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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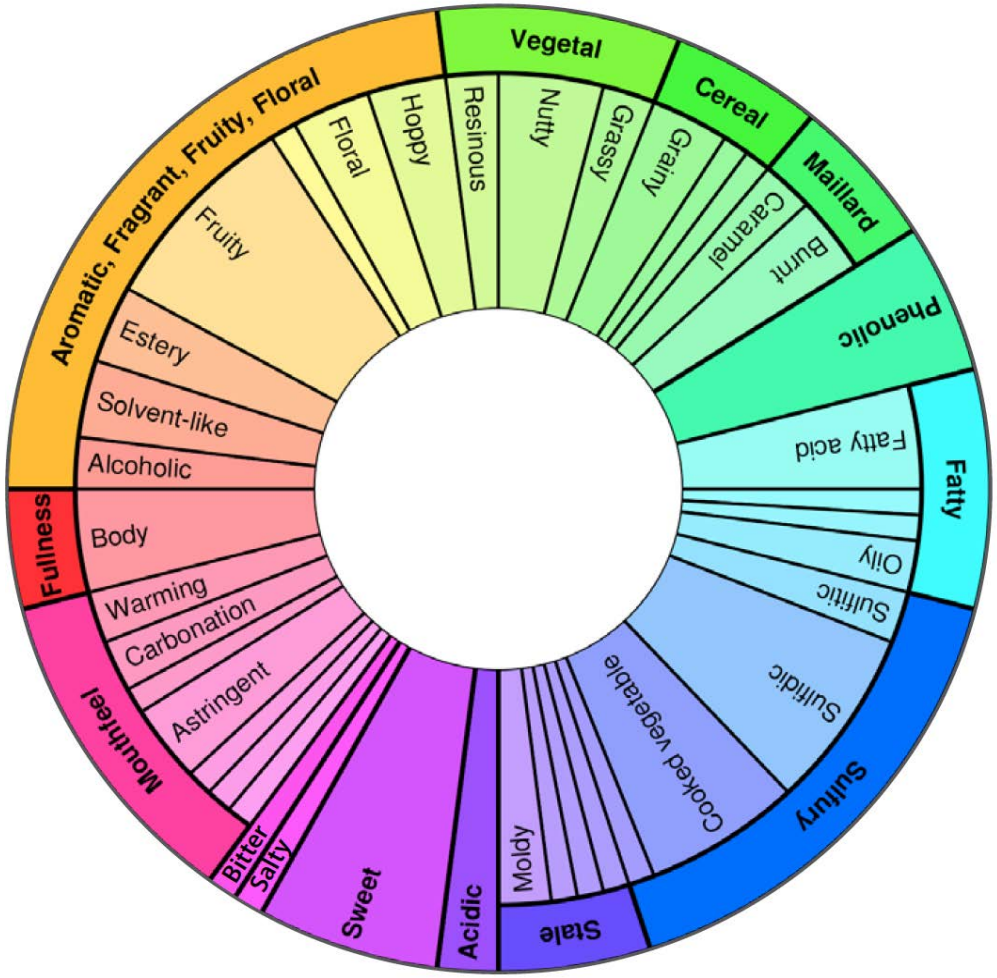
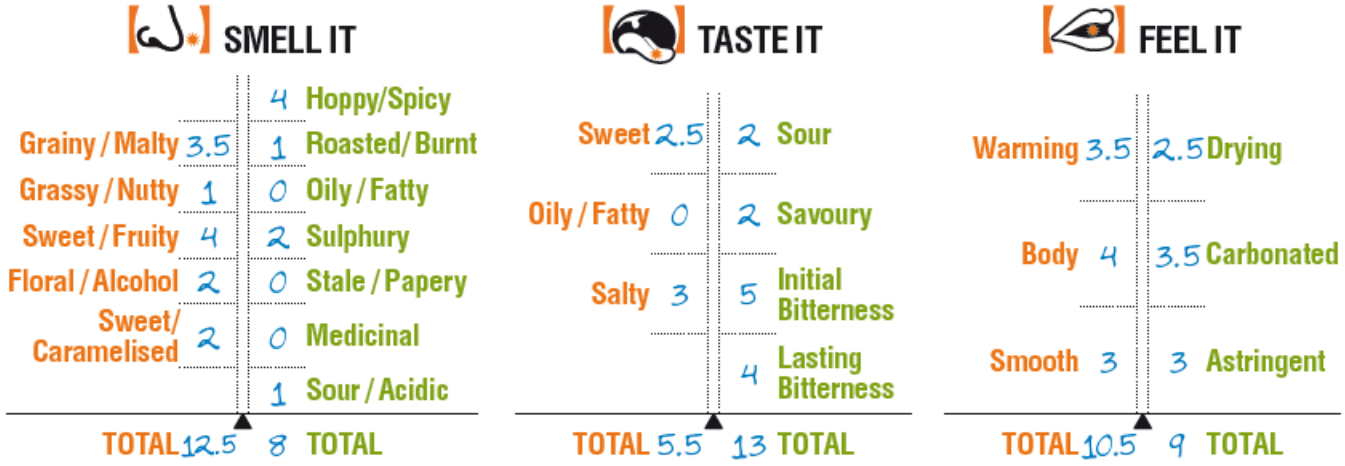
Research/ Presentation Purpose

