



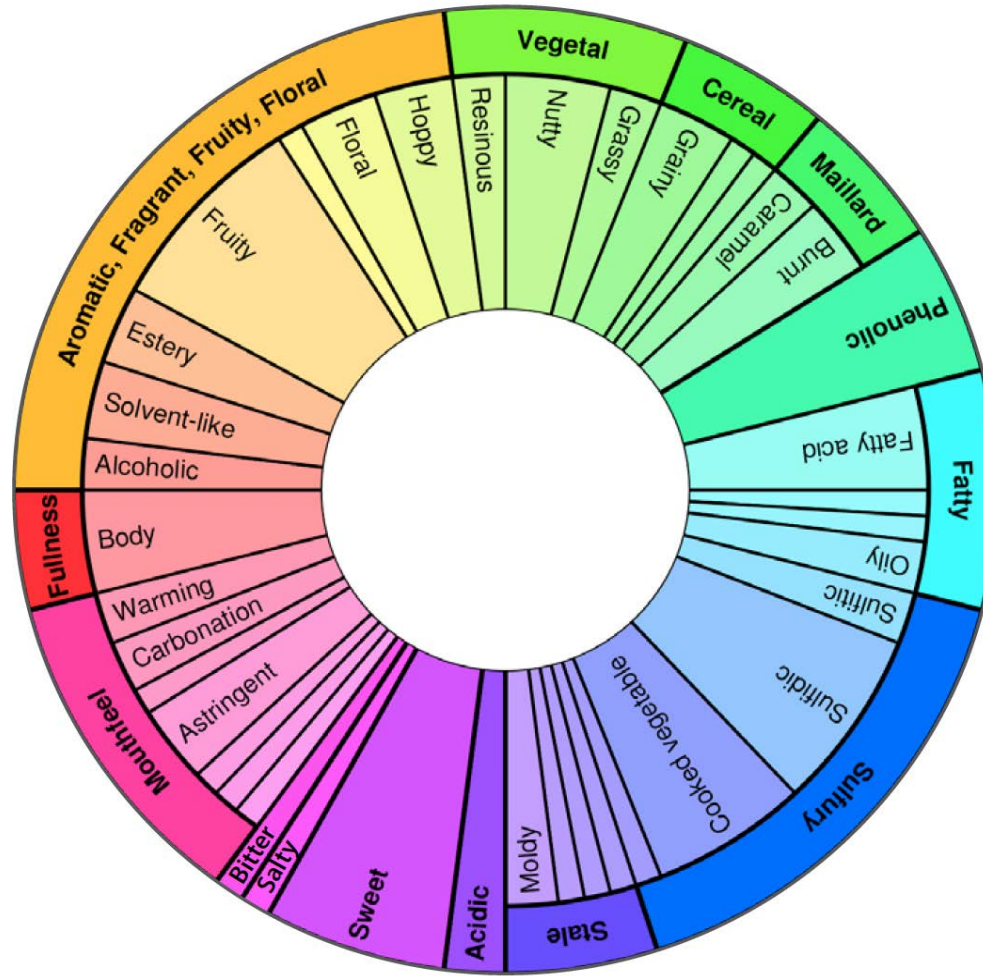
New Methods of Sensory Evaluation, their Implications and Applications for Drinkability Assessment and Beer-Food Pairing based upon Statistical and Consumer Studies

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Research/ Presentation Purpose

- To assess the efficacy of the ALL BEER Flavor Notepad (ABFN) as a tool for beer flavor evaluation
- To develop a working model for a Food Flavor Notepad, using cheese as an example
- To investigate causal links between beer and food pairing preferences

Methods: Beer evaluation



Methods: Beer evaluation

SMELL IT

		4	Hoppy/Spicy
Grainy / Malty	3.5	1	Roasted/Burnt
Grassy / Nutty	1	0	Oily / Fatty
Sweet / Fruity	4	2	Sulphury
Floral / Alcohol	2	0	Stale / Papery
Sweet / Caramelised	2	0	Medicinal
		1	Sour / Acidic
TOTAL		12.5	8

TASTE IT

Sweet	2.5	2	Sour
Oily / Fatty	0	2	Savoury
Salty	3	5	Initial Bitterness
		4	Lasting Bitterness
TOTAL		5.5	13

FEEL IT

Warming	3.5	2.5	Drying
Body	4	3.5	Carbonated
Smooth	3	3	Astringent
TOTAL		10.5	9

Copper Totals

12.5 +
5.5 +
10.5 =

Green Totals

8 +
13 +
9 =

OVERALL FLAVOUR BALANCE

28.5	GRAND TOTAL		GRAND TOTAL	30
(SMELL IT + TASTE IT + FEEL IT)		▲	(SMELL IT + TASTE IT + FEEL IT)	

TOTAL FLAVOUR SCORE

28.5 + 30 =

58.5

Methods: Beer evaluation

- Beer Flavor Notepad includes:

- Beer details
- Visual evaluation & scoring
- Numerical intensity scores for Aroma, Taste & Mouth-feel
- Food pairing suggestions

