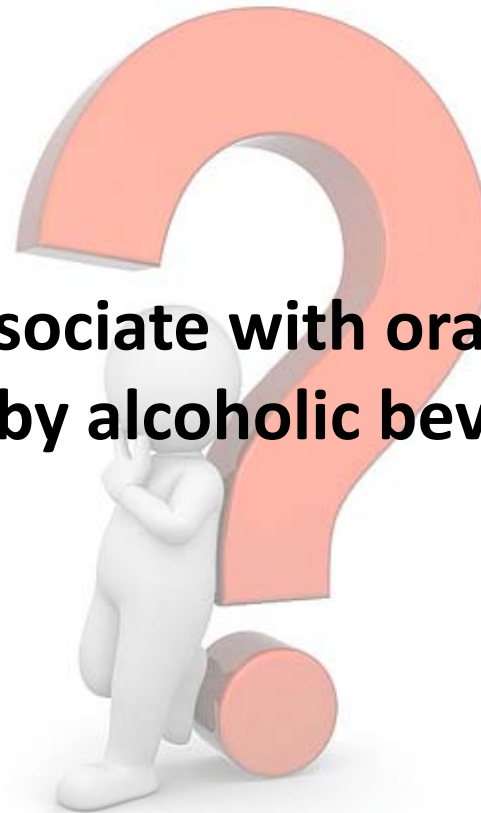
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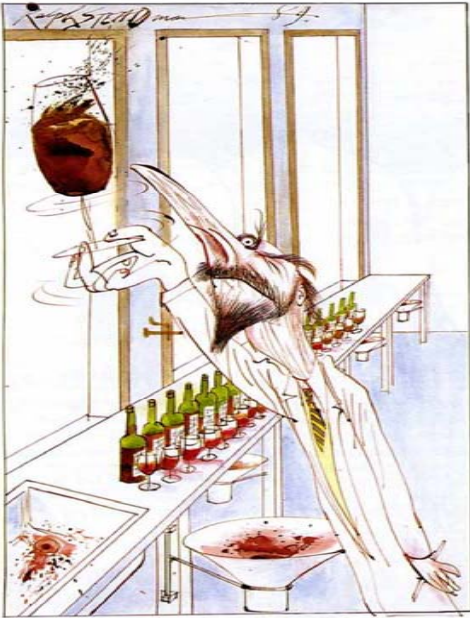




The PROP taster phenotype

Does PTS associate with oral sensations elicited by alcoholic beverages?





Experimental

- Use wine, because:
 - Many wines are bitter
 - Wines elicit tactile sensations
 - Keep Debbie happy
- 3 red commercial wines
- Dominant sensations rated in triplicate on LMS
- PTS determined per Tepper et al. ('01)