- 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



Copper Totals

12.5 +

5.5 +

10.5 =

Green Totals

8 +

13 +

9 =

OVERALL FLAVOUR BALANCE

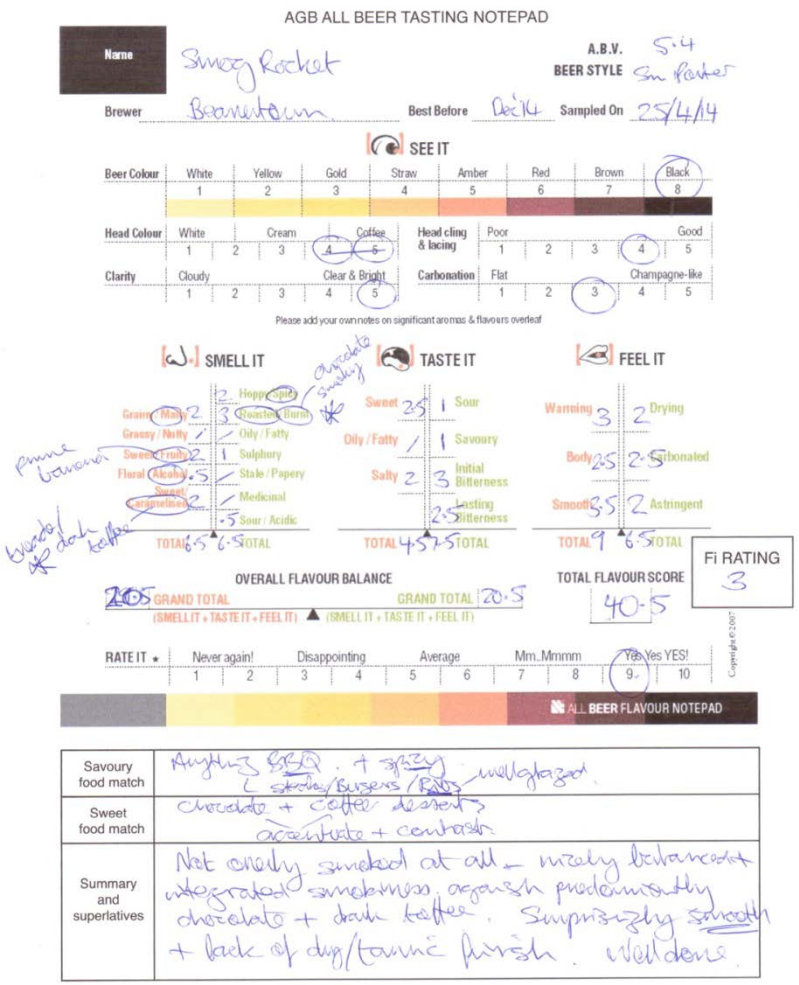
28.5 GRAND TOTAL (SMELL IT + TASTE IT + FEEL IT) ▲ GRAND TOTAL (SMELL IT + TASTE IT + FEEL IT) 30

