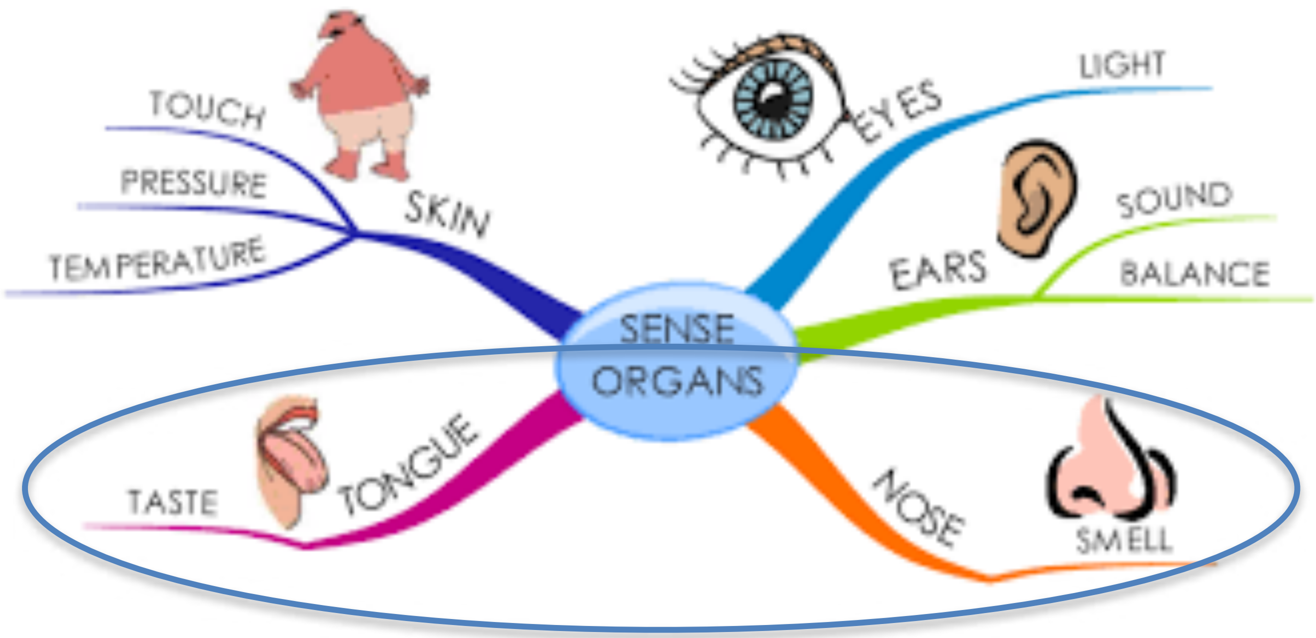
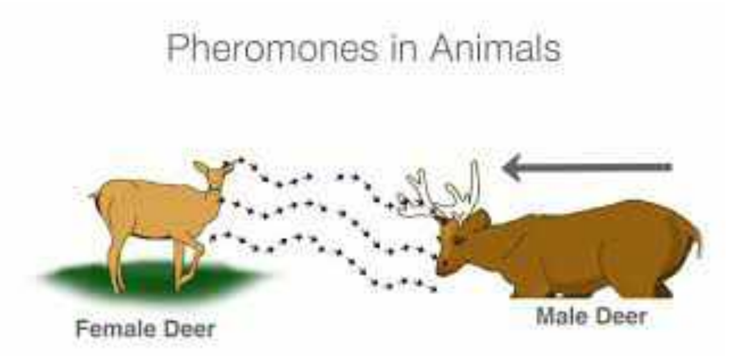
Sensory Systems



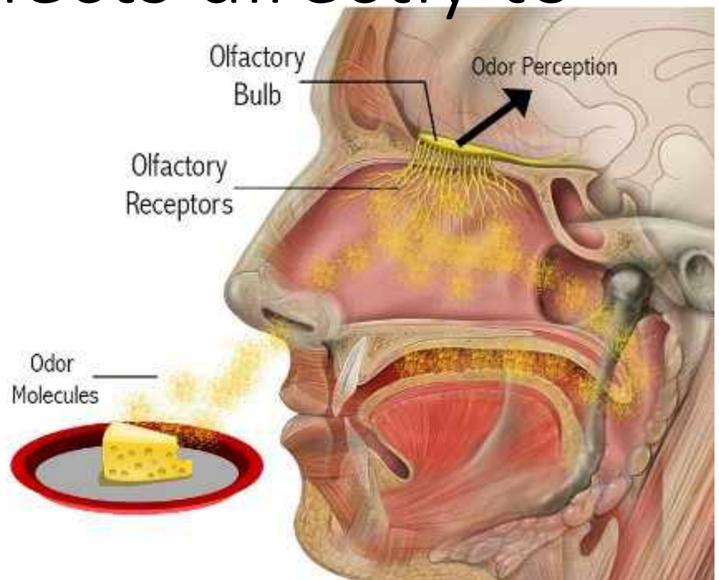
Sensory Systems: Olfaction

- Sense of Smell
  - important for survival
    - e.g.: toxins, food, reproduction
  - animals superior to humans in their olfactory abilities
  - detection of *pheromones* that in turn effects the behaviour of others of its species (typical in animals)
    - e.g. mating, fighting, marking territory in animals

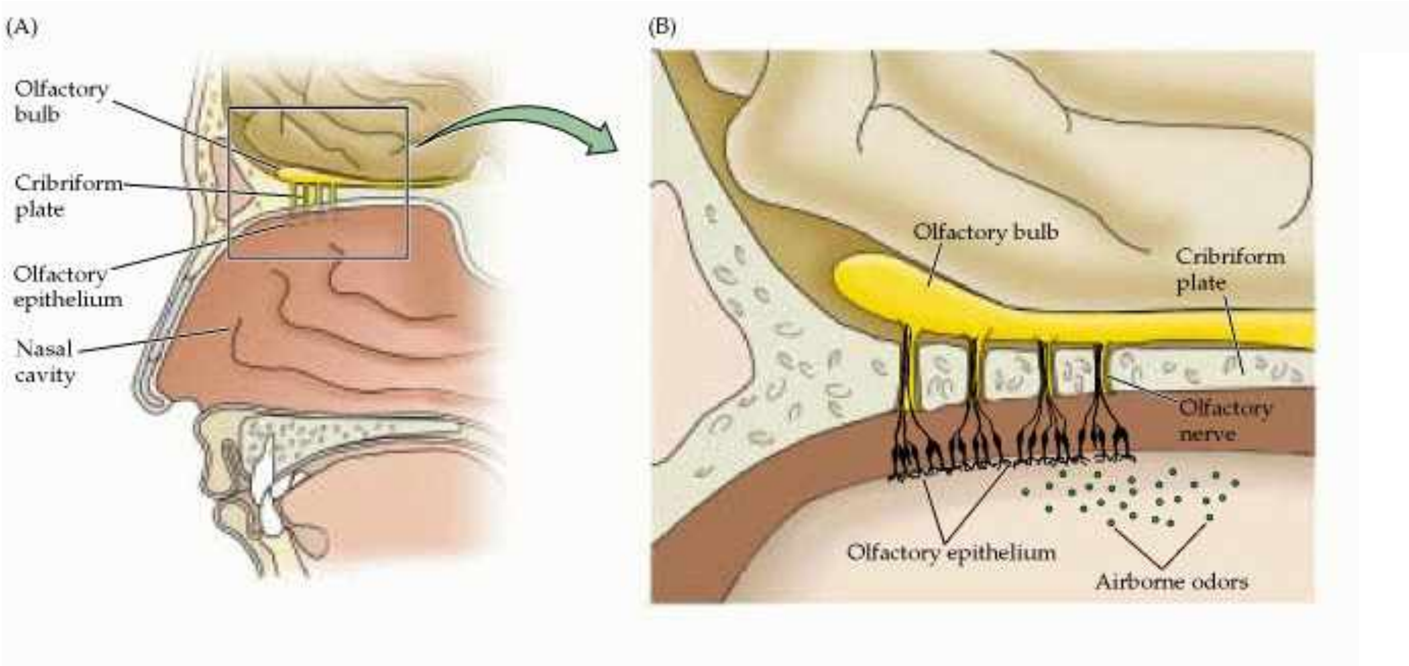


Sensory Systems: Olfaction

- detects odour molecules in our food and environment - chemoreceptors
- receptors present in nasal cavity
- send input to olfactory bulb in forebrain
- olfactory system is the only human sense that bypasses the thalamus and connects directly to the forebrain