AGB ALL BEER TASTING NOTEPAD

Name: Smog Rocket A.B.V. 5.4
 BEER STYLE Smoked
 Brewer: Beantown Best Before: Dec 14 Sampled On: 25/4/14

SEE IT

Beer Colour	White	Yellow	Gold	Straw	Amber	Red	Brown	<u>Black</u>
	1	2	3	4	5	6	7	8

Head Colour: White, Cream, Coffee, Head cling & lacing: Poor, 2, 3, 4, Good

Clarity: Cloudy, Clear & Bright, Carbonation: Flat, 2, 3, Champagne-like

Please add your own notes on significant aromas & flavours overleaf

SMELL IT **TASTE IT** **FEEL IT**

Green / Malty <u>2</u>	Hoppy <u>2</u>	Sweet <u>2.5</u>	Sour	Warming <u>3</u>	Drying
Greasy / Natty <u>1</u>	Woody / Barm <u>2</u>	Oily / Fatty	Savoury	Body <u>2.5</u>	Carbonated
Sweet / Fruity <u>2</u>	Only / Fatty	Salty <u>2</u>	Initial Bitterness	Smooth <u>3.5</u>	Astringent
Floral / Aldehydic <u>1.5</u>	Sulphury	2.5	Lasting Bitterness		
Sour / Acetic <u>1.5</u>	Stale / Papery				
	Medicinal				
	Sour / Acidic				
TOTAL <u>6.5</u>	TOTAL <u>6.5</u>	TOTAL <u>4.5</u>	TOTAL <u>7.5</u>	TOTAL <u>9</u>	TOTAL <u>6.5</u>

OVERALL FLAVOUR BALANCE: GRAND TOTAL (SMELL IT + TASTE IT + FEEL IT) 20.5

TOTAL FLAVOUR SCORE: 40.5

FI RATING: 3

RATE IT: Never again! (1-4), Average (5-6), Mm...Mmmm (7-8), Yes YES! (9-10)

ALL BEER FLAVOUR NOTEPAD

Savoury food match	<u>Anything BBQ + spicy, well aged, sticky burgers / ribs</u>
Sweet food match	<u>chocolate + coffee desserts, acerbate + contrast</u>
Summary and superlatives	<u>Not overly smoked at all - mazy balanced integrated smokiness against predominantly chocolate + dark kettle. Surprisingly smooth + back of dry/tannic finish. Well done.</u>

Methods: Beer evaluation

- Collation of numerical data from Beer Flavor Notepad (550 beers, 31 styles)
- Analysis of numerical data, including:
 - Multivariate Principle Component Analysis
 - Statistical analysis
 - Grouping by Beer Style
 - Grouping by Total Flavor Score

Methods: Cheese evaluation

ALL BEER Flavour Notepad – CHEESE

Source: Buffalo 1, Cow 2, Ewe 3, Goat 4

Hardness: Tube 1, Soft 2, Semi-Soft 3, Semi-Hard 4, Hard 5

Rind Colour: White 1, Yellow 2, Gold 3, Straw 4, Amber 5, Red 6, Brown 7, Black 8, Green 9, Blue 10

Body Colour: White 1, Cream 2, Yellow 3, Orange 4, Red 5

Aging: Fresh 1, Young 2, Mature 3, Extra Mature 4, Vintage 5

Pasteurised: Y 1, N 2

Mould: Soft-Ripen 1, Wash Rind 2, Blue Vein 3

Marbling: Low 1, Medium 2, High 3

SMELL IT

Others??? 5
Cereal Grains 1
Grassy / Nutty 1
Sweet / Fruity 1
Floral / fragrant 2
Sweet / Caramelized 1

Meaty / Fishy 5
Spicy aroma 1
Roasted / Burnt 1
Oily / Fatty 3
Stale / Aged 3
Medicinal 1
Sour / Acidic 1

TOTAL 11

TASTE IT

Sweet 2.5
Oily / Fatty 3
Salty 3

Sour 2
Savoury 3
Initial Bitterness 2
Lasting Bitterness 1.5

TOTAL 8.5

FEEL IT

Warming 1
Spicy / Hot 1
Fullness / Richness 5
Smooth / Consistent 4
Dry / Crisp 5
Lumpy / Inconsistent 1