TOTAL FLAVOUR SCORE

28.5 + 30 =

58.5

Methods: Beer evaluation


AGB ALL BEER TASTING NOTEPAD

Name: Smog Rocket — A.B.V. 5.4 — BEER STYLE Smoke Porter

Brewer: Beavertown — Best Before: Dec'14 — Sampled On: 25/4/14

SEE IT

Beer Colour	White 1	Yellow 2	Gold 3	Straw 4	Amber 5	Red 6	Brown 7	Black 8
Head Colour	White 1	Cream 2 3	Coffee 4 5					
Head cling & lacing	Poor 1	2	3	4	Good 5			
Clarity	Cloudy 1	2	3	4	Clear & Bright 5			
Carbonation	Flat 1	2	3	4	Champagne-like 5			

Please add your own notes on significant aromas & flavours overleaf

SMELL IT — TASTE IT — FEEL IT

SMELL IT: Hoppy/Spicy 2; Grainy/Malty 2; Roasted/Burnt 3; Grassy/Nutty 1; Oily/Fatty 1; Sweet/Fruity 2; Sulphury 1; Floral/Alcohol 2.5; Stale/Papery 1; Sweet/Caramelised 2; Medicinal 1; Sour/Acidic 2.5; TOTAL 6.5 6.5 TOTAL

TASTE IT: Sweet 3.5; Sour 1; Oily/Fatty 1; Savoury 1; Salty 2; Initial Bitterness 3; Lasting Bitterness 2.5; TOTAL 4.5 7.5 TOTAL

FEEL IT: Warming 3; Drying 2; Body 2.5; Carbonated 2.5; Smooth 3.5; Astringent 2; TOTAL 9 6.5 TOTAL

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

TOTAL FLAVOUR SCORE: 40.5

Fi RATING: 3

RATE IT: Never again! 1 2 3 4 5 6 7 8 9 10 Yes Yes YES!

ALL BEER FLAVOUR NOTEPAD

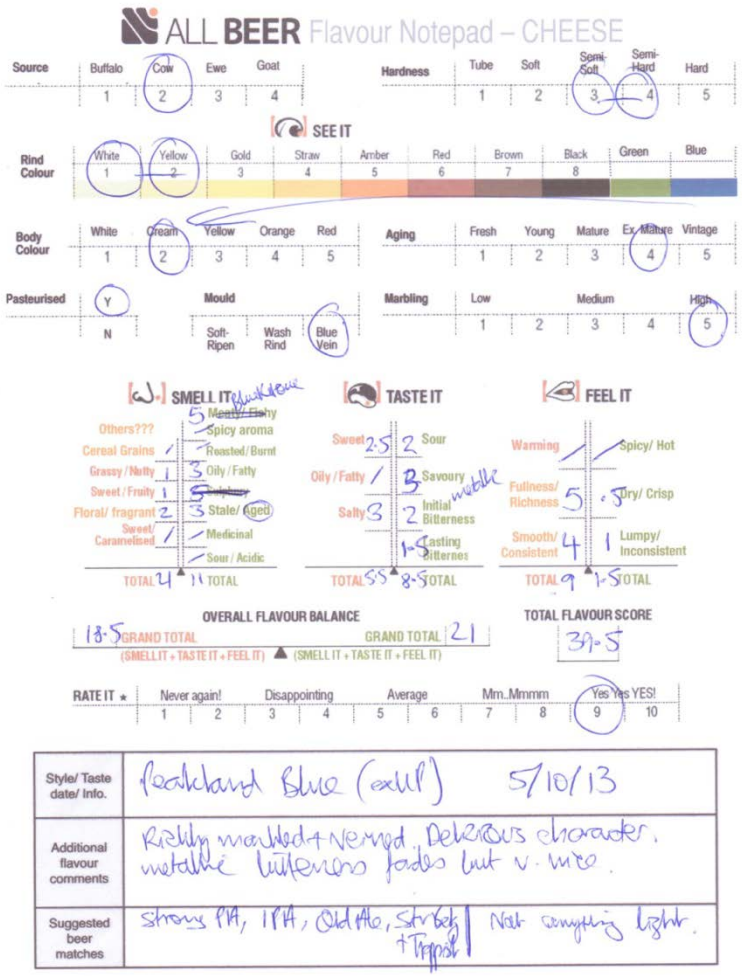
Savoury food match	Anything BBQ'd + smoky. Burgers / Ribs. Well glazed.
Sweet food match	Chocolate + coffee desserts. Accentuate + contrast.
Summary and superlatives	Not overly smoked at all – nicely balanced + integrated smokiness, ashy/ash predominantly chocolate + dark toffee. Surprisingly smooth + lack of dry/tannic finish. Well done.