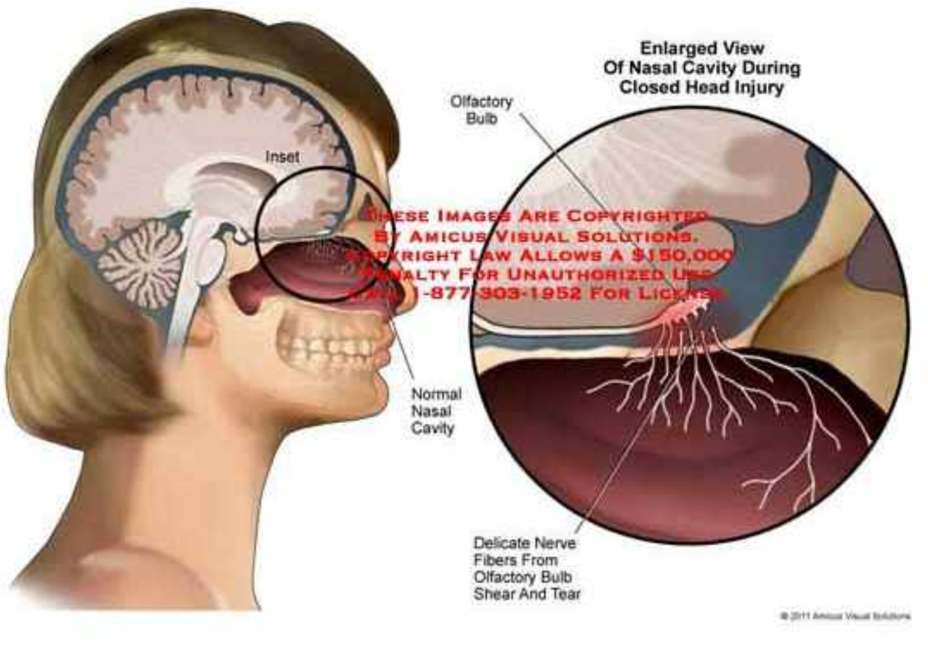


Sensory Systems: Olfaction



Each odor activates a different pattern of glomeruli

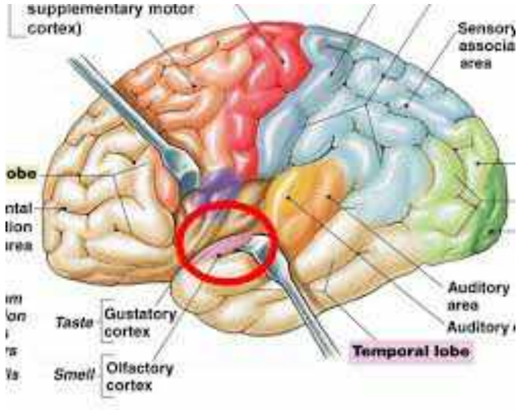
Anosmia


Enlarged View
Of Nasal Cavity During
Closed Head Injury
Olfactory
Bulb
Inset
Normal
Nasal
Cavity
Delicate Nerve
Fibers From
Olfactory Bulb
Shear And Tear

Gustation

Sensory Systems: Gustatory

- Importance:
  - Survival value
    - discrimination between nutrients and toxins (Scott, 1992)
    - provides pleasure
    - gustatory cortex **not the same** as tongue area of the somatosensory cortex but close



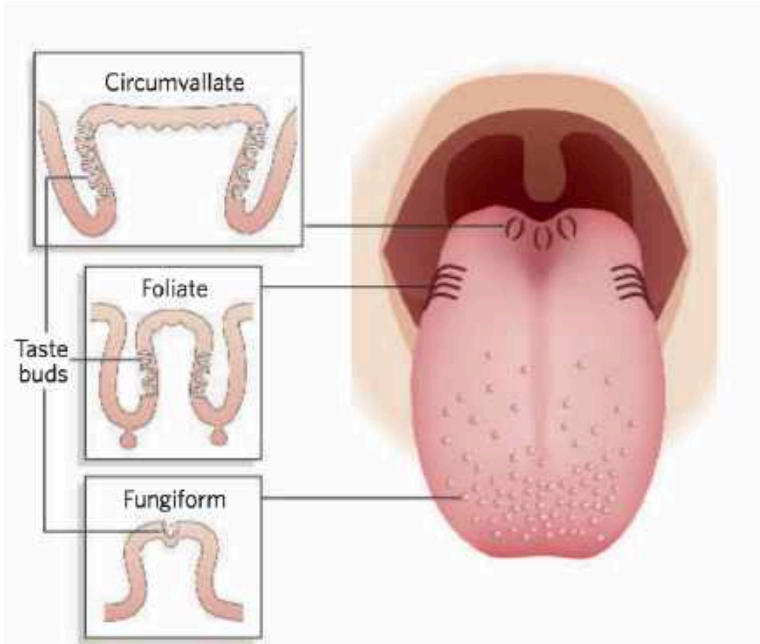
Sensory Systems: Gustatory

- Sense of taste
    - Sweet
    - Sour
    - Salty
    - Bitter
    - Umami (glutamate molecule)
  - “Taste” results from complex patterns of neural activity produced by ***taste buds***
  - *taste buds* - contain receptors

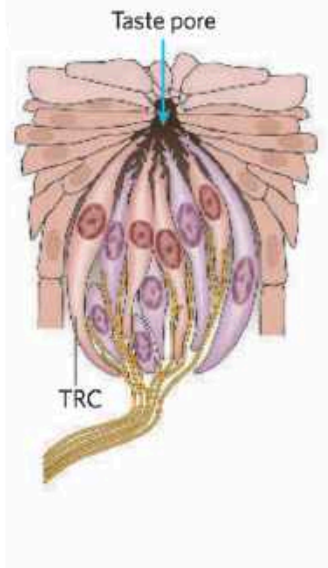
Umami????!!!

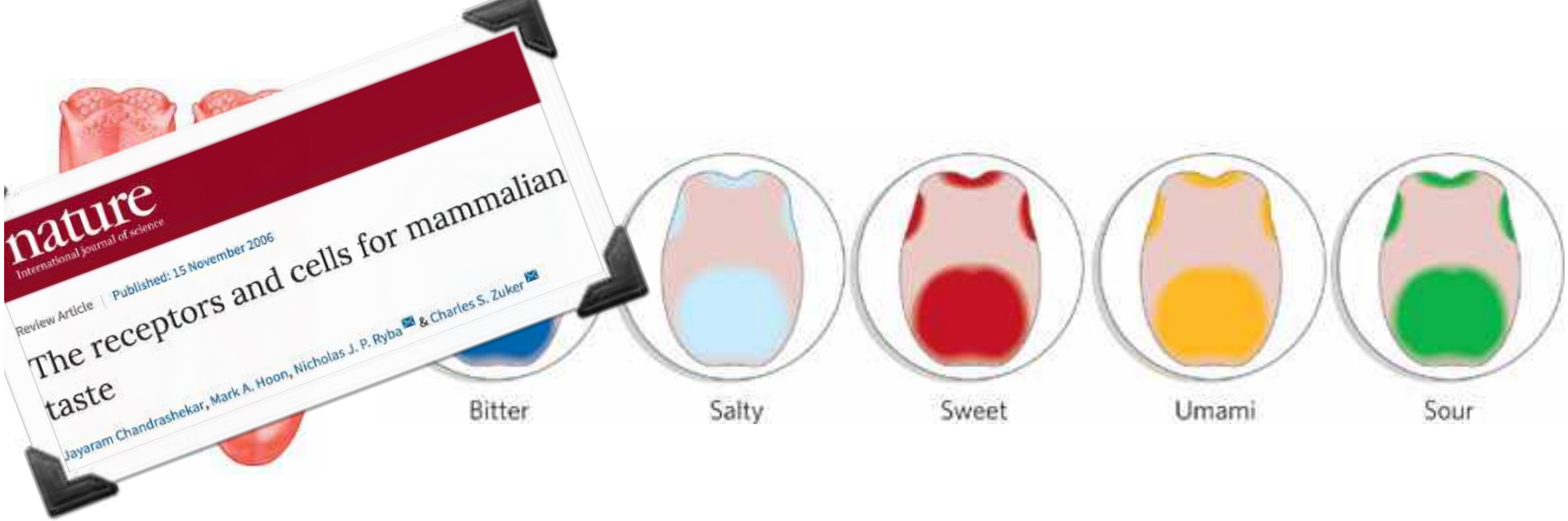
- Japanese word - “deliciousness”
- pleasant savoury taste
- by itself it is not palatable
- feeling of satiety, less craving