TOTAL 17.5

OVERALL FLAVOUR BALANCE: GRAND TOTAL (SMELL IT + TASTE IT + FEEL IT) 21

TOTAL FLAVOUR SCORE: 39.5

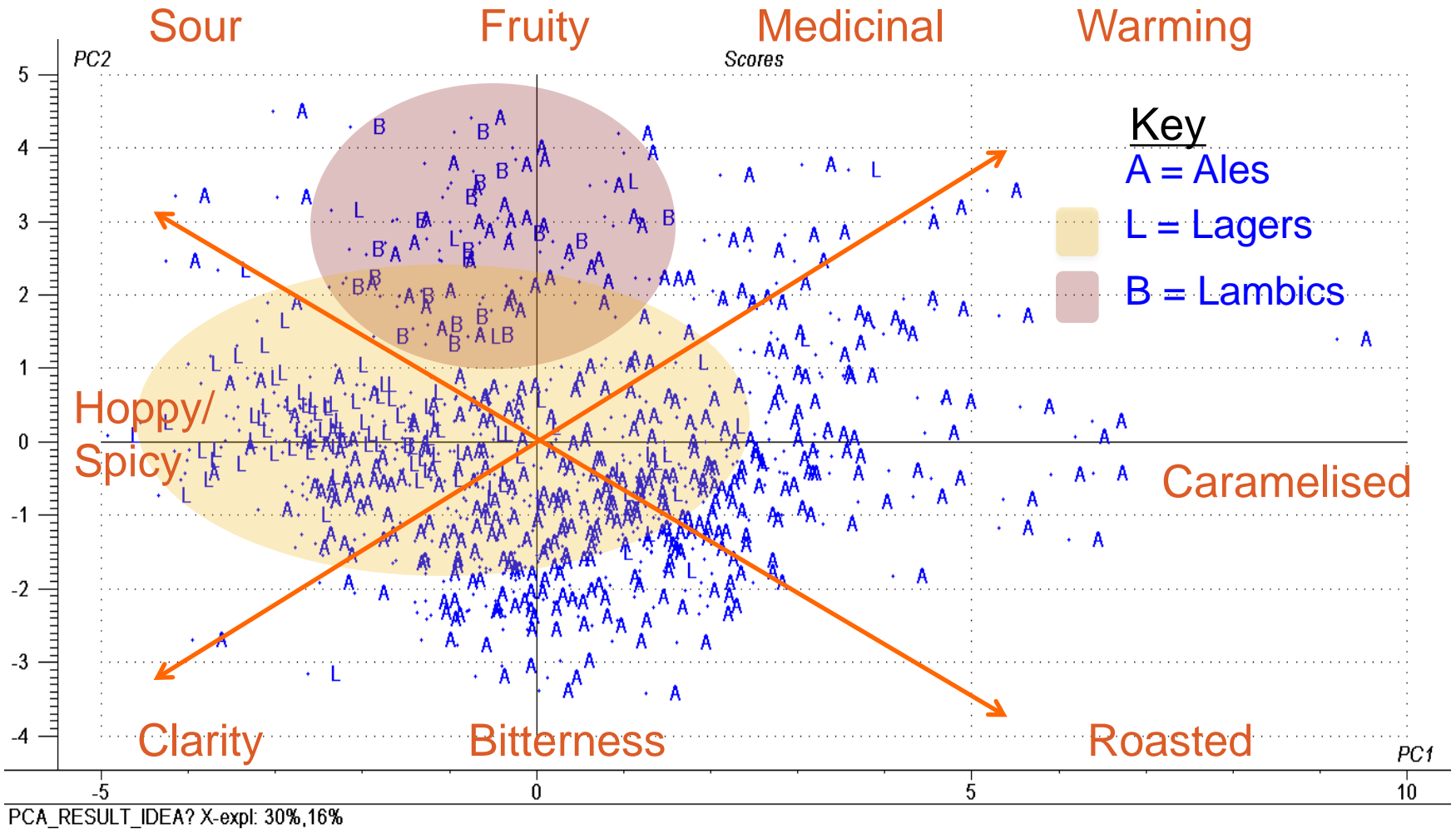
RATE IT: 1 Never again! 2 Disappointing 3 Average 4 Mm...Mmmm 5 Yes YES! 6 7 8 9 10

Style/ Taste date/ Info.	Peakland Blue (excl) 5/10/13
Additional flavour comments	Richly marbled + Nerved. Delectable character. metallic bitterness fades but v. nice.
Suggested beer matches	strong PA, IPA, Old Ale, Strong + Tipple. Not anything light.

- Beer Notepad adjusted to suit Cheese, incl.:
 - Milk source
 - Style/ Hardness
 - Aging scale
 - Some additional or different Aromatic & Mouth-feel descriptors
 - Beer pairing suggestions

- Collation of numerical data from Cheese Flavor Notepad
- Analysis of numerical data, including:
 - Multivariate Principle Component Analysis
 - Selection of disparate cheese styles
 - Recommendation of beer-cheese pairings
- Statistically significant sensory trials of beer & cheese pairings (n=132–134)