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

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

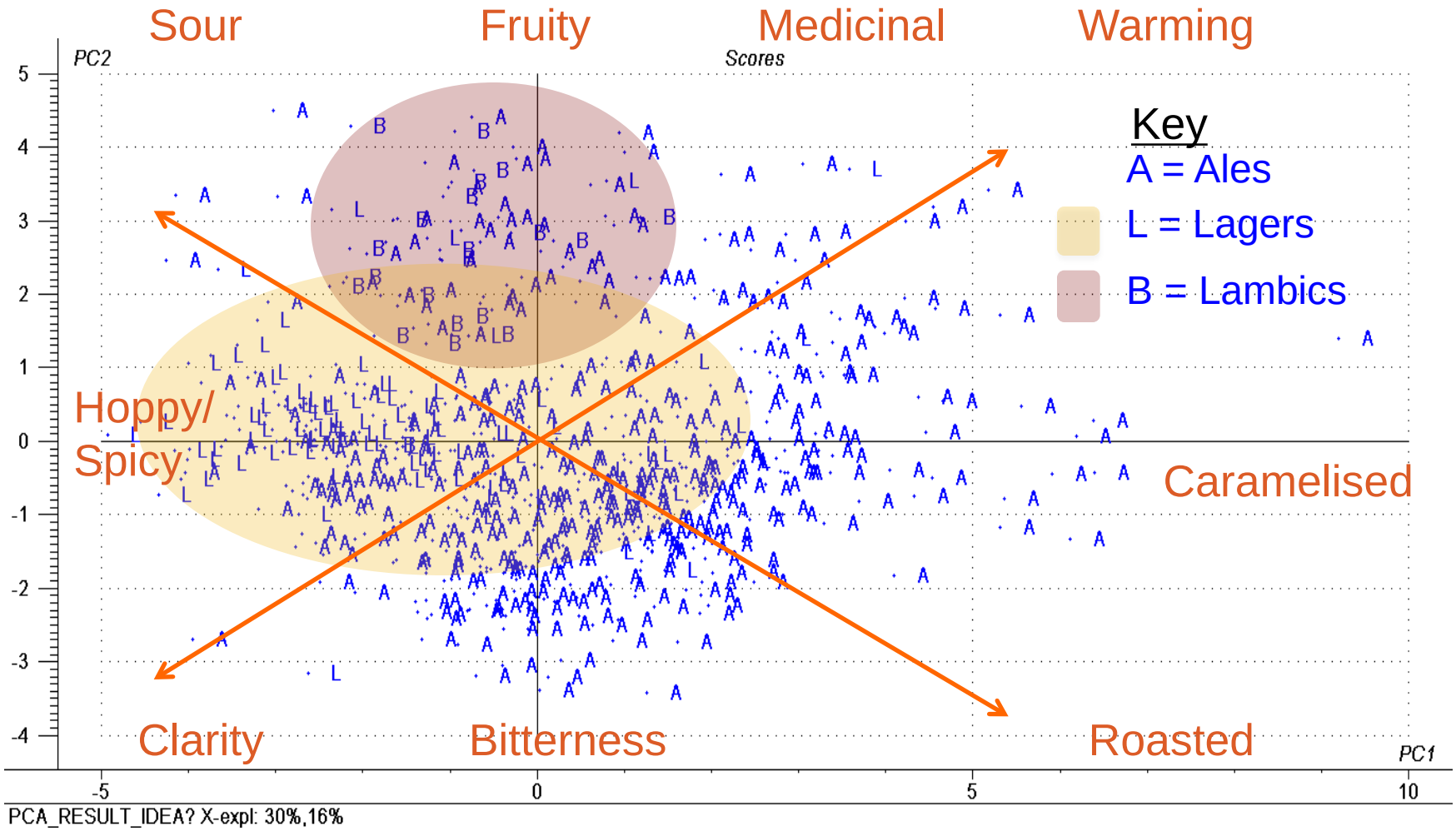


- Beer Notepad adjusted to suit Cheese, incl.:
  - Milk source
  - Style/ Hardness
  - Aging scale
  - Some additional or different Aromatic & Mouth-feel descriptors
  - Beer pairing suggestions