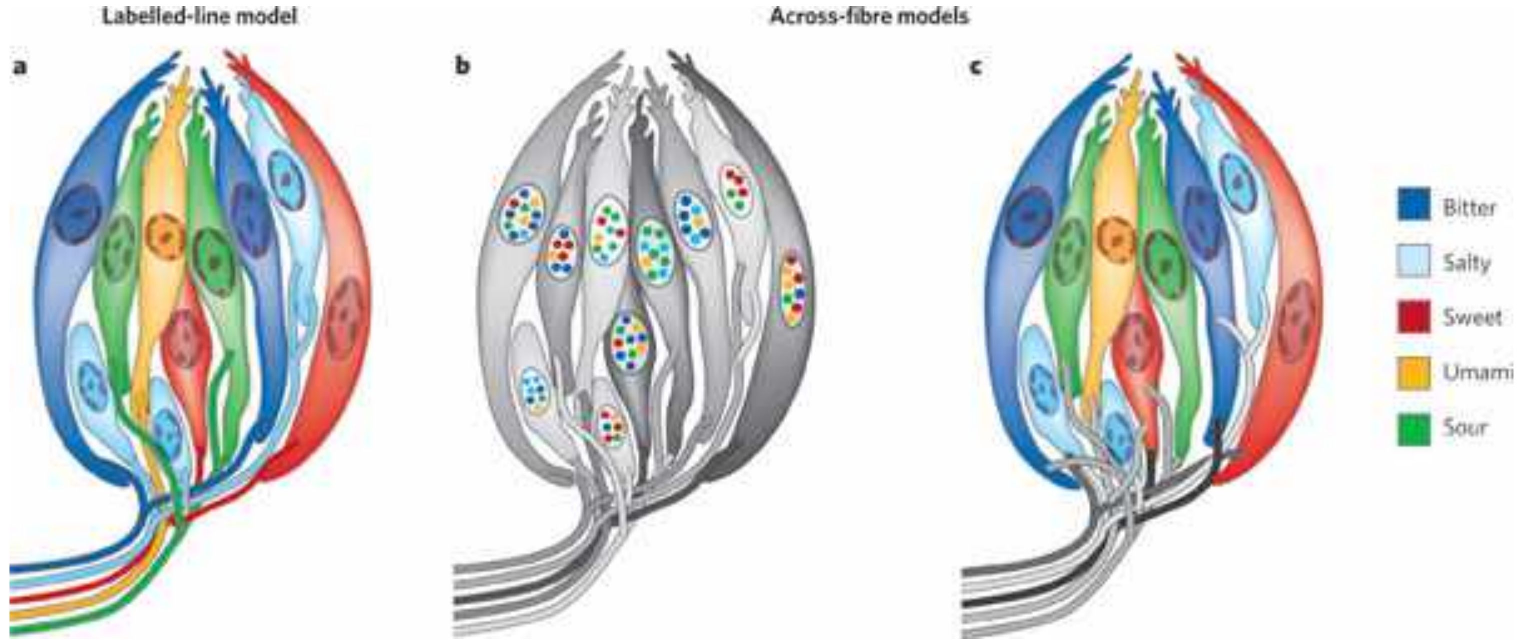
Tongue

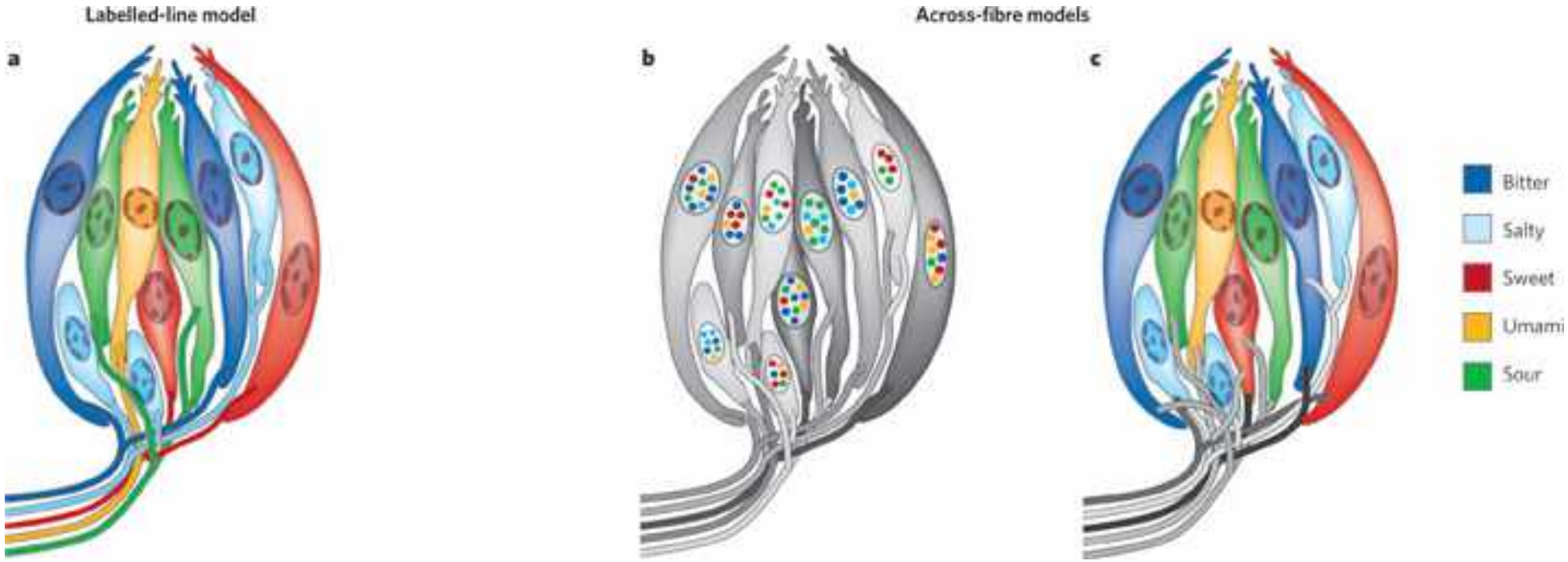


- bumps on tongue - *papillae* (3 kinds)
- taste buds located in *papillae* - contain receptor cell
- each taste bud has taste receptor cells for molecules of all 5 taste qualities




nature
International journal of science
Review Article | Published: 15 November 2006
The receptors and cells for mammalian taste
Jayaram Chandrashekar, Mark A. Hoon, Nicholas J. P. Ryba & Charles S. Zuker
Bitter
Salty
Sweet
Umami
Sour


