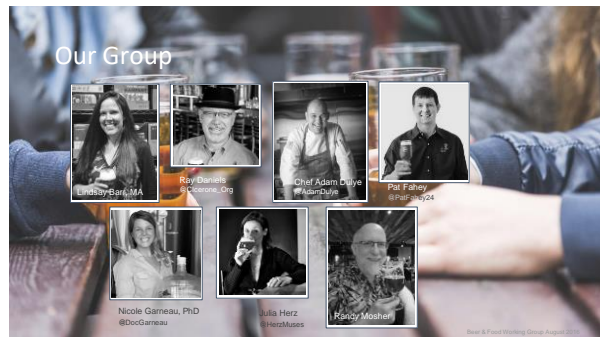




## Beer Pairing State of the Art



Beer & Food Working Group August 2016





## Our Mission

- Inherited a process for pairing from wine
- This working group could have taken up the process of consensus-making
  - Instead we've chosen a disruptive path with science at its core
- For now: necessarily incomplete; potentially frustrating.
- This is what progress looks like...

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## Warm Up/Wake Up Exercise



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From the big picture to the nitty gritty of human anatomy and physiology



Dr. Nicole Garneau

Beer & Food Working Group August 2016

## Sensory 101: What is Flavor?



We use all of our senses to detect individual notes.

Flavor is in the Brain! Data integration leads to perception.

Then we take action.



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When it comes to flavor, there are only two choices of action...

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### What you bring to the table...

Genetics (inherited biology)

Adaptations (learned biology)

Cultural Experiences (emotions, nostalgia, familiarity)

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### Detection and Identification: Combination of Genetics and Practice

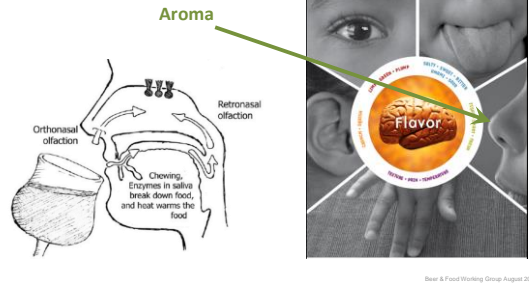
detection, due to genetics

methionial

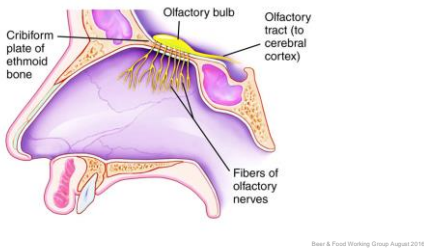
identification, due to practice

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Preference: Combination of Genetics, Cultural, & Biological Experiences



Aroma is Synthetic: "Firing" Pattern Leads to Detection and Identification

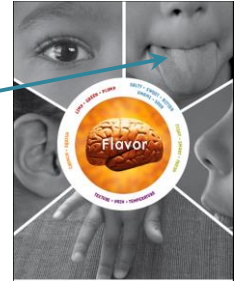




Possible 10k-100k identifiable aromas



If you only learn one thing about taste, remember this...



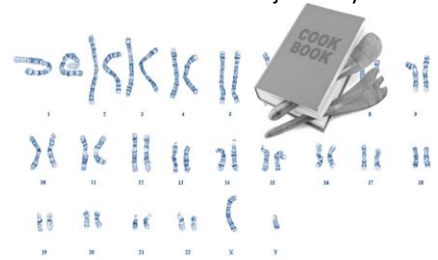
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Quick Detour on Genetics



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Your DNA is like a cookbook just for your body



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We have 25,000 genes, and each gene is like a recipe that makes something our body needs to survive

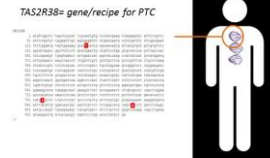


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Focus on bitter:  
Is this bitter to you or does it just taste like paper?

Small changes in your DNA change your taste detection ability



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**(IMPORTANT: there are 25 confirmed bitter taste genes, each for different groups of bitter taste molecules, this is not the same as the genes for alpha acids)**

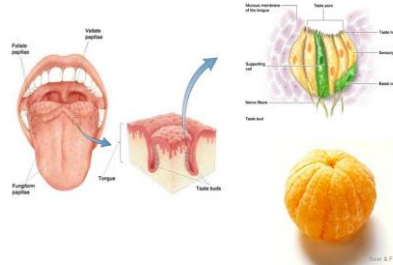
### Theory of Supertasters

Theory that flavor sensitivity is increased to "super" if you have high density of fungiform papillae (bumps on your tongue that house your taste buds)



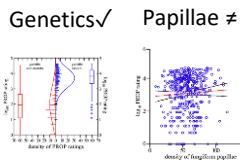
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### Taste Anatomy



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### Data from the Genetics of Taste Lab Challenges "Supertaster" Theory



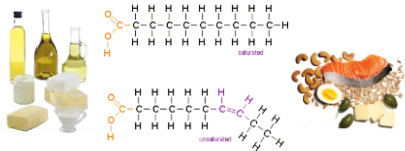
Garneau et al. 2014

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### What about the fats in our diet?