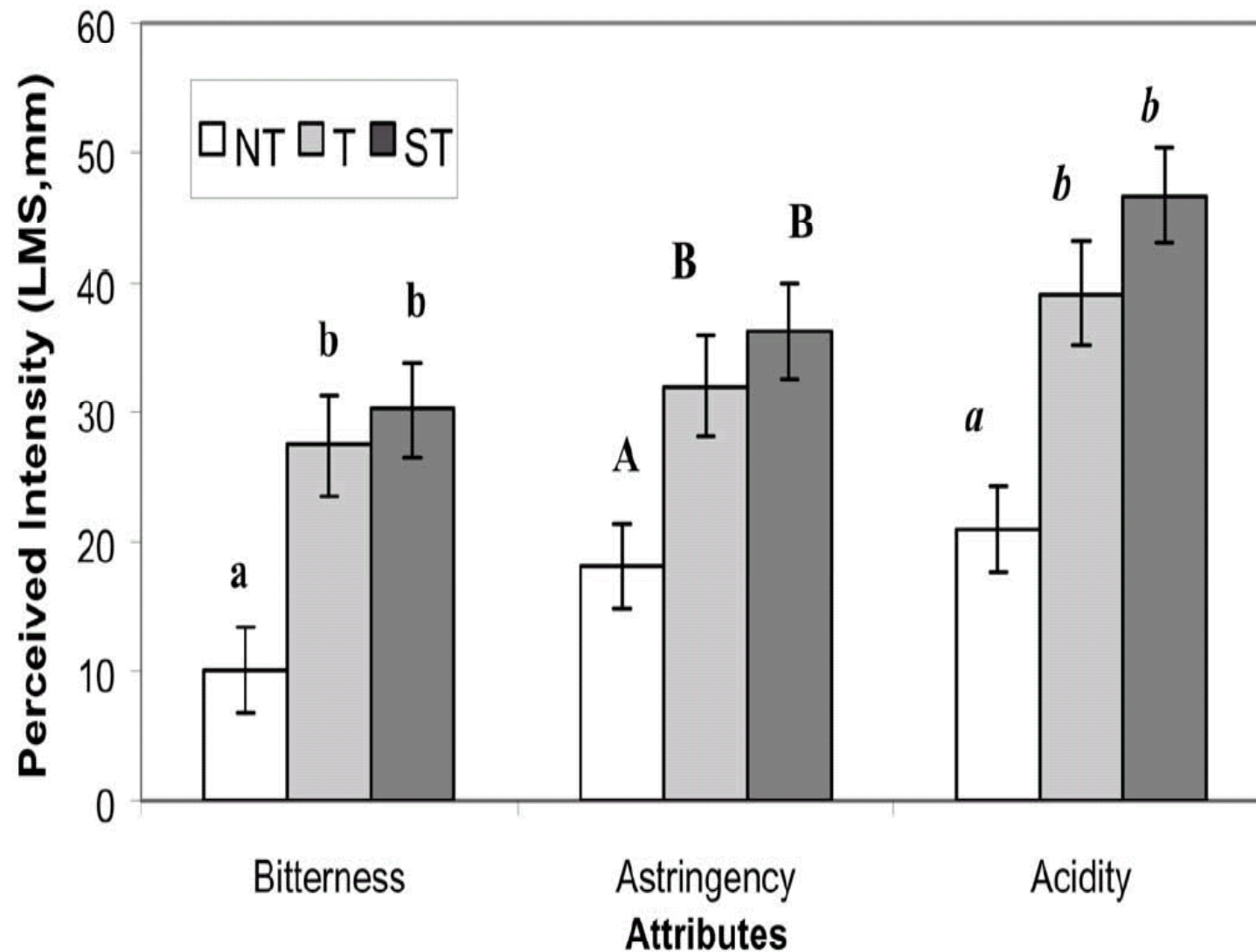
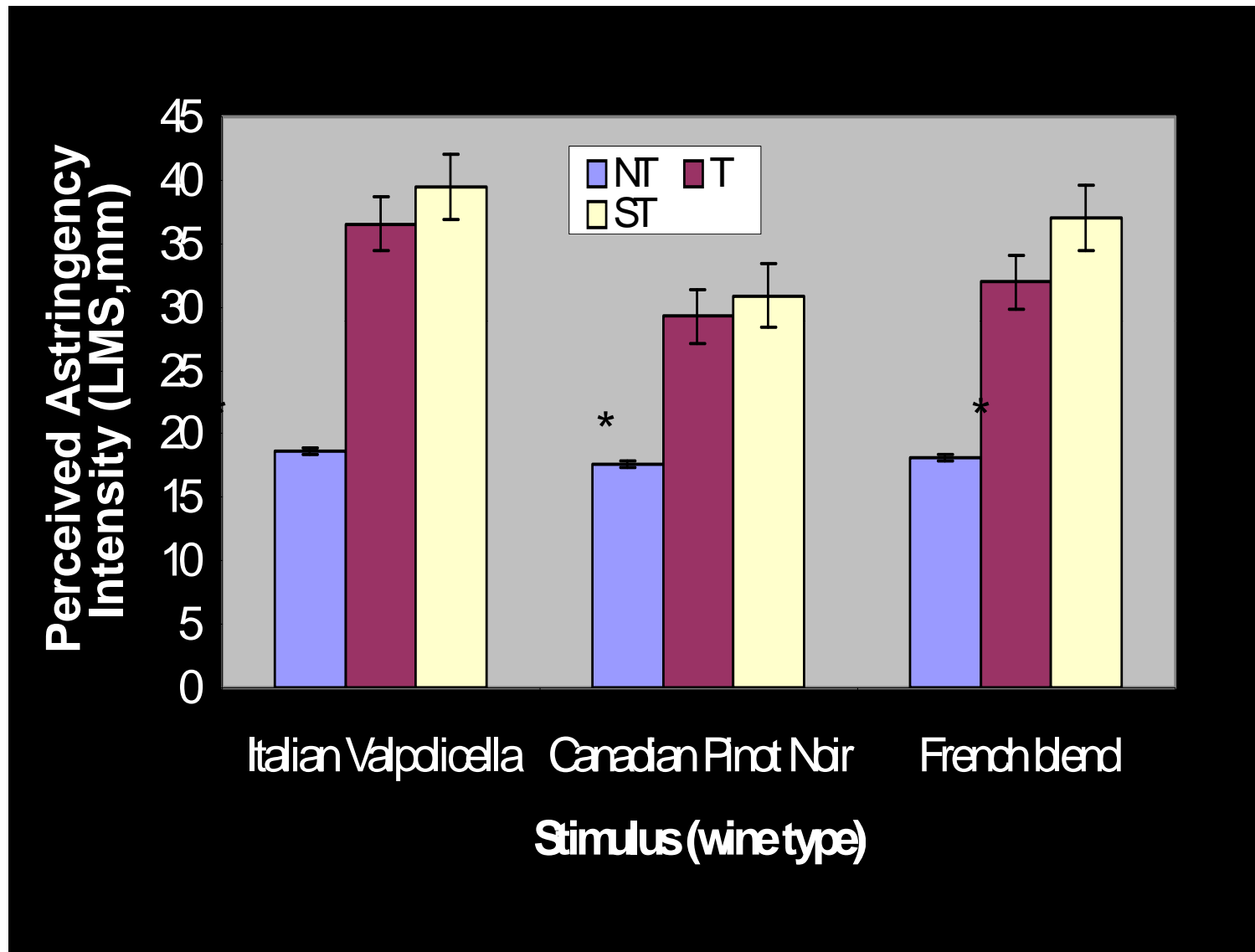