Results: PCA plot for ALL Beers



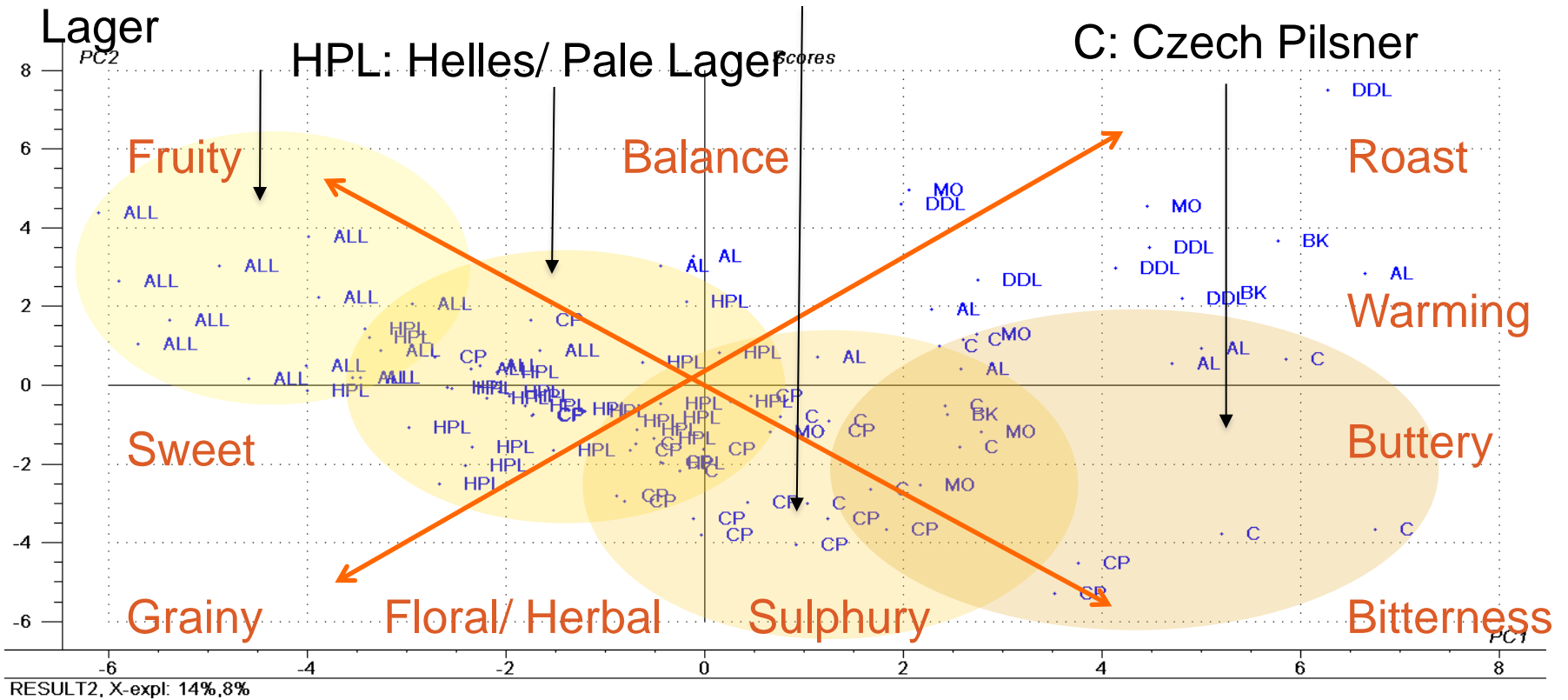
Results: PCA plot for Lagers

ALL: American/ Light CP: Continental Pilsener

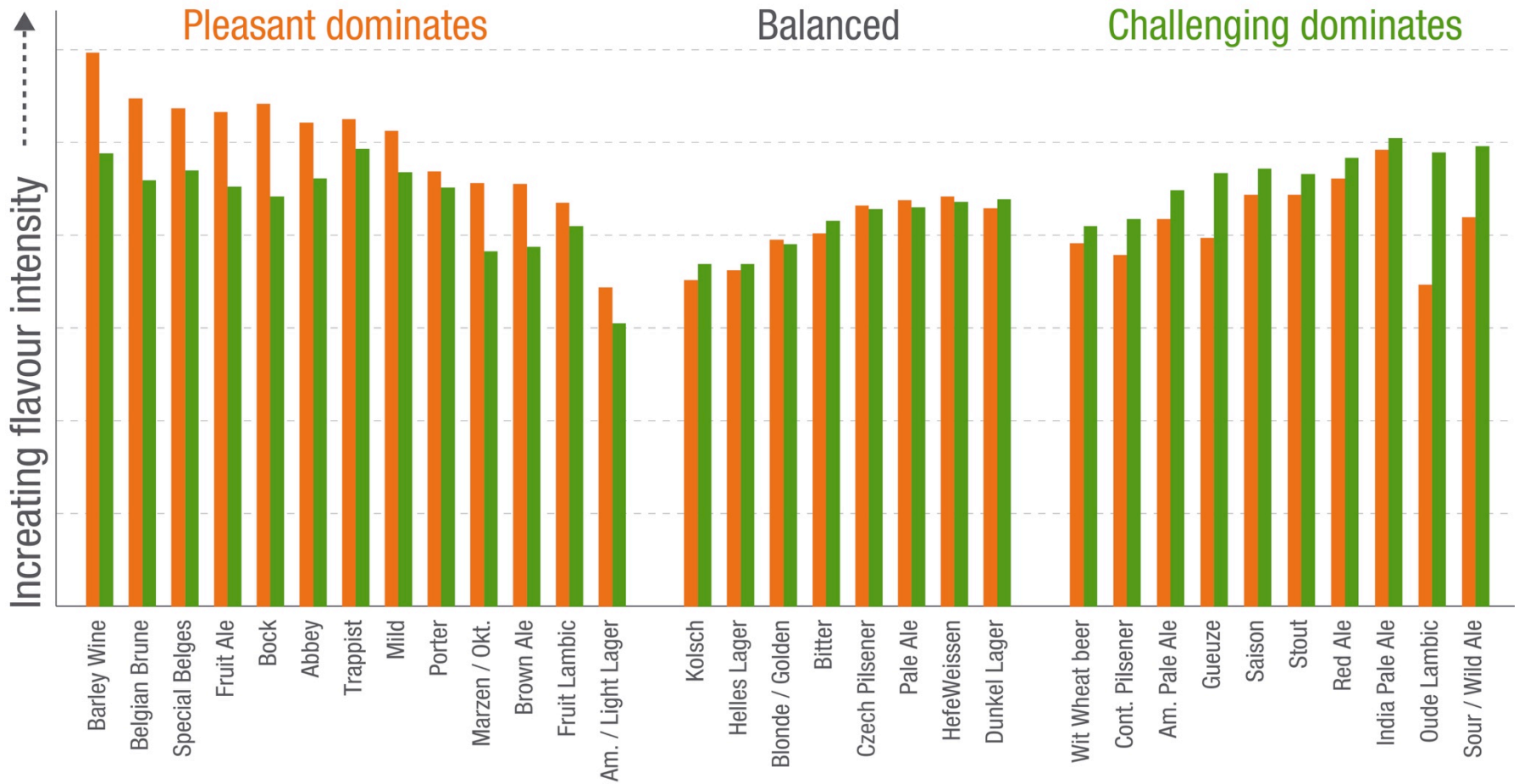
Lager

HPL: Helles/ Pale Lager

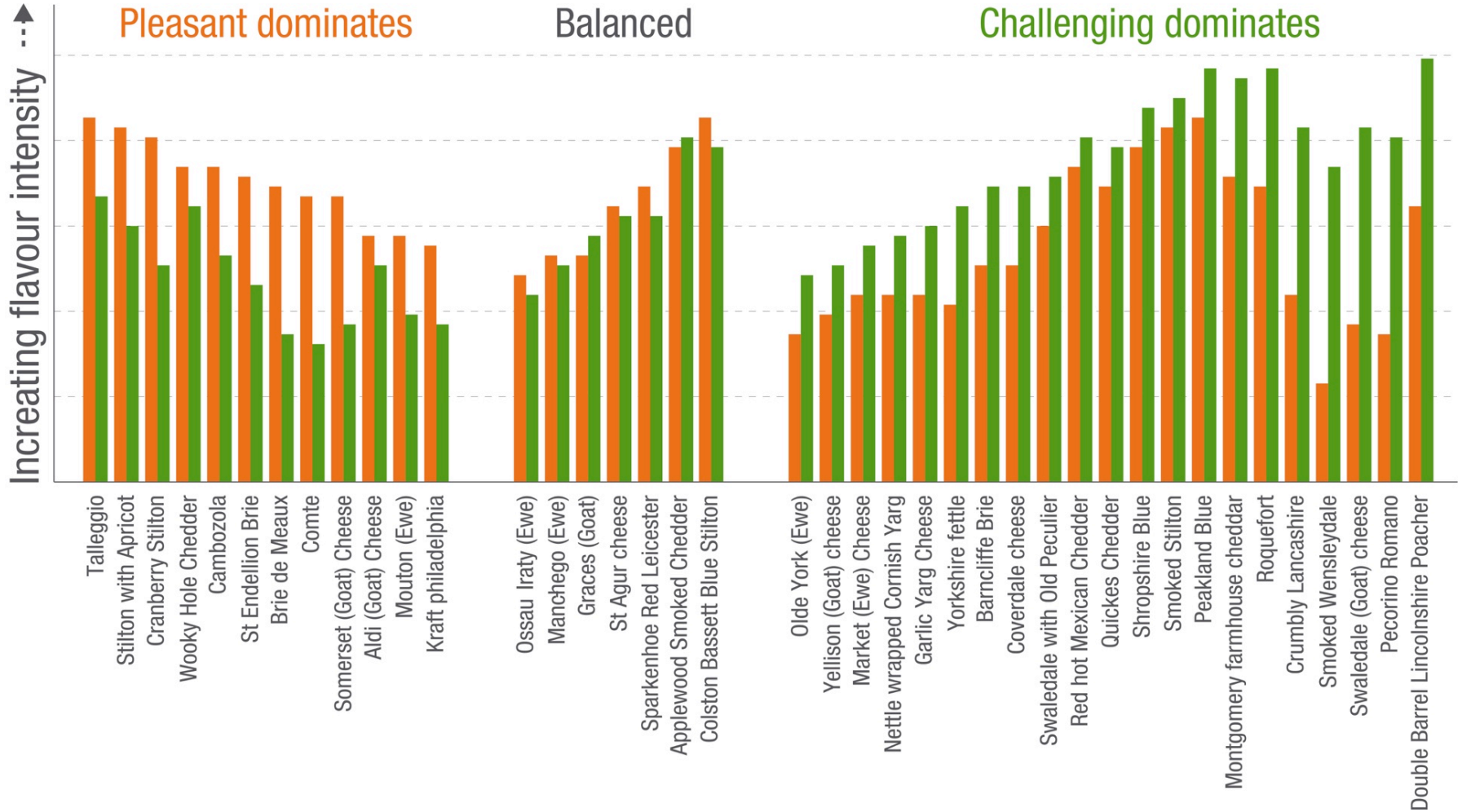