Labelled-line model
Across-fibre models
a
b
c
Bitter
Salty
Sweet
Umami
Sour

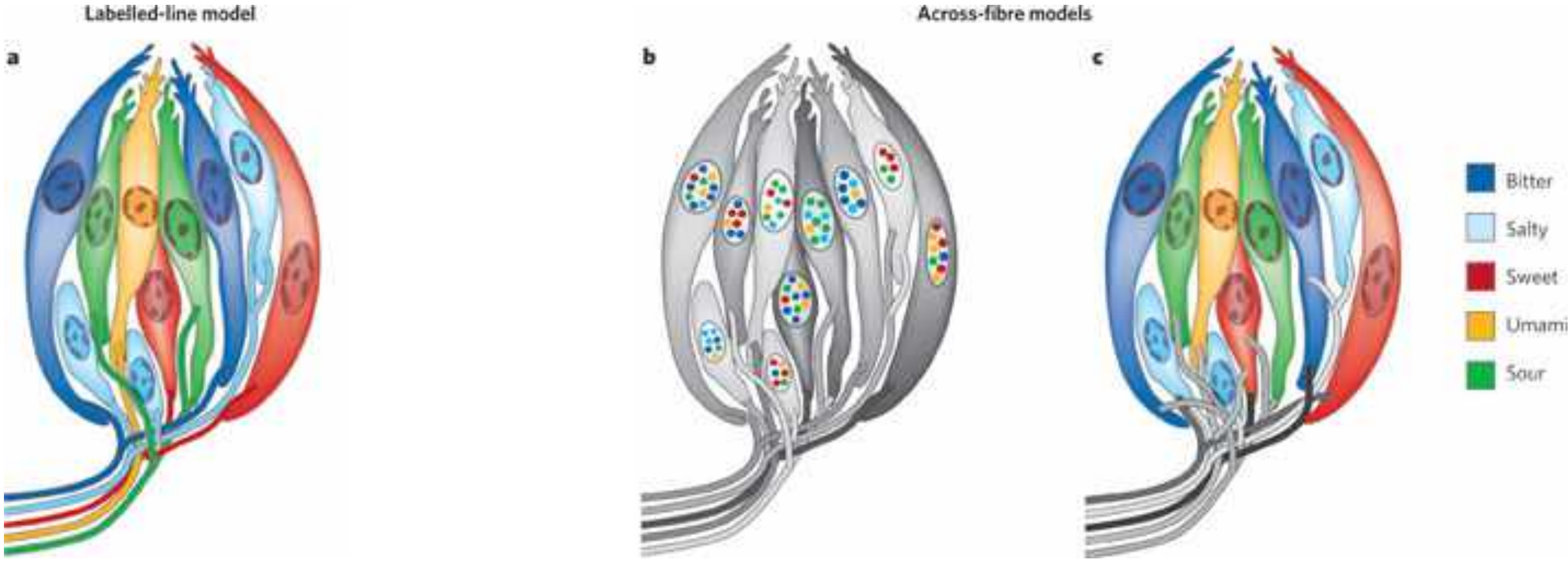


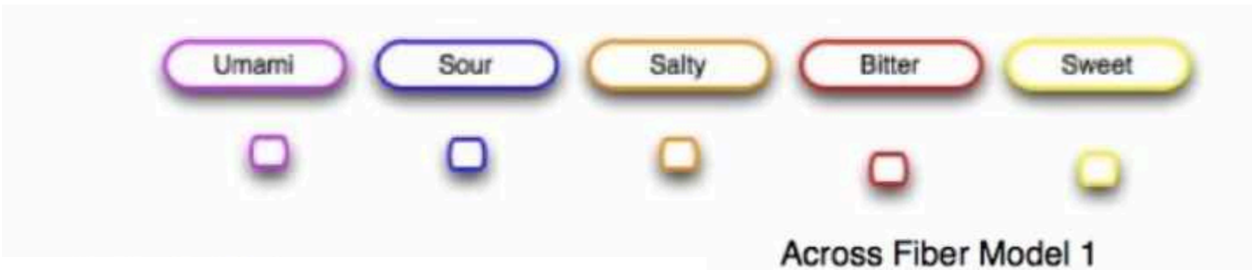
Labeled-line

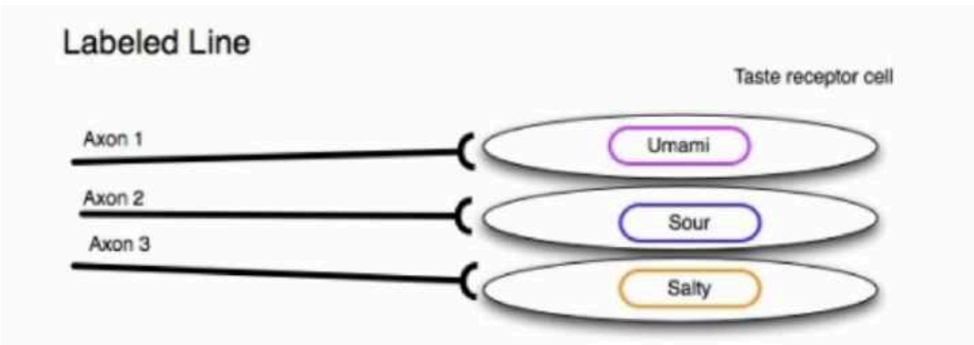
- receptor cells are tuned to respond to single taste modalities — sweet, bitter, sour, salty or umami - **dedicated line**
- each taste quality is specified by the activity of non-overlapping cells and fibres