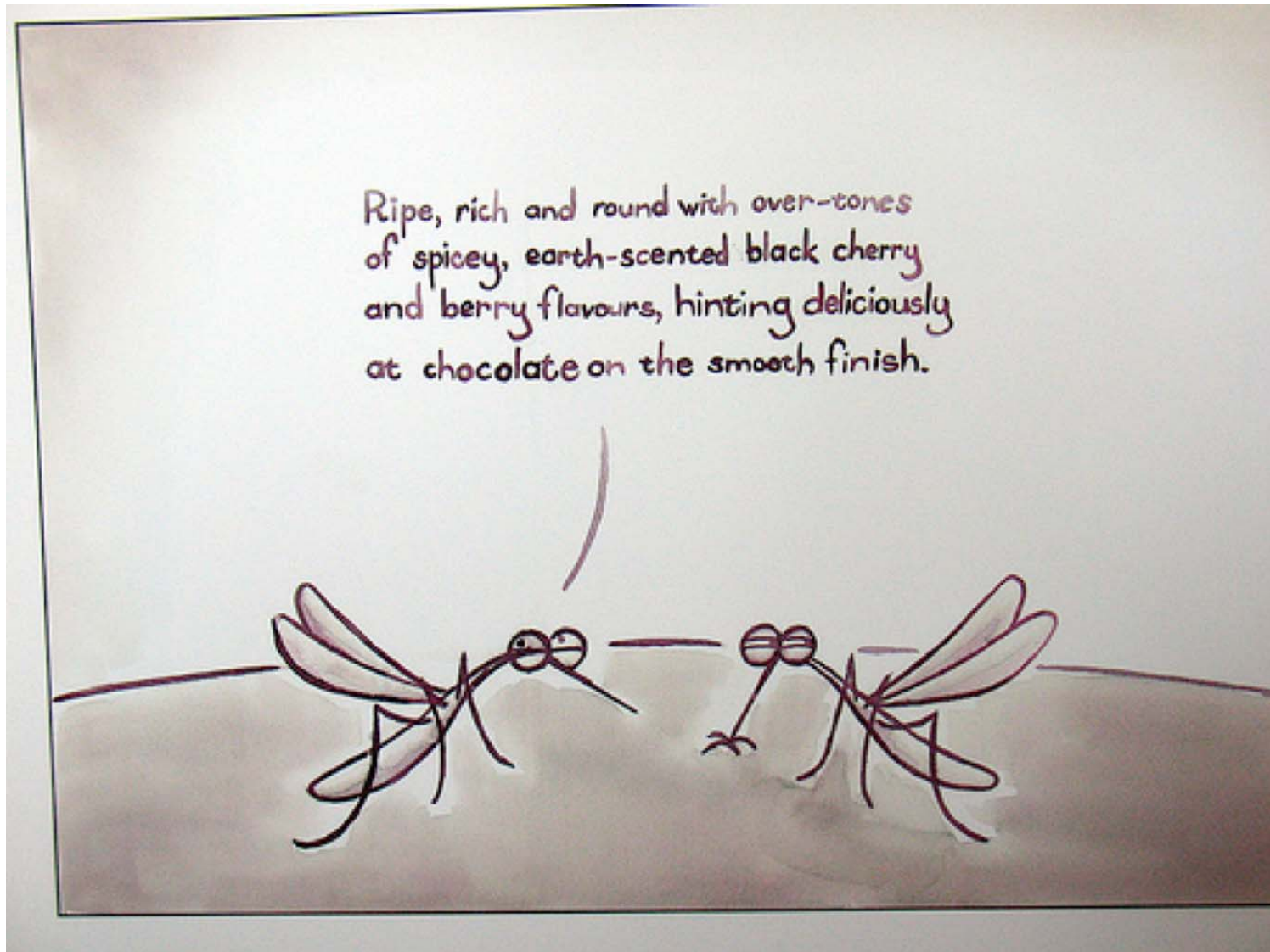