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We can detect increases in fat through taste  
 Ability to taste fat is due to genetics (30%)  
 Fat taste? YES! Oleogustus

Tucker et al. 2015, *Genetics*, doi:10.1534/genetics.115.172884  
 Beer & Food Working Group August 2016

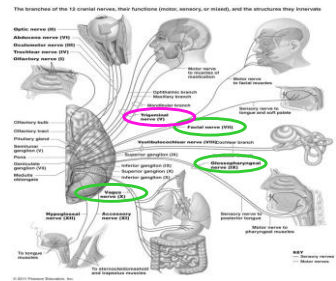
**Mouthfeel**  
 (Touch in the Mouth)

Flavor  
 TASTE  
 MOUTHFEEL

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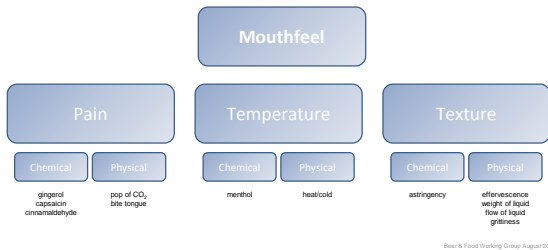
If you only learn one more thing about taste, remember this...

Spicy is NOT a taste, it is a mouthfeel!



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**Touch in the Mouth: Mouthfeel**  
Candied Ginger vs. Carbonated Beer



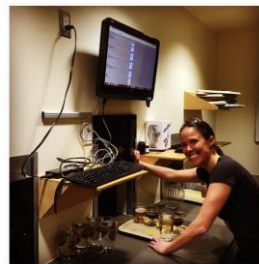
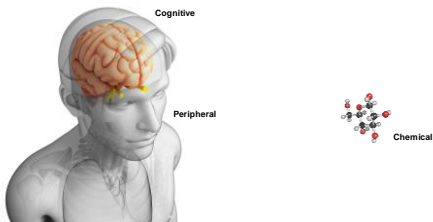
The senses that originate from the mouth and contribute to flavor



- Retronasal Olfaction
- Taste
- Mouthfeel

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**Three types of interactions that can occur with flavors originating from the mouth**



Lindsay Barr, MA

**Sensory Testing in the Lab**

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## Sensory Tests

- Discrimination – Analytic test that asks *if* products are different.
- Descriptive Analysis – Analytic test that inform *how* products differ.
- Affective – Hedonic test that answers how well the products are *liked*.

The test method must match the objective

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## Descriptive Analysis

- Who – *Highly* trained expert panelists
- Answers a whole mess of questions!
  - “Where does my product fall in comparison to others?”
  - “Why are the products different?”
  - When paired with hedonics, DA can even answer: “What are the sensory drivers of liking?”
- When using highly trained *validated* panelists you can get away with using only about 10 individuals.
- Free form descriptions v. scaling of attributes

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## Affective Testing

- Who – *Untrained* product users
- When the question is: how much is the product liked and how does that compare to other products.
- Preferences vary widely amongst users so these tests require very large numbers to achieve a normal distribution of responses.



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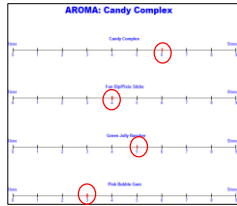
## Training

- Language Development – Develop and standardize terms
- Scale Development – Frame of reference for intensities
- Achieve panel consensus on the scale and definitions of terms
- Continue training at a regular intervals

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### Vocabulary Generation

- Term generation
  - Select samples that span the range of concern
  - Brain dump
- Terms should be...
  - Orthogonal – Non-redundant, independent, unrelated
  - Singular – Specific, having only one meaning...but what about complexes?
  - Clearly defined – Anchored on references