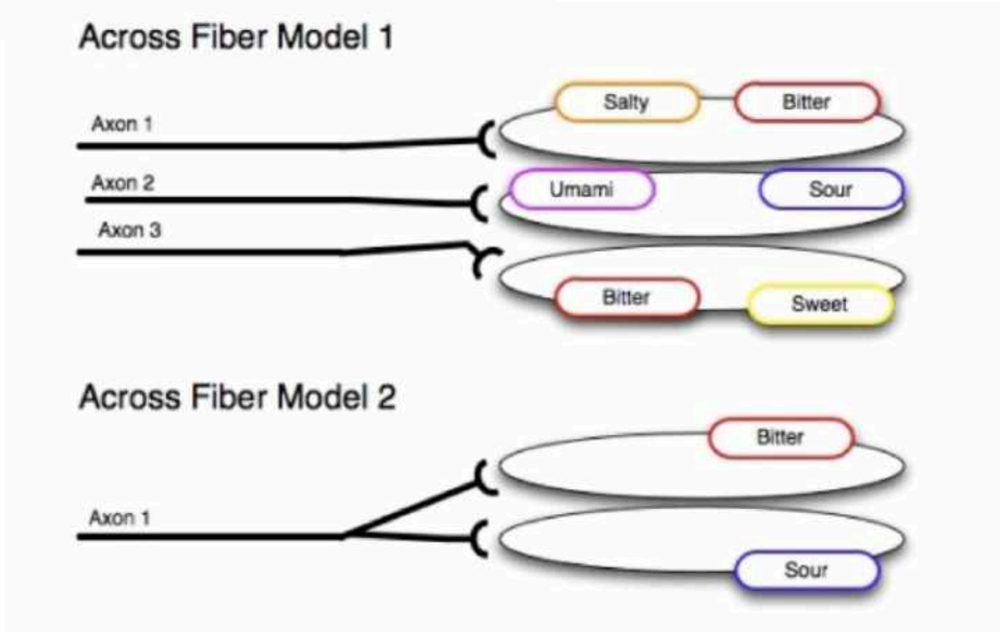
Across-fibre

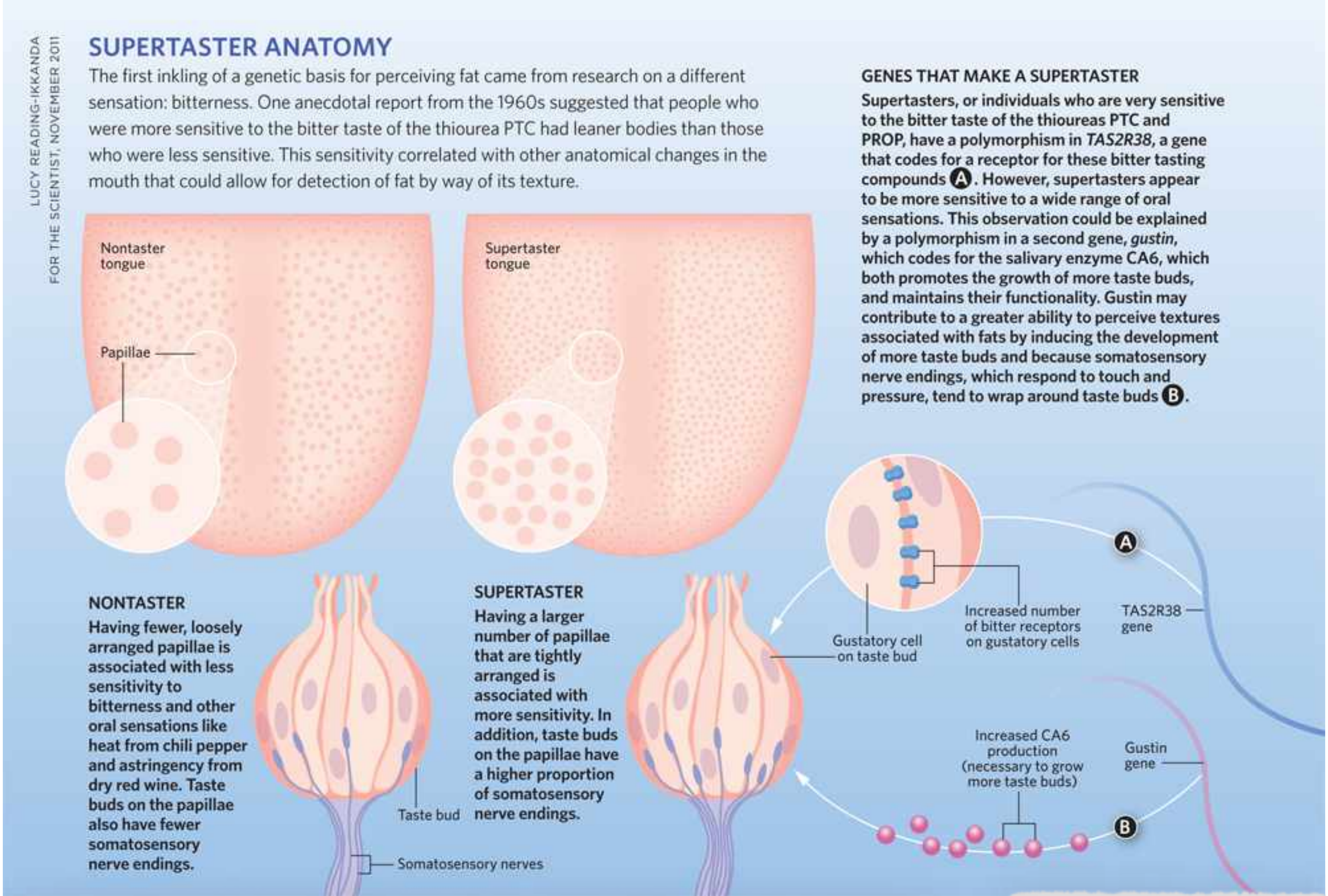
- individual taste receptor cells (TRCs) are tuned to multiple taste qualities; consequently the same afferent fibre carries information for more than one taste modality
- the specification of any one taste quality is embedded in a complex pattern of activity across various lines


Labelled-line model
Across-fibre models
a
b
c
Bitter
Salty
Sweet
Umami
Sour


Umami
Sour
Salty
Bitter
Sweet

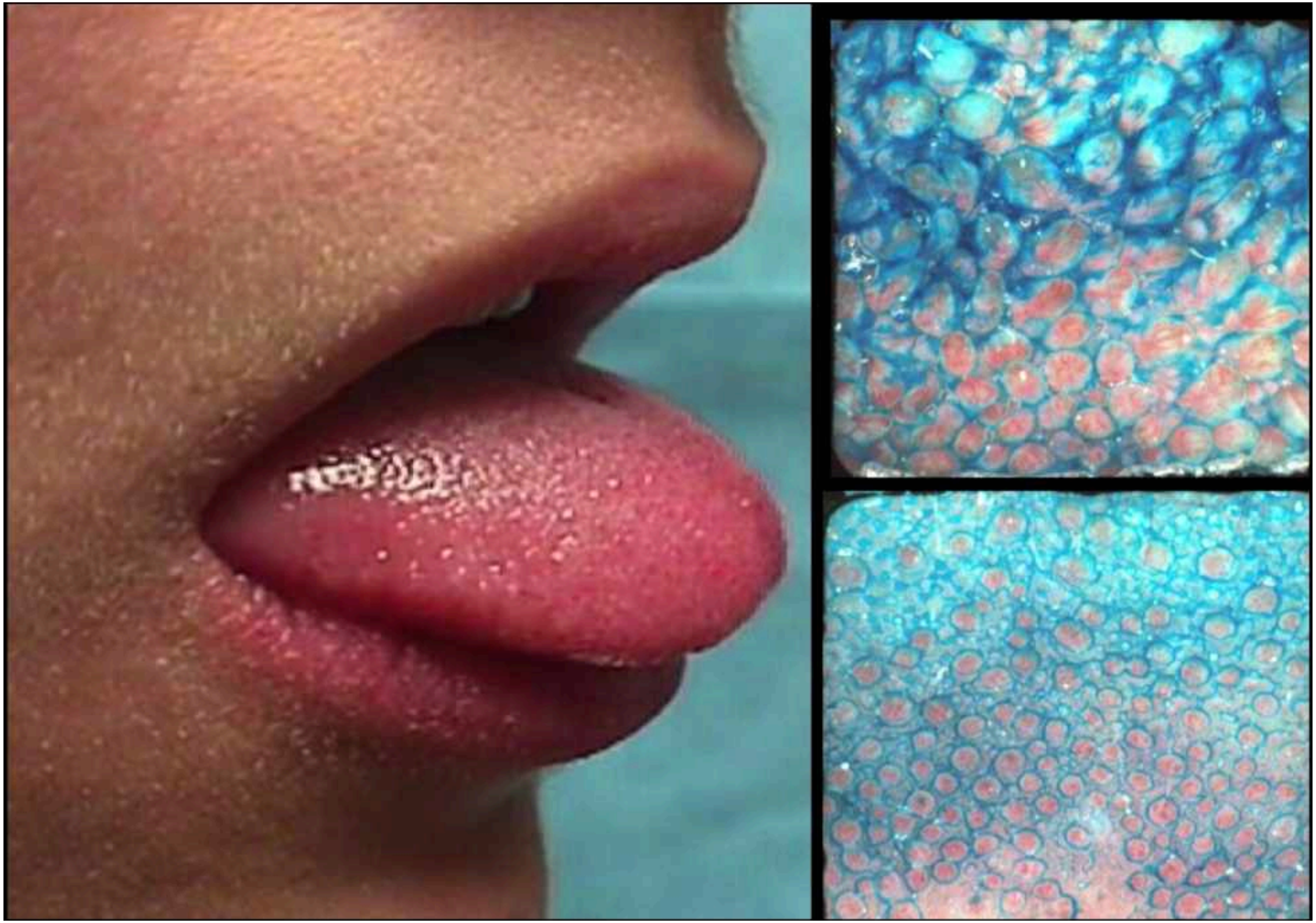

Labeled Line
Taste receptor cell
Axon 1
Umami
Axon 2
Sour
Axon 3
Salty


Across Fiber Model 1
Salty
Bitter
Axon 1
Axon 2
Umami
Sour
Axon 3
Bitter
Sweet
Across Fiber Model 2
Bitter
Axon 1
Sour



supertaster = typically more sensitivity to **bitter** taste

Tepper, "Nutritional implications of genetic taste variation: the role of PROP sensitivity and other taste phenotypes," Annu Rev Nutr, 28:367-88, 2008



the supertaster paradox

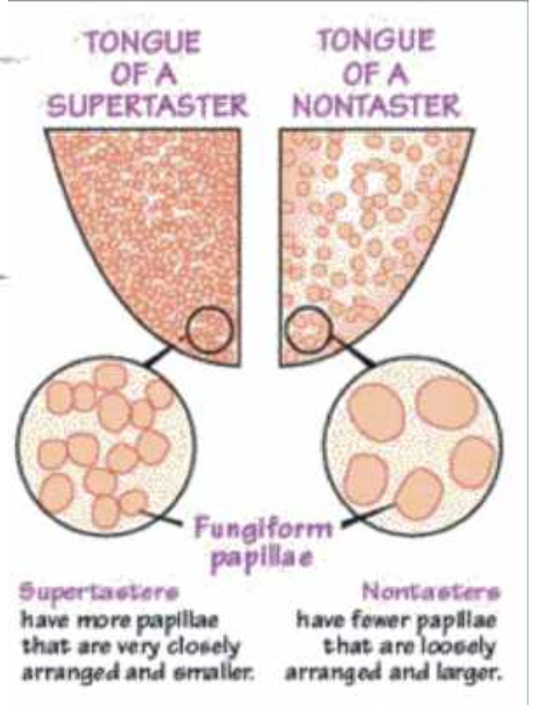
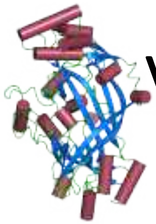


Image source: PBS

DO THEY MAKE GOOD FOOD CRITICS?