Fig. 1. Mean intensity ratings for bitterness, astringency and acidity elicited by red wines across the three taster groups; PROP non-tasters NT ($n=10$), tasters T ($n=7$) and super-tasters ST ($n=8$). Values shown are means \pm SE averaged across sessions (3), and wine types (3). For each attribute, means sharing the same letter do not differ significantly ($LSD_{0.05}$).

PROP status & astringency intensity elicited by red wine

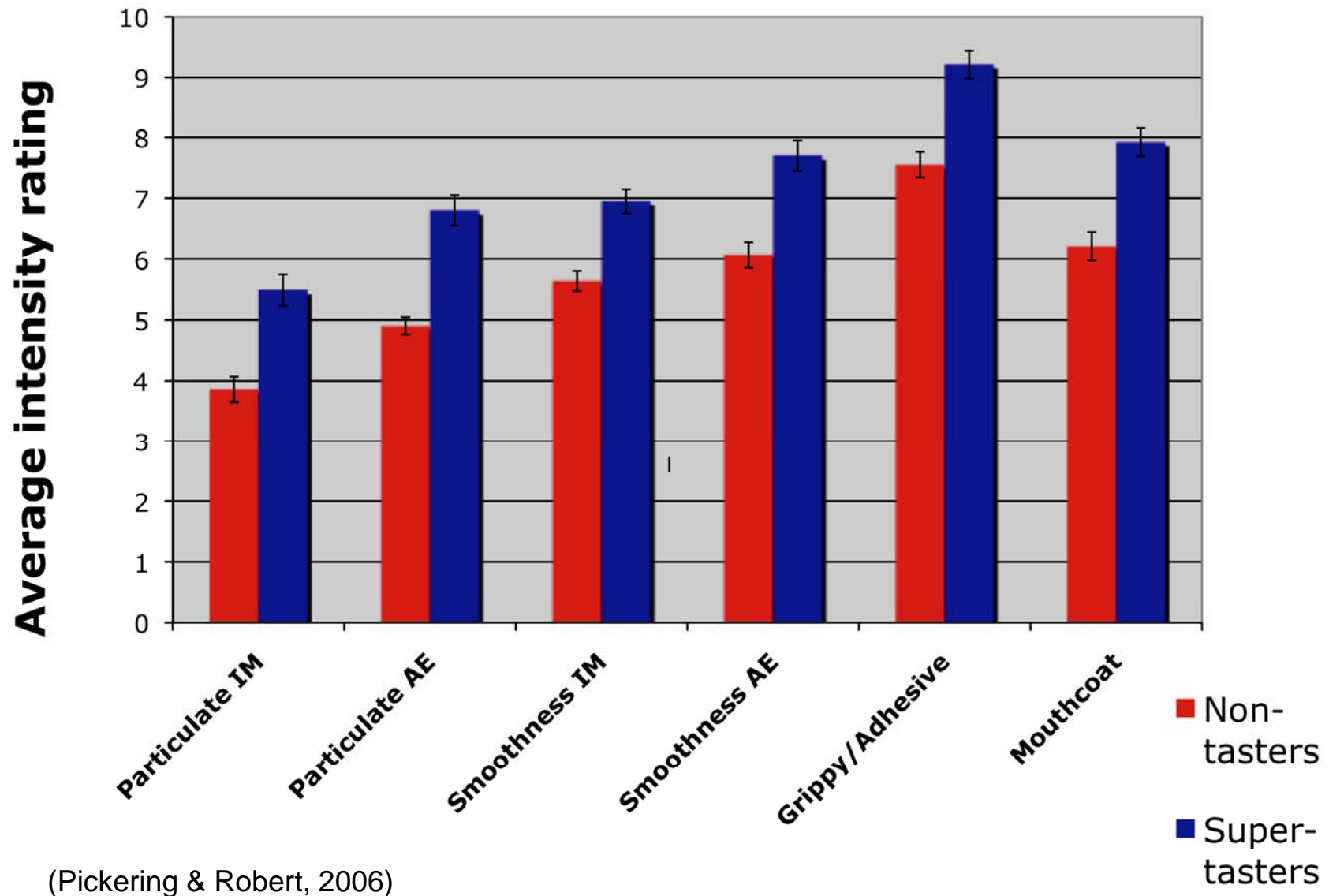


What about some of the more complex sensations?



Ripe, rich and round with over-tones
of spicy, earth-scented black cherry
and berry flavours, hinting deliciously
at chocolate on the smooth finish.

PROP status & astringency sub-quality ratings elicited by red wine ($p(t) < 0.001$)





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Food Quality and Preference 15 (2004) 147–154

Food Quality
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Intensity of taste and astringency sensations elicited by red wines is associated with sensitivity to PROP (6-n-propylthiouracil)

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PERCEPTION OF MOUTHFEEL SENSATIONS ELICITED BY RED WINE ARE ASSOCIATED WITH SENSITIVITY TO 6-N-PROPYLTHIOURACIL