Methods: Cheese evaluation

- 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



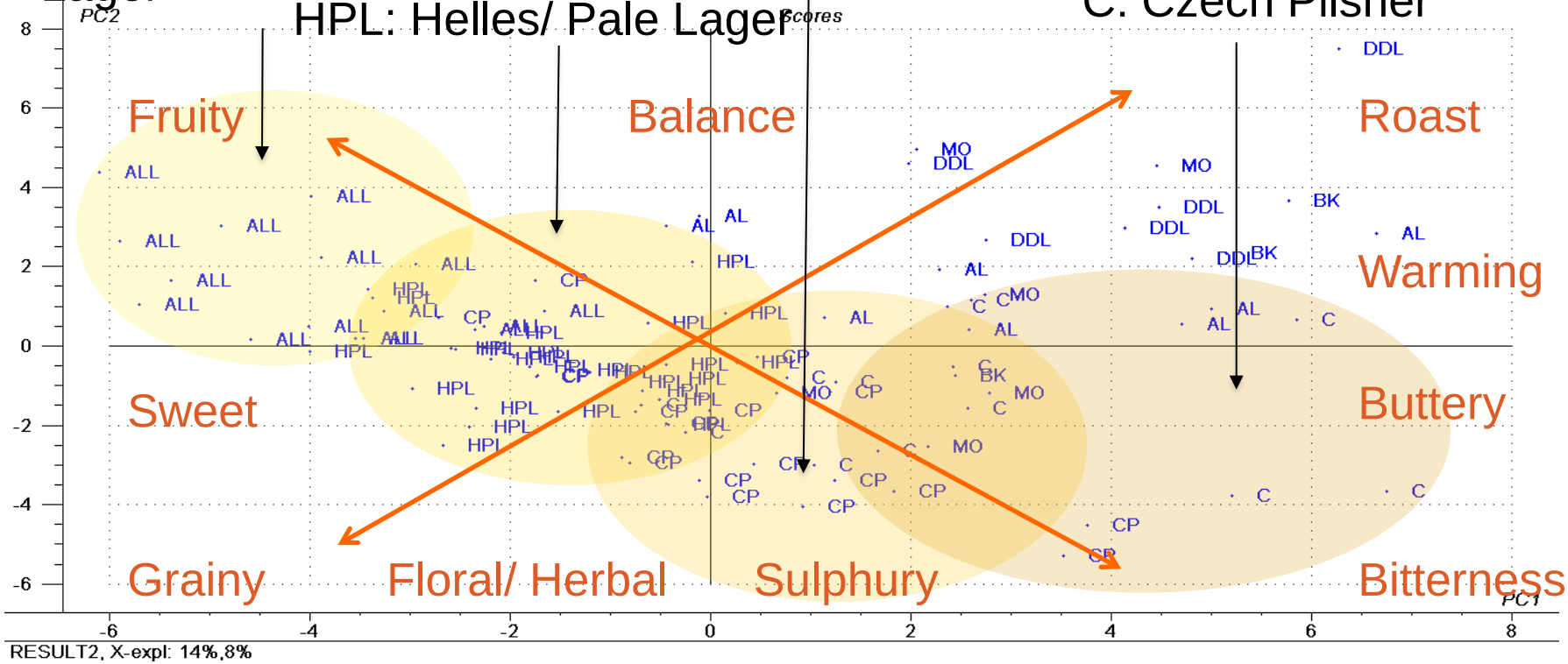