K.L. Keller et al., "Common variants in the CD36 gene are associated with oral fat perception, reported fat acceptance, and obesity in African-Americans," Obesity, 2012



variations of a gene CD36

ability to detect fat in the mouth

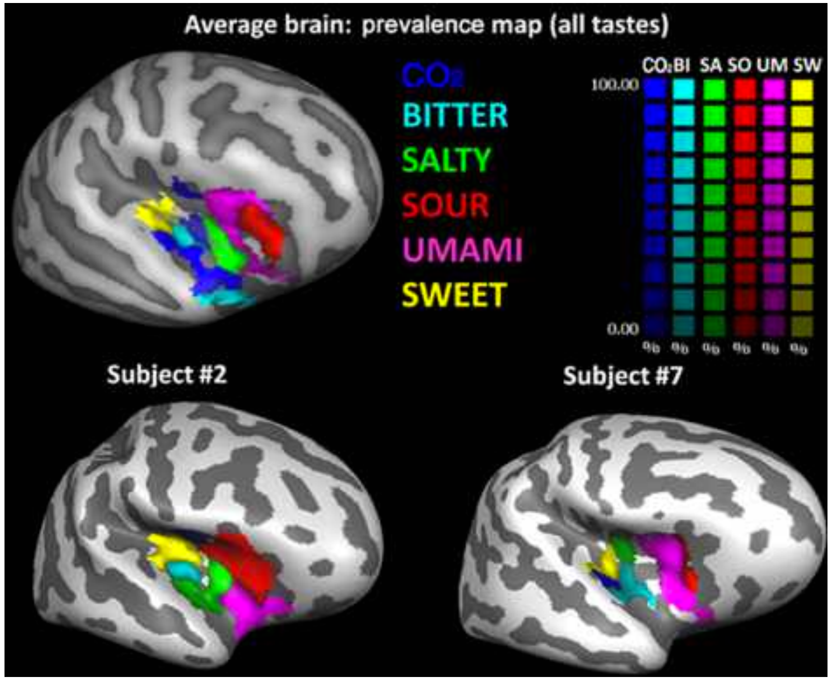
C.A. Andersen et al. Cortical response to fat taste. Chemical Senses. Vol. 45, published online March 14, 2020. doi: 10.1093/chemse/bjaa019.

https://www.youtube.com/watch?v=P7vnspDNx7g

- sixth taste compound???

Gustatory cortex

- chemotopic organisation of taste compounds
- sixth taste compound???



Cortical representation of different taste modalities on the gustatory cortex: A pilot study

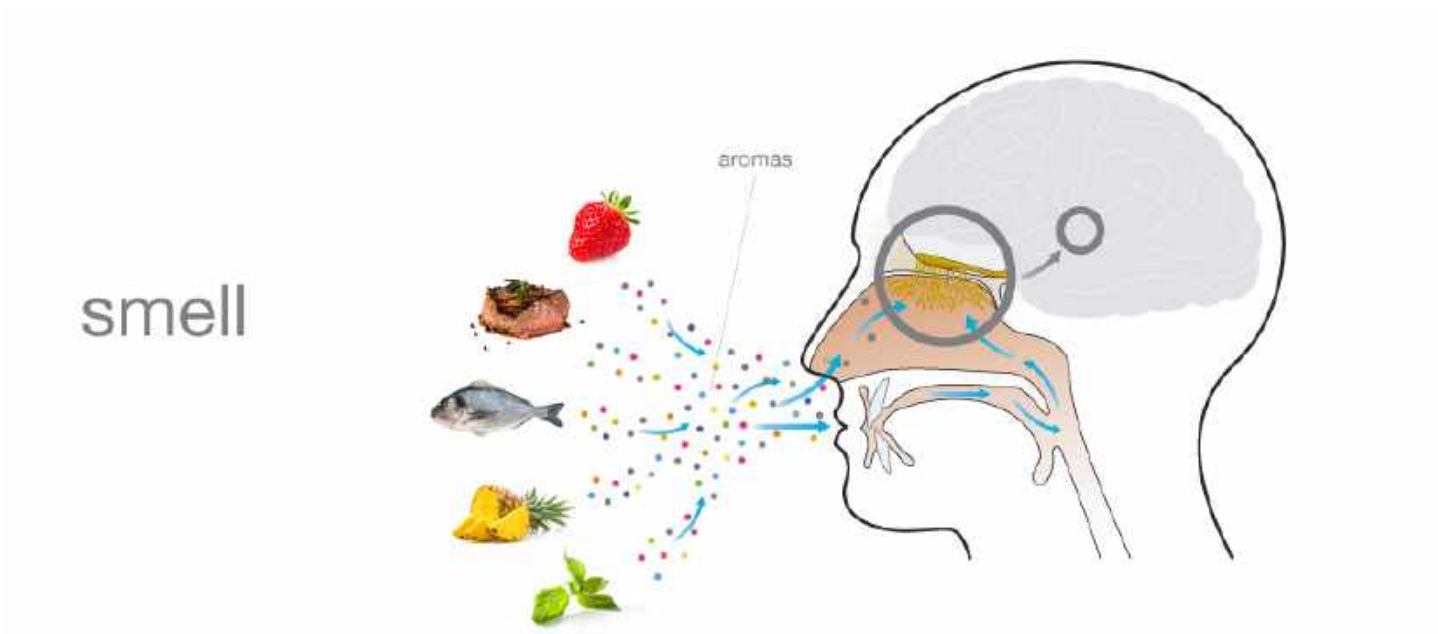
Anna Prinster, Elena Cantone, Viviana Verlezza, Mario Magliulo, Giovanni Sarnelli, Maurizio Iengo, Rosario Cuomo, Francesco Di Salle, Fabrizio Esposito