C: Czech Pilsner



Results: Relative balance by Style



Results: Cheese flavor balance

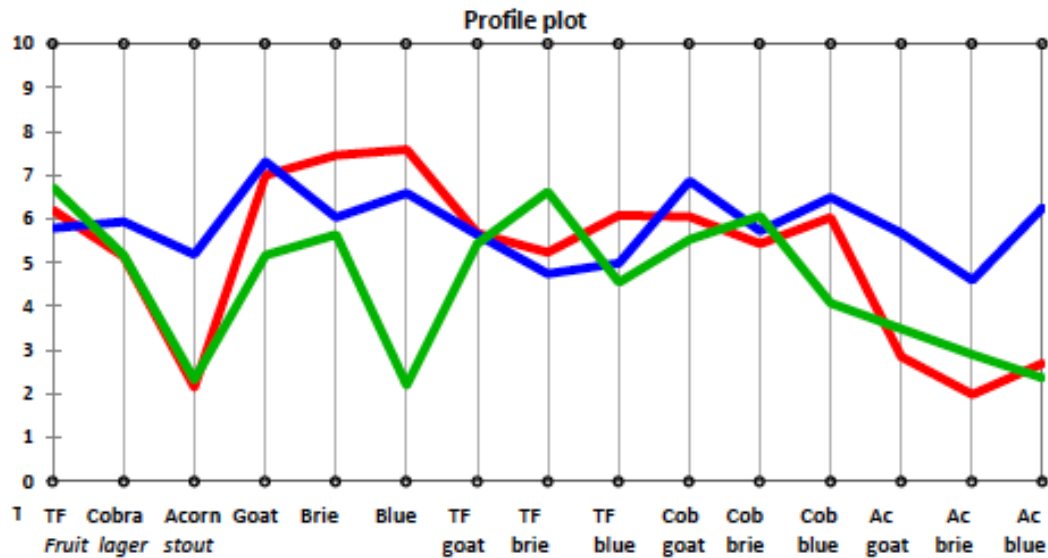


Results: Beer & Cheese Hedonic liking

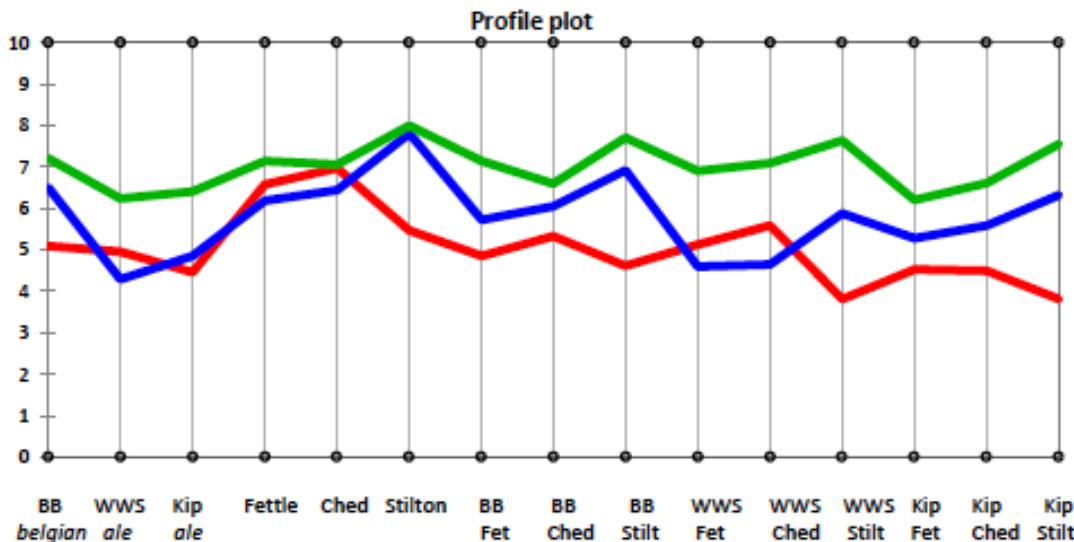
Beer	Cheese		
	Yellinsons Goat 6.71 ± 2.13	St Endellion Brie 6.37 ± 2.16	Peakland Blue 5.86 ± 2.79
Timmermans Framboise Lambic 6.13 ± 2.18	5.6 ± 2.28	5.33 ± 2.19	5.21 ± 2.27
Cobra (Helles) 5.51 ± 1.91	6.3 ± 1.77	5.71 ± 1.85	5.78 ± 2.04
Acorn Gorlovka (Imperial Stout) 3.59 ± 2.55	4.3 ± 2.2	3.4 ± 1.96	4.27 ± 2.39