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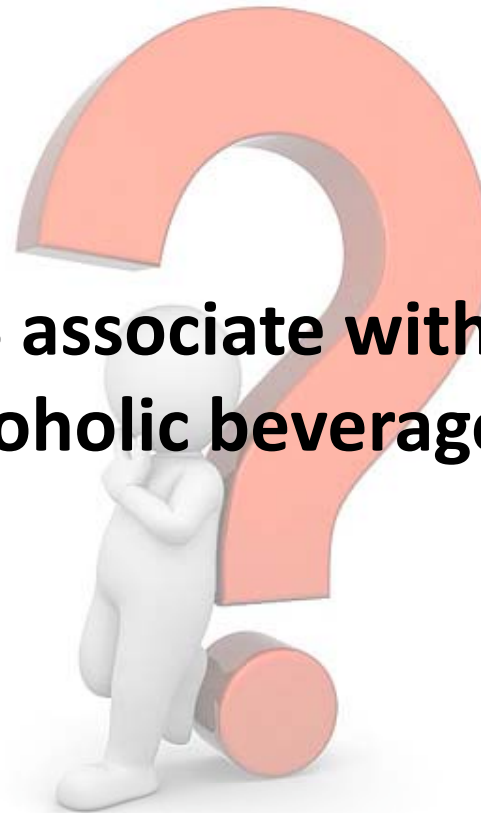
St. Catharines, Ontario L2S 3A1, Canada





The PROP taster phenotype

Does PTS associate with liking of alcoholic beverages?





Why interest in liking?

1. Liking scores can indicate preference

- If PTS groups differ in wine/alcohol preferences, may create product formulation, branding, & marketing opportunities

2. Potential measure of alcohol consumption

- In nutrition field, liking advocated as superior measure of actual dietary intake
- IF principle applies with alcohol, MAY be useful in predicting alcoholism and other alcohol-related disease risk



Pontifications

- Why expect that alcohol preference or consumption varies with PROP sensitivity?

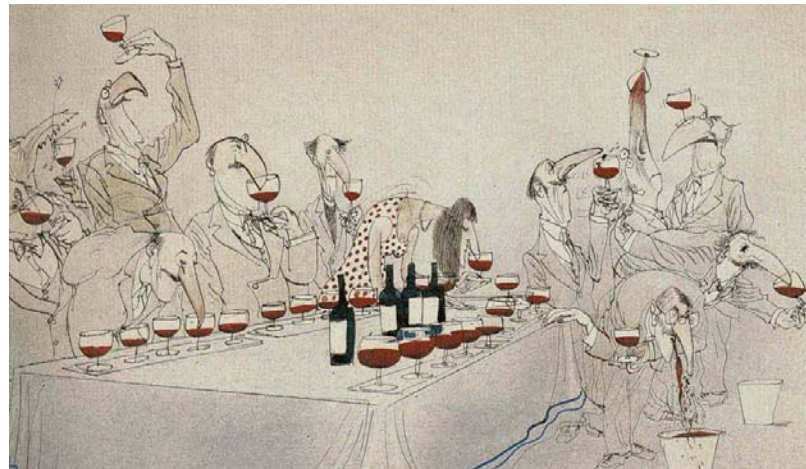
- We see it with some foods
- Some prior data, but results conflicted
- Mechanism? Alcohol is bitter (& sweet) and hot
 - STs would show an aversion to bitterness &/or heat & drink less, or
 - avoid spirits
 - greater use of mixers/diluting/sweeteners
 - STs would consume the same, but compensate for higher bitterness/heat intensity in beverage preference
 - avoid spirits
 - greater use of mixers/diluting/sweeteners