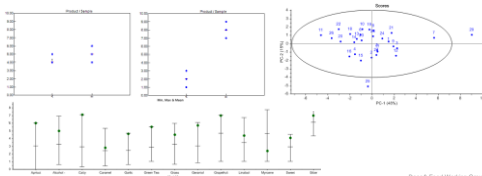
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Attribute	Definition	Reference
Geraniol	Aroma reminiscent of the sweet, heavy smell of floral, like roses, or citronella? Or pine so?P	Geraniol
Green Tea	Grassy green aroma like wheatgrass juice, with faint citrus. Herbal and lightly woody.	Moistened green tea leaves
Grass	Fresh, juicy smell like fresh-cut grass or torn green leaf volatiles; herbaceous, chlorophyll	Cut grass, grassy standard
Grapefruit Peel	Zesty citrus with a pithy, bitter smell	Grapefruit peel
Linalool	Light floral, like lavender, and a more sweet fruitiness, like Froot Loops, citronella?	Linalool
Myrcene	Hop aroma associated with herbaceous, resinous, woody, spicy, and piney.	Myrcene

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### Scale Alignment

- Perception varies from person to person so it is imperative to clearly define each attribute and anchor on intensities.
- Outlier determination, realignment in the case of scale misuse



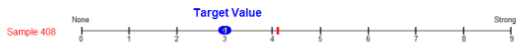
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**Rate how sweet you think this sample is.**  
**Directly after, a circle will appear indicating the target value.**



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**Rate how sweet you think this sample is.  
Directly after, a circle will appear indicating the target value.**



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### Running a Descriptive Analysis Panel

- Scale Development and Validation Using Sweet
  - Evaluate the three sweet standards in front of you to align the concept of sweet intensity.
    - Sample #1: Low = 2
    - Sample #2: Medium = 4
    - Sample #3: High = 8
  - After grounding on the three standards, evaluate the two sweet tests using this Survey Gizmo link: <http://goo.gl/B3Z2pv>
    - Sample A: ?
    - Sample B: ?



Rinse your mouth with plenty of water between samples.

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Stay tuned, we will see how you did after the break but for now you're in good hands with...



Julia Herz



Ray Daniels

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### Free Form Pairing Exercise

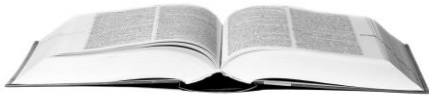
Science ✓  
Methods ✓  
Now let's do one for yourself: two beers, two cheese selections = 4 pairings



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## Pairing Lexicon

a.k.a. the language of pairing



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## Lexicon

1. a wordbook or dictionary, especially of Greek, Latin, or Hebrew.
2. the vocabulary of a particular language, field, social class, person, etc.



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## Pairing

[pair-ing]

1. a coupling.

\* Dictionary.com. Dictionary.com Unabridged. Random House, Inc. <http://www.dictionary.com/browse/pairing> (accessed: May 27, 2016).

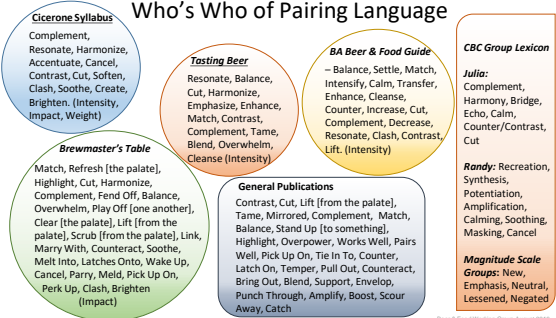


Language



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Who's Who of Pairing Language



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What About Wine Pairing Terms?

- "Buy on an apple and sell on cheese"
  - Malic acid in apple intensifies acidity and tannin in wine
  - Lactic acid in cheese softens, rounds off wine
- "White wine with fish; red wine with meat."

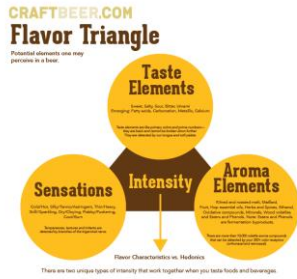


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Getting Everyone On the Same Page

- What kinds of interactions happen during pairing
- How we perceive them
- How we describe them

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## When Beer Meets Food

Pairing leads to discussion that may include the following:

- Balance/Intensity
  - How *much* flavor in each
  - Ability of the two to play nicely together
- Interaction: How the presence of one affects perception of the other
  - Basic level: flavors (tongue tastes)
  - Advanced: aromas (olfactory stimulus)
- Synergy: New flavors unseen in either alone

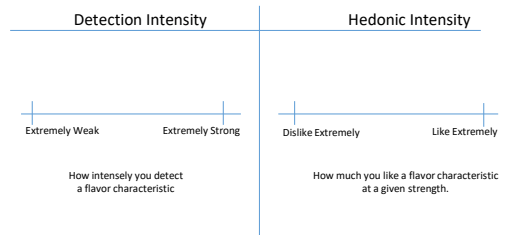
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## Two Measures of Intensity