Results: PCA plot for Lagers

ALL: American/ Light Lager

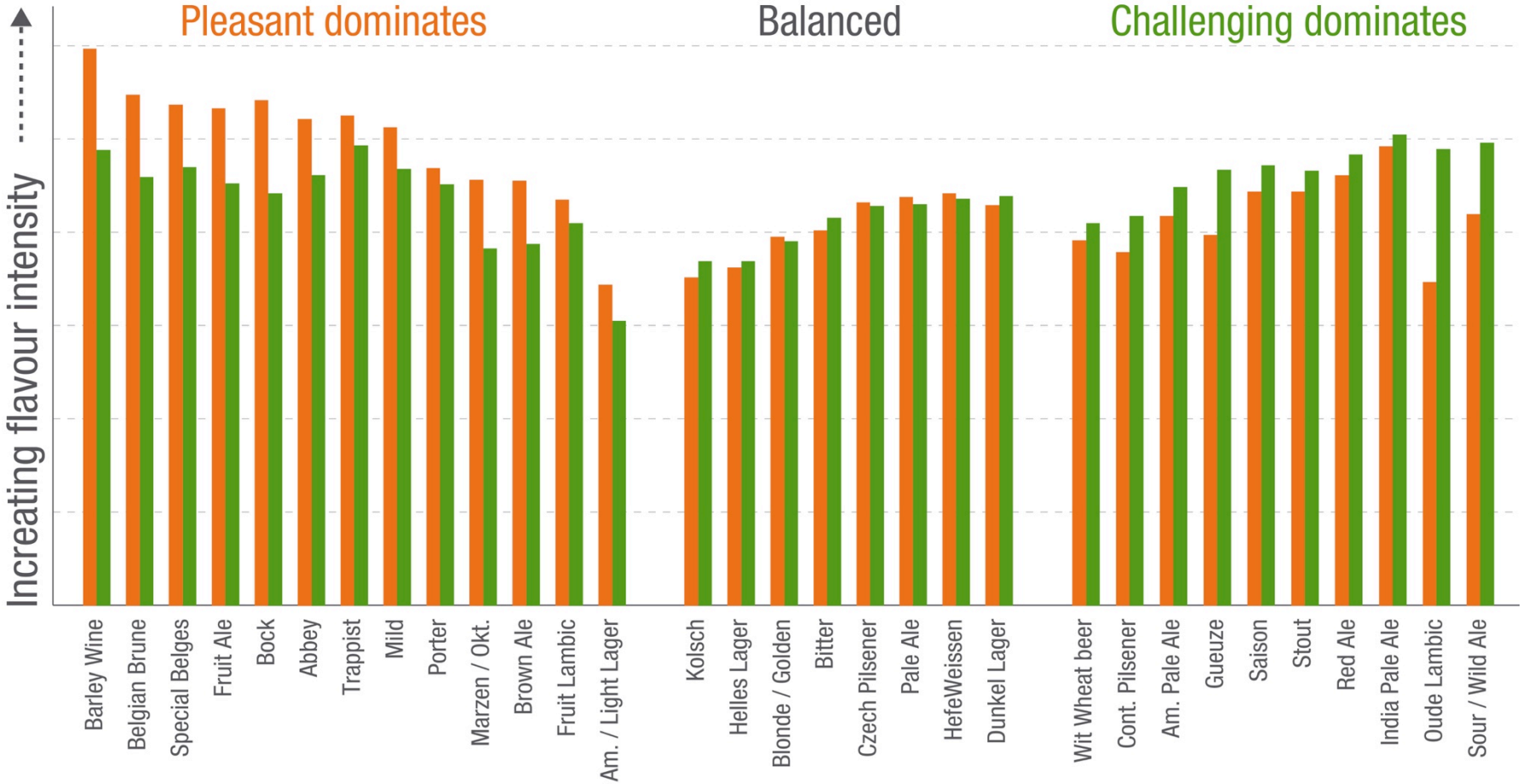
CP: Continental Pilsener