Published: December 27, 2017 • https://doi.org/10.1371/journal.pone.0190164

PLOS ONE

Food Pairing

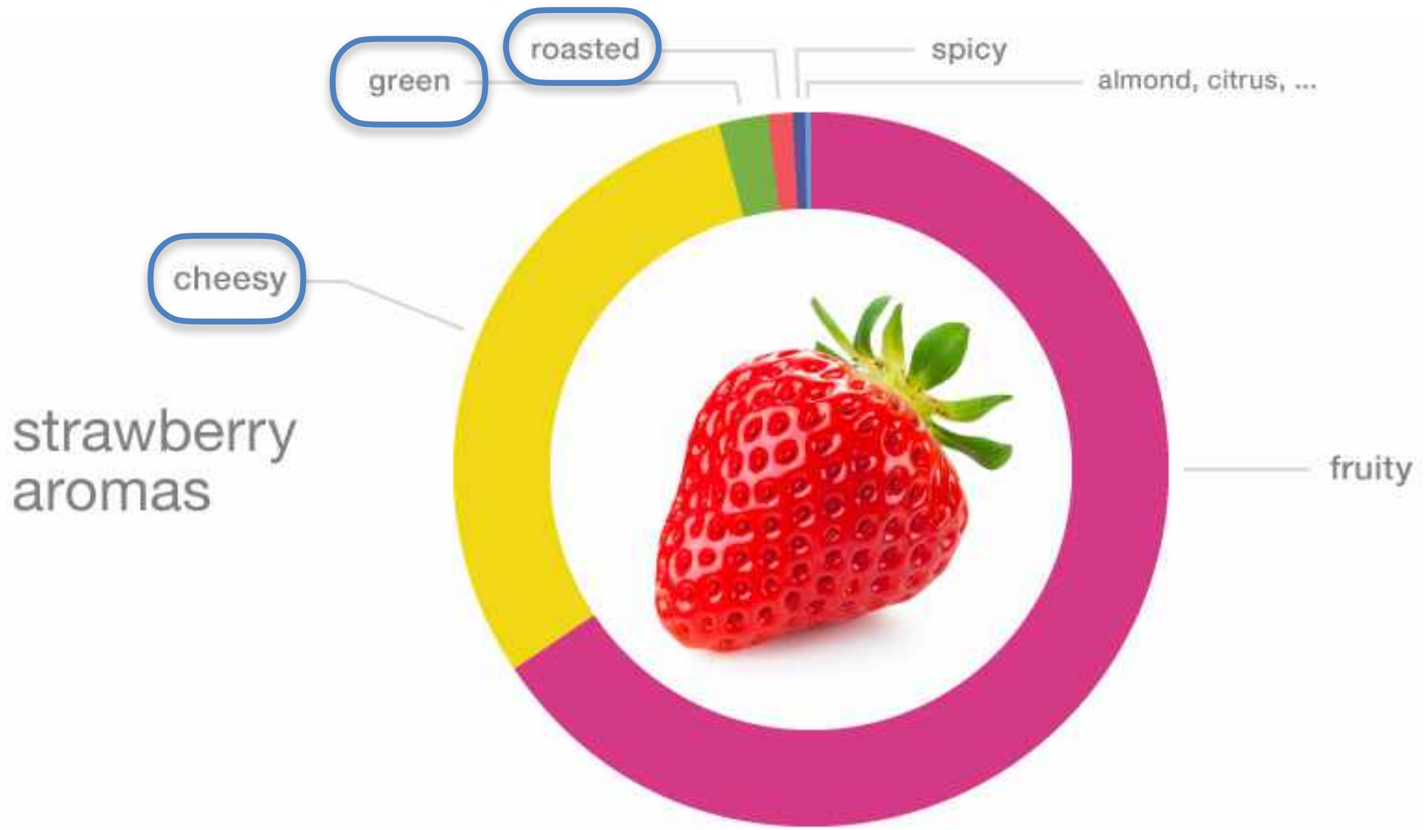
- scientific method to identify which ingredients/ foods &/or drinks go well together
- 80% of taste is aroma perceived through the nose (orthonasal) and through the mouth (retronasal)



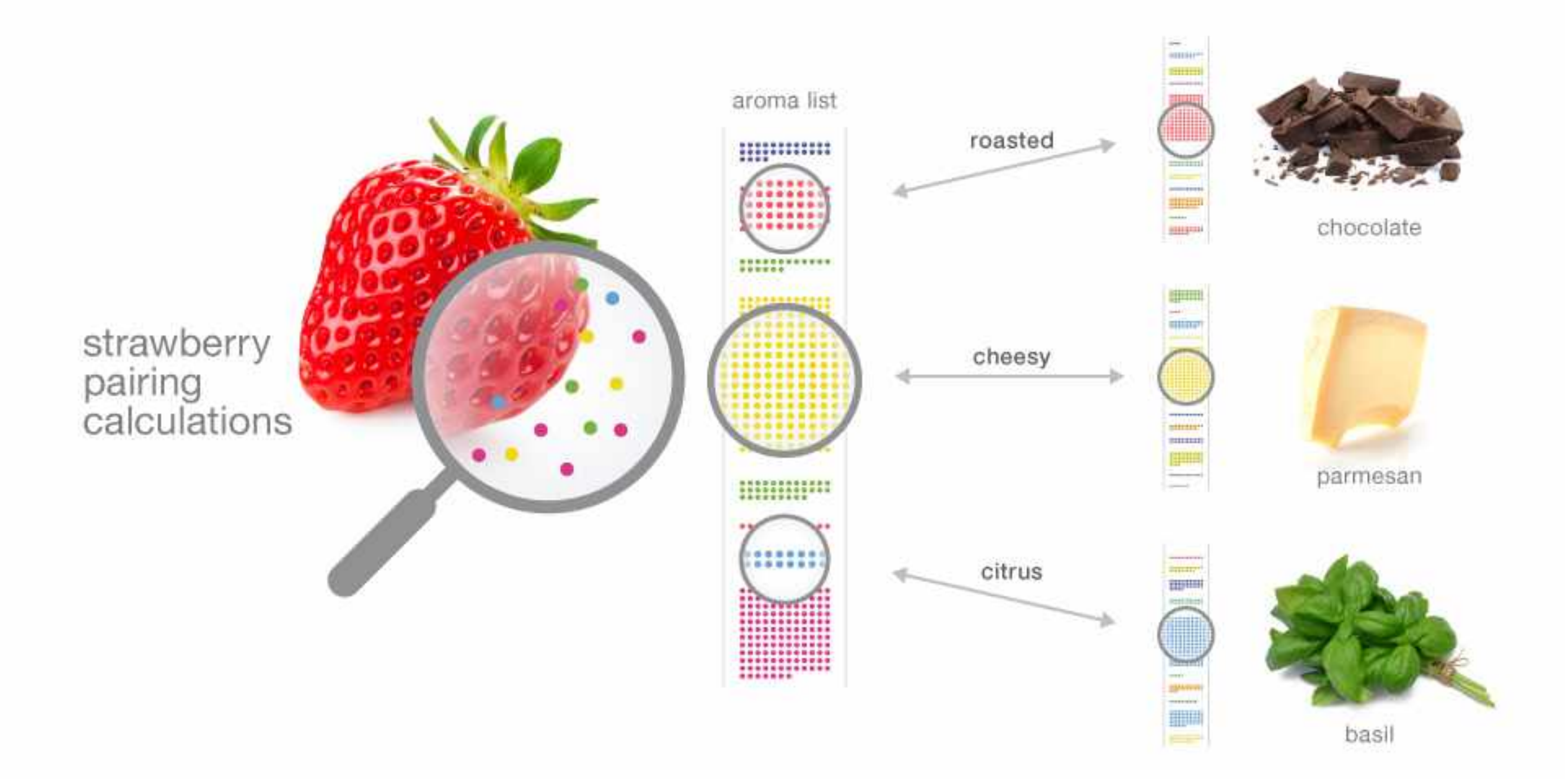
Food Pairing

- based on flavour compounds/molecules present in them
- aroma profile via gas chromatography coupled mass spectrometry (GC-MS)
- data analysis and machine learning to create algorithms calculating how well foods & drinks match
- **Computational Gastronomy**