- Overall: holistically describes level of flavor in a given beer or dish
- Scientifically: two dimensions
- Detection Intensity
- Hedonic Intensity
  - Taster's degree of like/dislike
  - Experience-dependent factors
- Overall Intensity = Detection Intensity as modified by Hedonic Intensity

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## Two Measures of Intensity



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## Balance or Intensity

- Everyone talks about this in some way
- Idea: flavor quantity or intensity from each part of pair
  - Intensity, balance, compatibility
  - Overwhelms, gets lost, etc.
- Can identify intensity factors in both food and beer
- Goal:
  - Generally look for similar levels between the partners
  - This alone doesn't make a good pairing or avoid bad ones
  - More a necessary pre-condition

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## Balance or Intensity

Beer Intensity	Food Intensity
<ul style="list-style-type: none"> <li>• Maltiness/Alcohol</li> <li>• Hop Flavor/Aroma</li> <li>• Bitterness</li> <li>• Roast and smoke character</li> <li>• Fermentation traits:                             <ul style="list-style-type: none"> <li>• Fruity, spicy, tart</li> </ul> </li> <li>• Mouthfeel</li> </ul>	<ul style="list-style-type: none"> <li>• Ingredient</li> <li>• Cooking method</li> <li>• Spices, sauces, garnish</li> <li>• Acidity</li> <li>• Bitterness</li> <li>• Mouthfeel</li> </ul>

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## Interactions

- How the juxtaposition affects perception of each partner
  - Basic level: taste (tongue tastes)
    - Most limited set of interactions
    - Focus of our initial work: should yield specific and tangible recommendations
  - Advanced: aromas (olfactory stimulus)
    - A vast matrix of possibilities
    - Conclusions will have to be generalized
- Whole package/all senses (even more complicated)
- In all cases, various outcomes

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## Interactions



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## Compare & Contrast: Sweet vs. Salty with Double IPA



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## Pairing Steps in A Nutshell

1. Consider your beer and food elements separately.
2. Find flavor harmonies
3. Think about potential interactions
4. Carefully match overall intensities
5. Perform a test tasting (and describe what stands out)
6. Tweak and modify the pairing

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## Umami

- a. combining the Japanese characters for delicious and taste.
- b. the name for the fifth basic taste
- c. originally defined (1908) as coming from the salt of glutamic acid, later other umami taste substances identified from inosinate (animal protein) and guanylate (plant based; mushrooms)

**simply defined: umami harmonizes tastes and aromas, the two main components of flavors and in doing so heightens the sensation of both**

\*it takes cooking, curing or fermentation to bring out the glutamates and unleash the savory on your palate

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### Maillard Reaction

The important thing about the Maillard reaction is that once you have achieved the color it's no longer about the color, it's the flavors and aromas. In cooking it is "the flavor reaction," not the "browning reaction." The molecules provide the intense aromas responsible for the familiar smells of roasting, baking, and frying.



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### The Pairing

rye bread with hummus w/



Combining the Maillard Reaction "aroma" of the rye bread with the umami from the hummus (garbanzo beans contain glutamic acid)

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Lindsay and Nicole

### Future of Pairing Science: Conducting Research to Support Knowledge

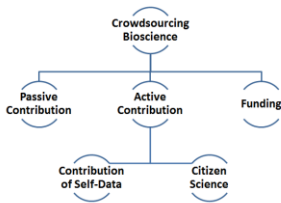
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Everyday people using their spare time to "create content, solve problems, even do corporate R&D."  
-Jeff Howe  
Wired Mag 2006

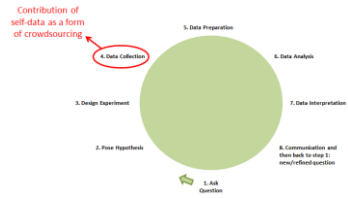
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## Crowdsourcing's Family Tree



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## Crowdsourcing & the Scientific Process



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## Our Crowdsourced Sensory Research



March 25, 2016  
Population Preferences  
n= 400



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## Experimental Design

- Objective: Generate hypotheses surrounding what drives the liking of food and beer pairs.
- Consumers scaling for overall liking:
  - Three foods chosen to highlight umami, sweet and spicy.
  - Four very different beer styles: Brown, Hefe, Stout and IPA
  - Each combination of food and beer
- Expert Descriptive Analysis Panelist scaled tastes and mouthfeels (sweet, sour, salty, bitter, umami, fatty, astringency, irritation, body) for the three foods and four beers individually and as a pair.