Experimental

- 123 alcohol drinking participants from Brock University student & staff populations
 - 81 females, 42 males; mean age 31.1 yrs
- PTS classification, etc, per Bajec & Pickering (2008)
- Liking scores for 43 alcoholic beverages collected on 7-point hedonic scale

Hedonic scale

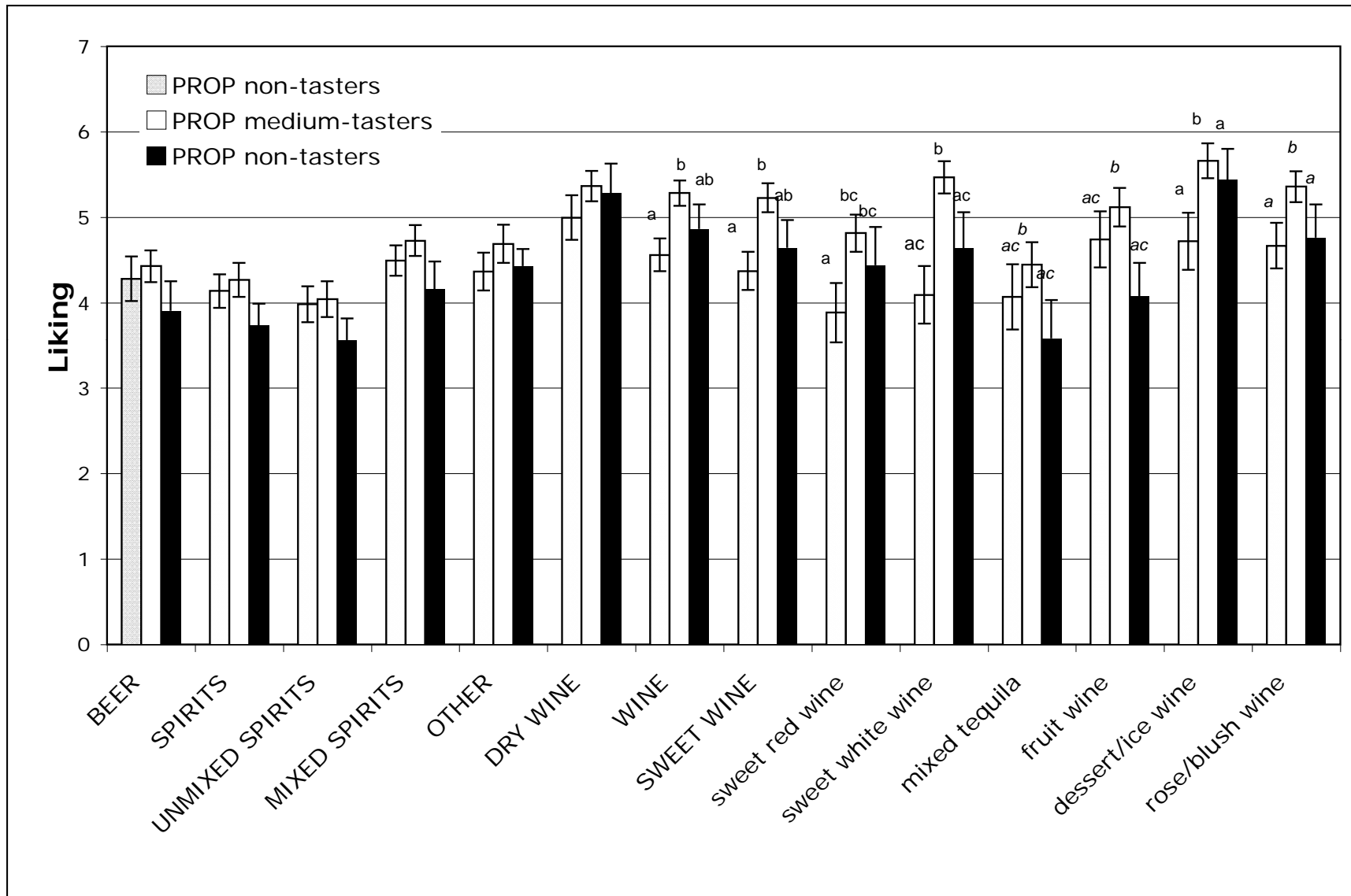
Beverage	like extremely		neither like nor dislike				dislike extremely		allergic	never tried	don't know what it is
Ale											
Pale ale											
Lager											