Food Pairing



Food Pairing

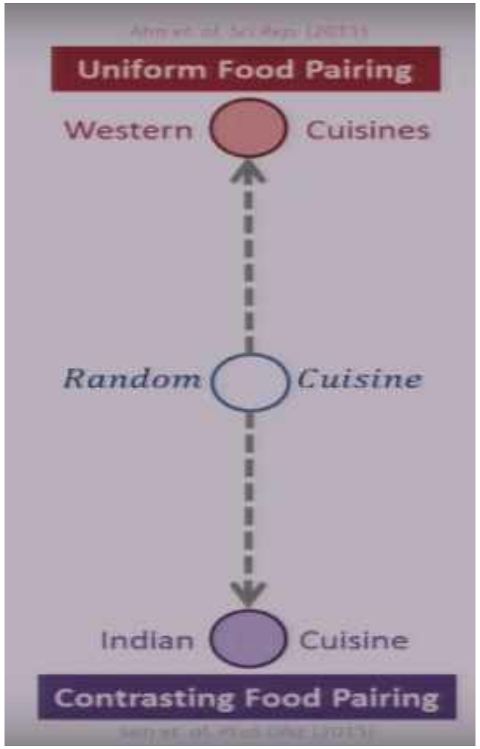


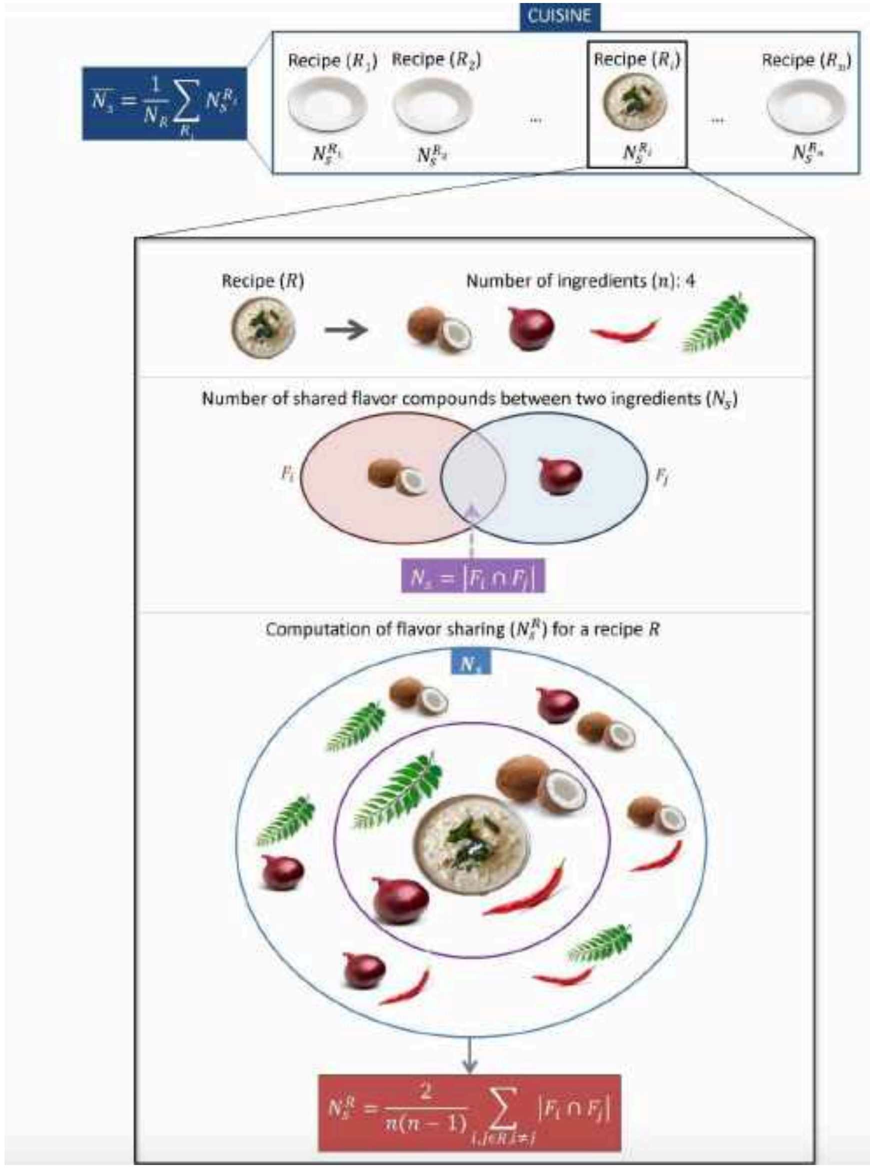
Food Pairing

- traditional and surprising pairings!

Computational Gastronomy in India

- Ganesh Bagler - IIIT-D

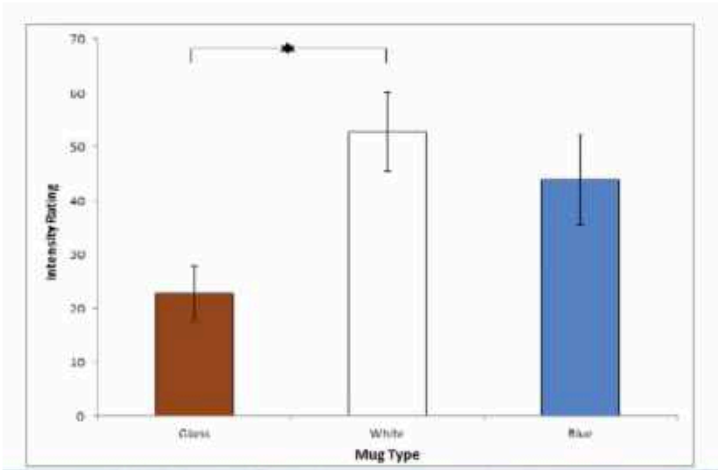




Gastrophysics = Gastronomy + Psychophysics

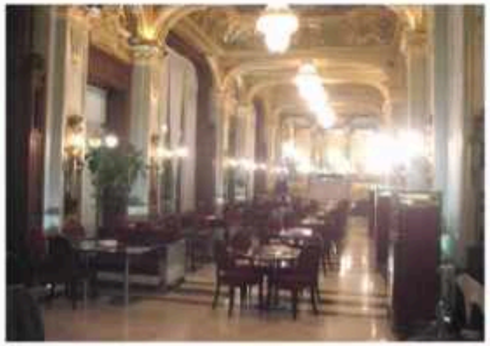
https://www.youtube.com/watch?v=vVKabsudi1I

Mug Type vs Intensity

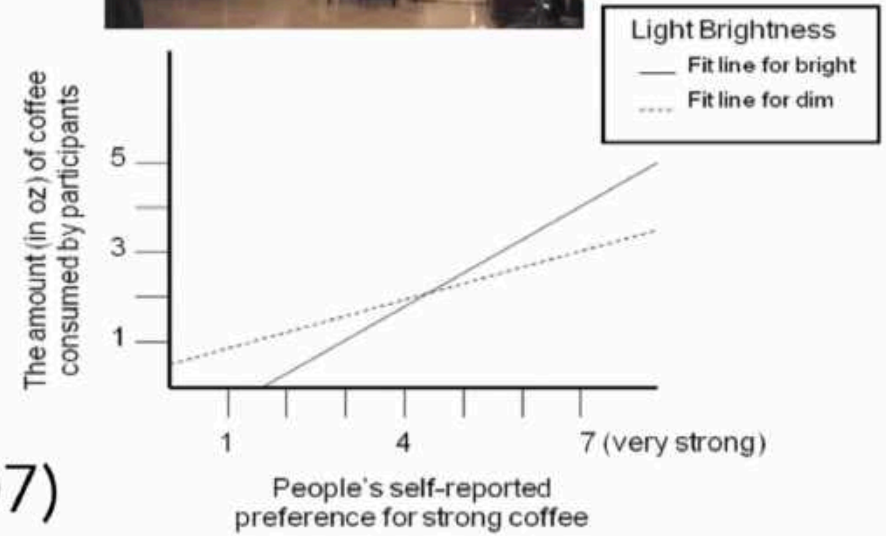


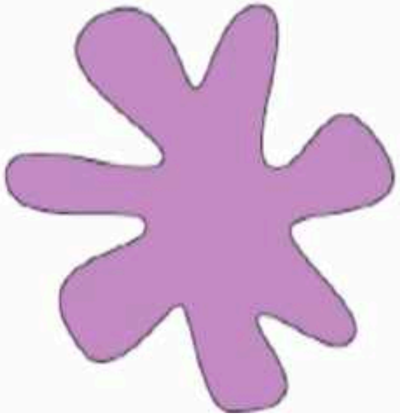
Van Doorn, Wuillemin, & Spence
(2014)

Background lighting?



Gal et al. (2007)





Place a mark on line that

matches the coffee

weight and material

Try this at home

https://www.thecut.com/2016/01/drink-your-coffee-and-listen-to-these-two-clips.html

End
of
Sensory Systems