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### Instruments Used

#### Hedonics

Select the phrase that best describes your overall opinion about this food.

Dislike Extremely   Dislike Very Much   Dislike Moderately   Dislike Slightly   Neither Like Nor Dislike   Like Slightly   Like Moderately   Like Very Much   Like Extremely

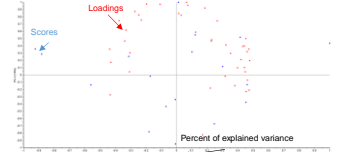
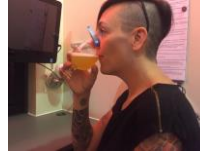
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#### Intensity

None Strong

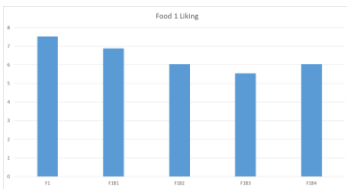
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### Expert (n=7) and Consumer Data (n=364)



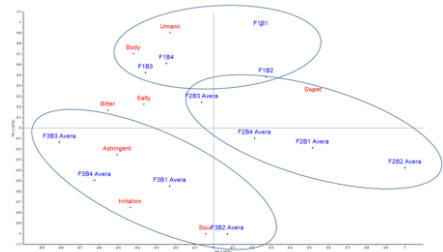
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### Preference data for umami-based food



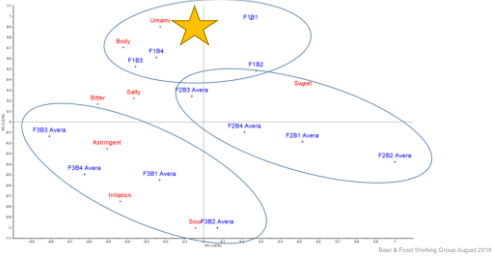
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### Did the Pairings Achieve What we Expected?



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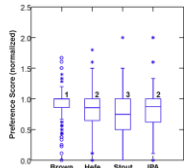
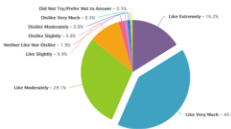
Did the Pairings Achieve What we Expected?



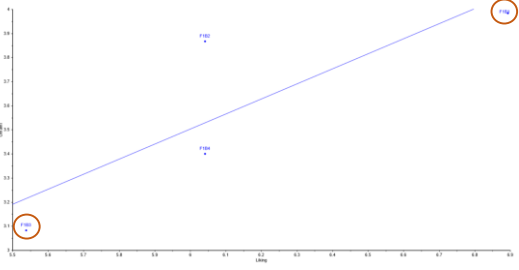
High Preference for Umami- Brown Pairing

- the Brown Ale was significantly more preferred than the Hefe, Stout and IPA when paired with umami
- The Stout was significantly less preferred than the other beers.

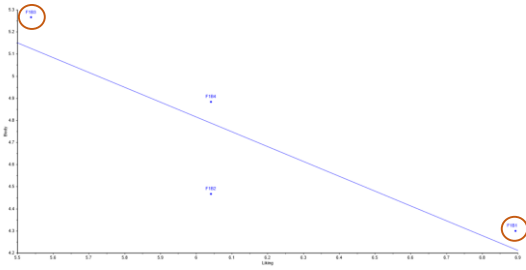
Preference Scores for Savory Tart



Taste and Liking Correlations



Mouthfeel and Liking Correlations



### Umami Example

- Taste beer with nose plugged, scale sweet, umami and body
- Taste food with nose plugged, scale sweet, umami and body
- Taste both with nose plugged, scale sweet, umami and body
  
- Taste beer with nose unplugged and scale liking
- Taste food with nose unplugged and scale liking
- Taste both with nose unplugged and scale liking

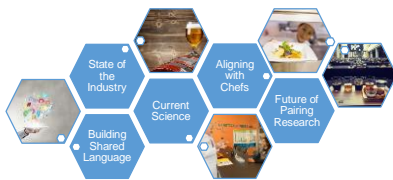
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### Best Practices and Caveats

1. Randomization is logistically difficult but important
2. Have lots of water available
3. Inform participants about the basic food ingredients (being careful to avoid bias) as to not expose anyone to allergies or aversions
4. Pairings should be in order of the foods, not beers
5. Less is more. Fatigue comes into play so it is best to ask more questions with fewer pairings.
6. Pre-taste beers and foods to make sure they don't overpower one another
7. Do a dry run

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### Bringing It All Together



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### Cheers to your own beer pairing journey!



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