Beer	Cheese		
	Yorkshire Fettle 6.55 ± 1.76	Montgomery Cheddar 6.77 ± 1.59	Stilton with Apricots 7.13 ± 2.01
Blanche de Bruxelles (Witbier) 6.25 ± 1.83	5.81 ± 1.71	5.96 ± 1.57	6.4 ± 1.98
Worthington's White Shield (IPA) 4.99 ± 2.12	5.35 ± 1.92	5.57 ± 1.97	5.68 ± 2.13
Thombridge Kipling (Pale Ale) 5.12 ± 2.1	5.28 ± 1.74	5.51 ± 1.86	5.85 ± 2.08

Results: Beer & Cheese cluster analysis

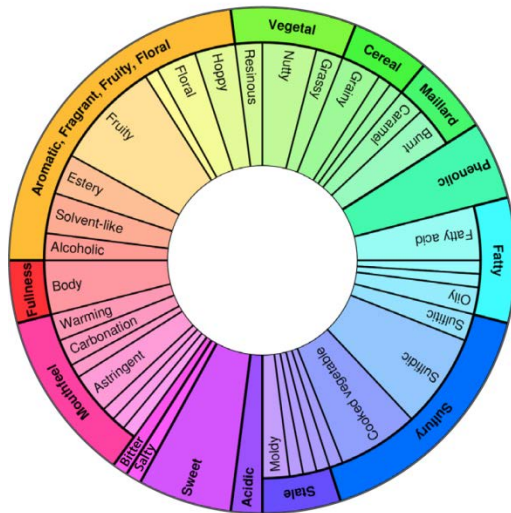


Cluster 1 (40): <40yrs, lager
 Cluster 2 (61): ↑male, ↑>50yrs, ↑freq beer consumption, ale/bitter/stout
 Cluster 3 (31): <30yrs, ↑Asian, ↓freq beer consumption, ↓consumption blue/brie cheeses



Cluster 1 (42): ↑British, ↓females,
 Cluster 2 (58): ↑females, ↓freq beer consumption, lager
 Cluster 3 (34): ↑>50yrs,