Alcoholic Beverage Categories

TYPE		BEVERAGE	
BEER		Ale	Mild/Brown
		Pale Ale	Pilsner
		Lager	Strong
		Lambic	Stout/Porter
		Light	Wheat
SPIRITS	UNMIXED	Bitters	Rye
		Bourbon	Scotch
		Brandy	Bitter/Sour/Spicy Shots
		Gin	Sweet Shots
		Rum	Tequila
	MIXED	Vodka	
		Mixed Bourbon	Mixed Rye
		Mixed Gin	Mixed Tequila
		Mixed Rum	Mixed Vodka
WINE	DRY	Dry Sparkling	Dry Red
		Dry White	
	SWEET	Sweet Sparkling	Rose/Blush Wine
		Sweet Red	Fruit Wine
		Sweet White	Desert/Ice Wine
OTHER		Wine Cooler	Cider
		Rum Cooler	Sherry
		Cream Liqueurs	Port
		Clear Liqueurs	

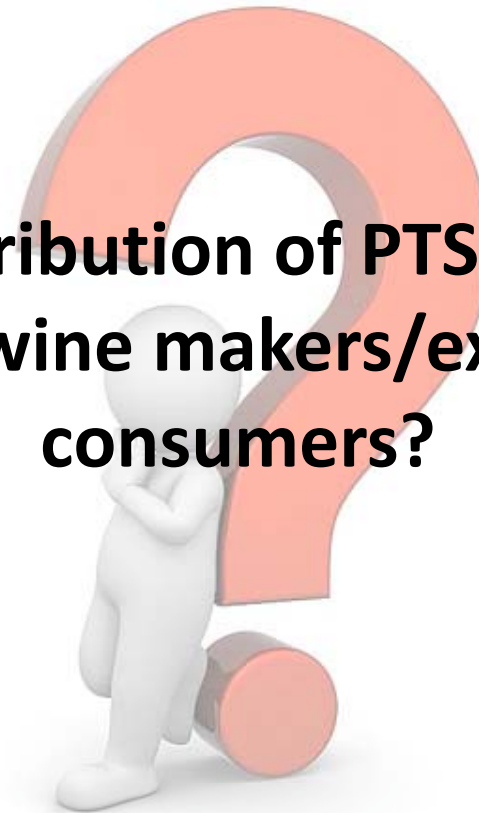
Alcoholic beverage liking - PTS





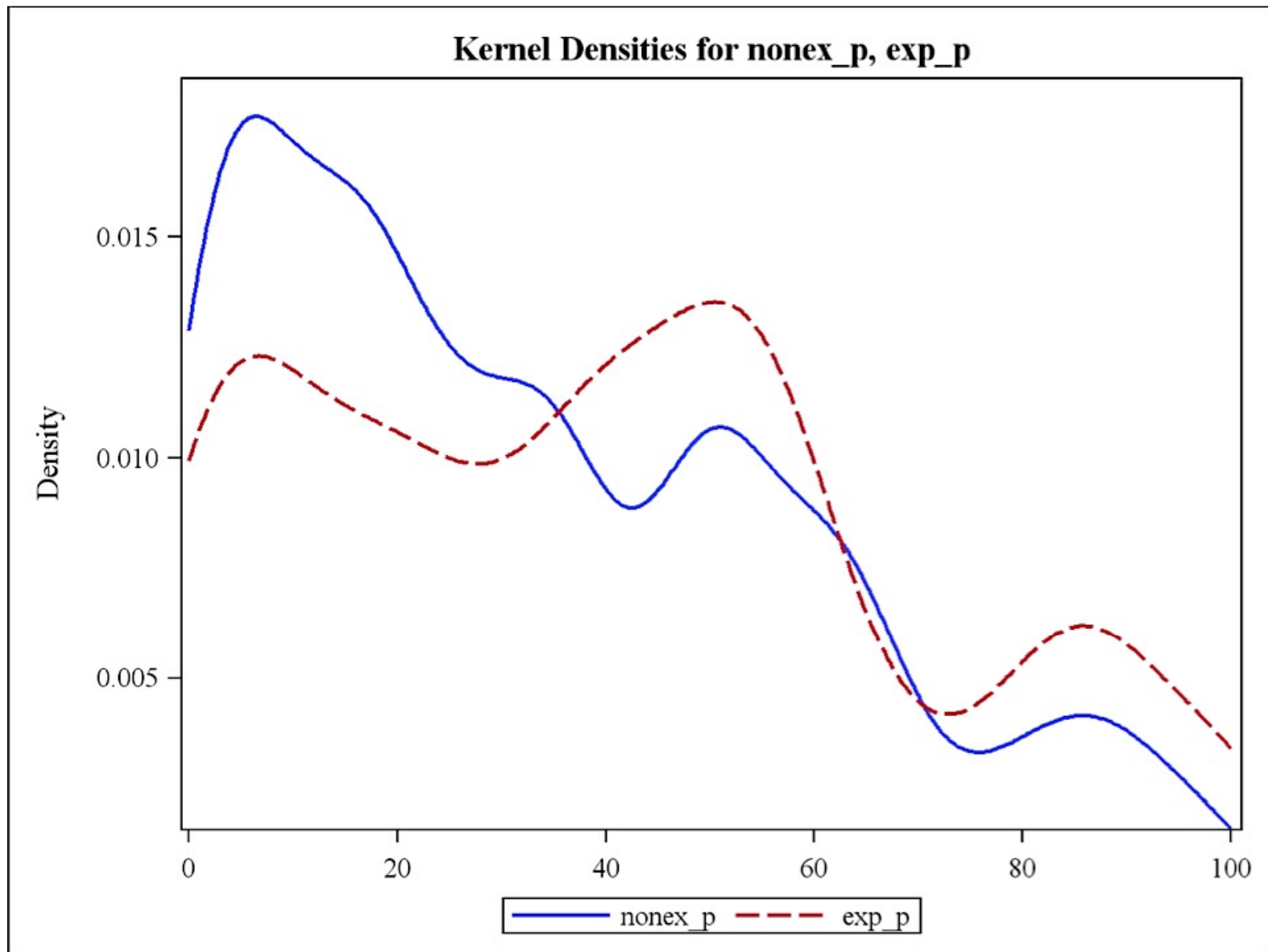
The PROP taster phenotype

Does the distribution of PTS groups differ between wine makers/experts and consumers?



Experimental

- A convenience sample of Ontario wine drinkers (n=330) recruited and phenotyped for PROP bitterness via filter paper disk.
- Also filled out a short questionnaire regarding willingness to try new foods & alcoholic beverages, as well as level of wine involvement
 - level of wine involvement used to classify them as a wine expert (n=110) or wine consumer (n=220).



Differences in PROP distribution across wine experts and non-experts (Pickering & Hayes, 2011 in preparation)



Results + thoughts

- Mean PROP bitterness higher among wine experts than wine consumers
- The conditional distribution functions differed between experts and consumers
- Data suggest individuals may self-select for specific professions based on sensory ability (i.e., an active gene-environment correlation)
- Think about:
 - implications for wine experts as authority figures in guiding consumer purchase decisions
 - “winemakers making wine for winemakers”

Summary

- PROP 'Supertasters' more responsive than others to wide range of taste & tactile stimuli relevant to wine/alcohol
- PROP STs more responsive than others to retronasal aroma
- PROP STs and medium tasters more responsive to dominant wine sensations than non-tasters
- PROP STs more responsive to subtle mouthfeel sensations in wine than non-tasters
- PROP medium tasters tend to like alc. beverages more than STs or NTs
- Wine experts more likely to be STs or MTs

Conclusion: Supertasters and winemakers are freaks !

Further research

- Predictive models of wine/alcohol liking & preferences based on PTS, expertise, gender, beverage neophobia and other taste phenotypes (PSU)
- Does greater liking in MTs translate into higher alcohol consumption/alcohol-related disease risk? (SUNY-UB + Rutgers)
- What sensory features of wine are responsible for different wine preferences between the PTS groups?
- Wine development, formulation and marketing opportunities from market segmentation by 'taste' types
- Other taste phenotypes (thermal tasters)





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