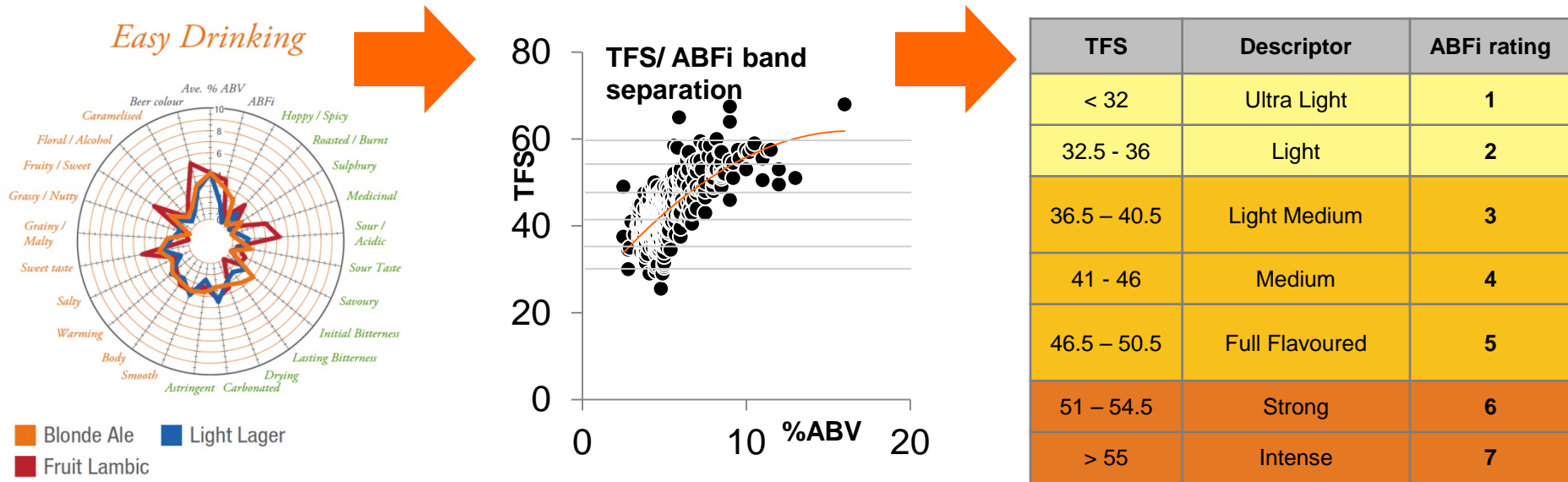
Conclusions: Communication progression



[👃] SMELL IT		[👅] TASTE IT		[👁️] FEEL IT							
Grainy / Malty	3.5	1	Roasted/ Burnt	Sweet	2.5	2	Sour	Warming	3.5	2.5	Drying
Grassy / Nutty	1	0	Oily / Fatty	Oily / Fatty	0	2	Savoury	Body	4	3.5	Carbonated
Sweet / Fruity	4	2	Sulphury	Salty	3	5	Initial Bitterness	Smooth	3	3	Astringent
Floral / Alcohol	2	0	Stale / Papery			4	Lasting Bitterness				
Sweet / Caramelised	2	0	Medicinal								
		1	Sour / Acidic								
TOTAL 12.5		8	TOTAL	TOTAL 5.5		13	TOTAL	TOTAL 10.5		9	TOTAL
Copper Totals			Green Totals			OVERALL FLAVOUR BALANCE			TOTAL FLAVOUR SCORE		
12.5 +			8 +			28.5			GRAND TOTAL		
5.5 +			13 +			(SMELL IT + TASTE IT + FEEL IT)			30		
10.5 =			9 =			(SMELL IT + TASTE IT + FEEL IT)			28.5 + 30 =		
									58.5		

- Flavor wheel is well-established & utilized
- ABFN allows intensity score of flavor characteristics & relative balance for each sense






Conclusions: Communication progression



- Visual expression of characteristic intensity
- Linear progression of flavour intensity with %ABV
- Consumer-friendly ABFi, 1 – 7 Flavor intensity rating

Conclusions

- With minor adjustments, ABFN offers a basis for evaluation of flavor balance & intensity in other foods (& drinks) too
- PCA, relative balance and flavor intensity (Total Flavor Score) results for cheese indicate appropriate style grouping/ separation
- Similar techniques offer potential for consumer flavor communication based upon a consistent platform

Name	A.B.V. BEER STYLE									
Brewer	Best Before					Sampled On				
 SEE IT										
Beer Colour	White	Yellow	Gold	Straw	Amber	Red	Brown	Black		
	1	2	3	4	5	6	7	8		
Head Colour	White	Cream	Coffee	Head cling & lacing	Poor				Good	
	1	2	3	4	5	1	2	3	4	5
Clarity	Cloudy	Clear & Bright			Carbonation	Flat	Champagne-like			
	1	2	3	4	5	1	2	3	4	5
<small>Please add your own notes on significant aromas & flavours overleaf</small>										
 SMELL IT			 TASTE IT			 FEEL IT				
Grainy / Malty	Hoppy/Spicy	Sweet	Sour	Warming	Drying					
Grassy / Nutty	Roasted / Burnt	Oily / Fatty	Savoury	Body	Carbonated					
Sweet / Fruity	Oily / Fatty	Salty	Initial Bitterness	Smooth	Astringent					
Floral / Alcohol	Sulphury	Lasting Bitterness								
Sweet / Caramelised	Stale / Papery									
	Medicinal									
	Sour / Acidic									
TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL					
OVERALL FLAVOUR BALANCE					TOTAL FLAVOUR SCORE					
GRAND TOTAL (SMELL IT + TASTE IT + FEEL IT)					GRAND TOTAL (SMELL IT + TASTE IT + FEEL IT)					
RATE IT ★	Never again!	Disappointing	Average	Mm..Mmmm	Yes Yes YES!					
	1	2	3	4	5	6	7	8	9	10
 ALL BEER FLAVOUR NOTEPAD										
Savoury food match										

Conclusions

- ABFN analysis can drive beer recommendations based on drinker preference (www.allbeerfinder.com)
- Experienced beer & food pairing practitioners suggest certain beer styles suit certain foods
- Developing ABFN food analogues offers the potential to suggest harmonious beer-food pairings
- With further research, the potential for these methods to drive beer-food matching algorithms can be developed



What we'd do differently:

- No compromises on beer selection
 - 3 of the 6 beers featured were last minute substitutes due to supplier stock-outs
- Sample group selection from a wider pool (not just University staff & students)
- Greater mix of ages and preferences in the sample groups
- More extensive analysis of the cheese data, splitting results by age/ sex
- Assess ABFN of paired beer & food for causal links

Further work:

- Solicit interested sponsors to support further research:
 - Beer industry?
 - Food industry?
 - App developers?
- Repeat/ expand the beer-cheese trials
- Test the Flavor Notepad on other food groups
- Extend sensory pairing trials to other food groups

Research/ Presentation Purpose

- To assess the efficacy of the ALL BEER Flavor Notepad (ABFN) as a tool for beer flavor evaluation ✓
- To develop a working model for a Food Flavor Notepad, using cheese as an example ✓
- To investigate causal links between beer and food pairing preferences ?



Thank you for your attention

Q&A?

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