HPL: Helles/ Pale Lager

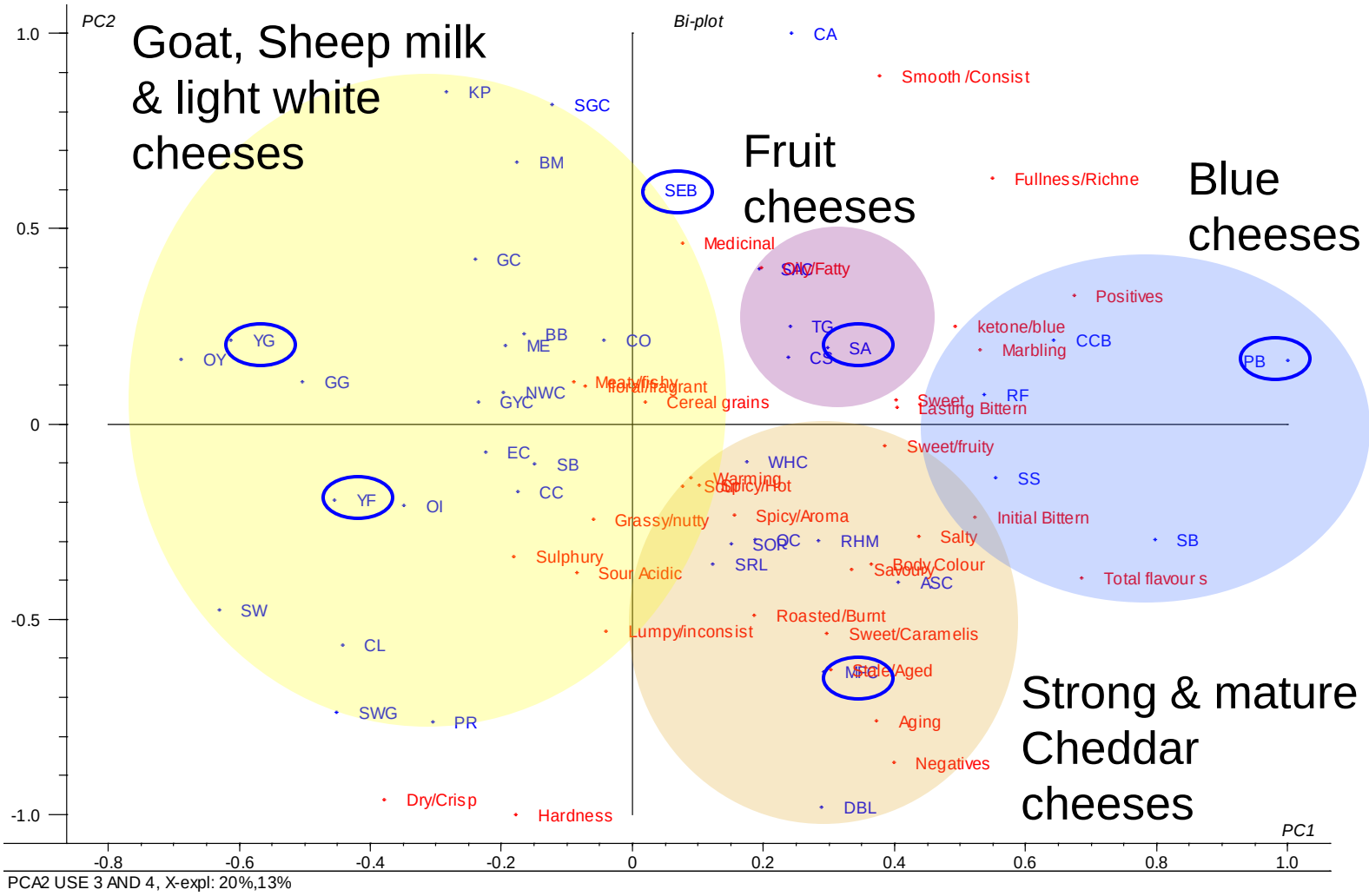
C: Czech Pilsner



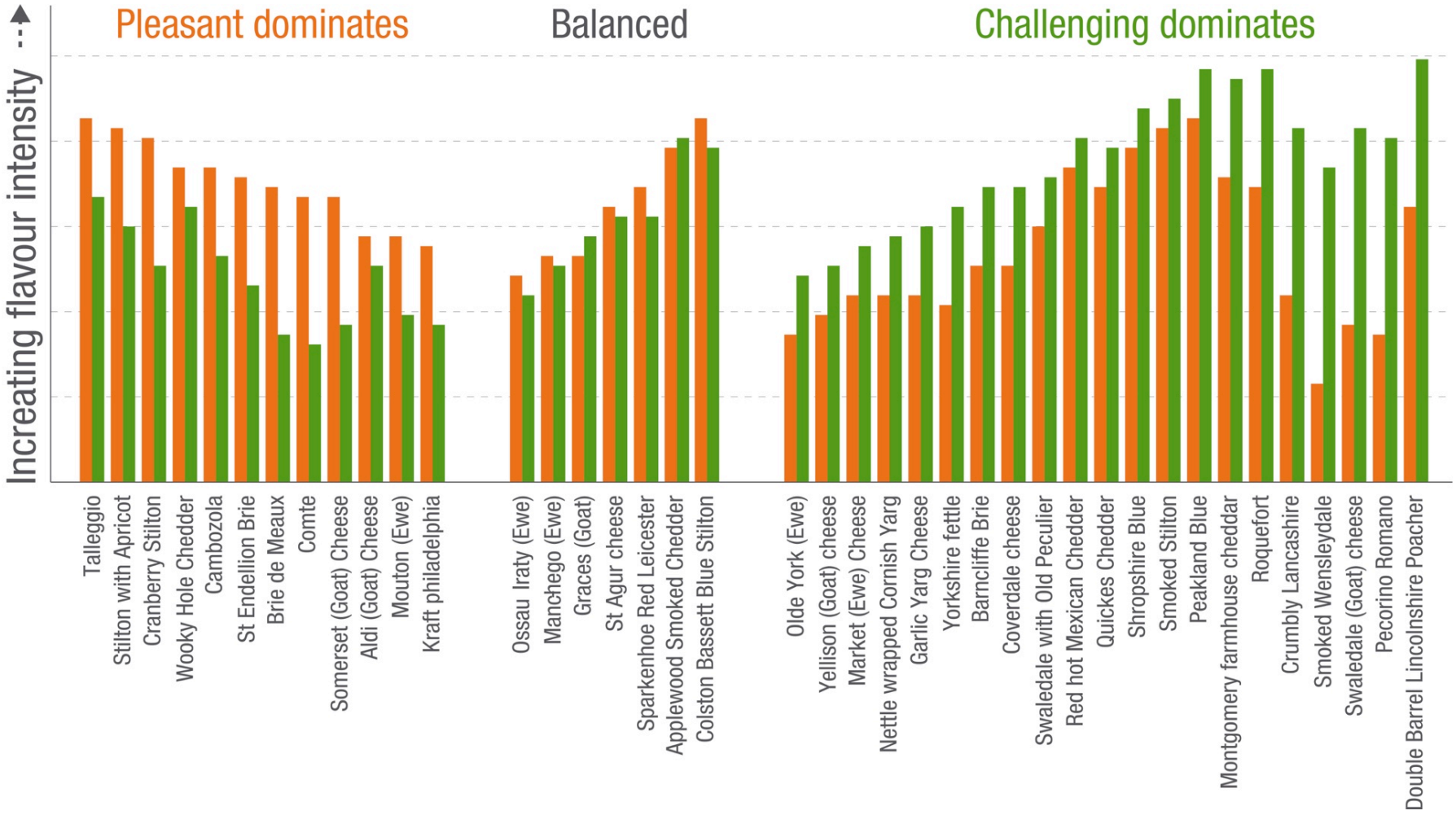
Results: Relative balance by Style



Results: PCA plot for Cheeses



Results: Cheese flavor balance

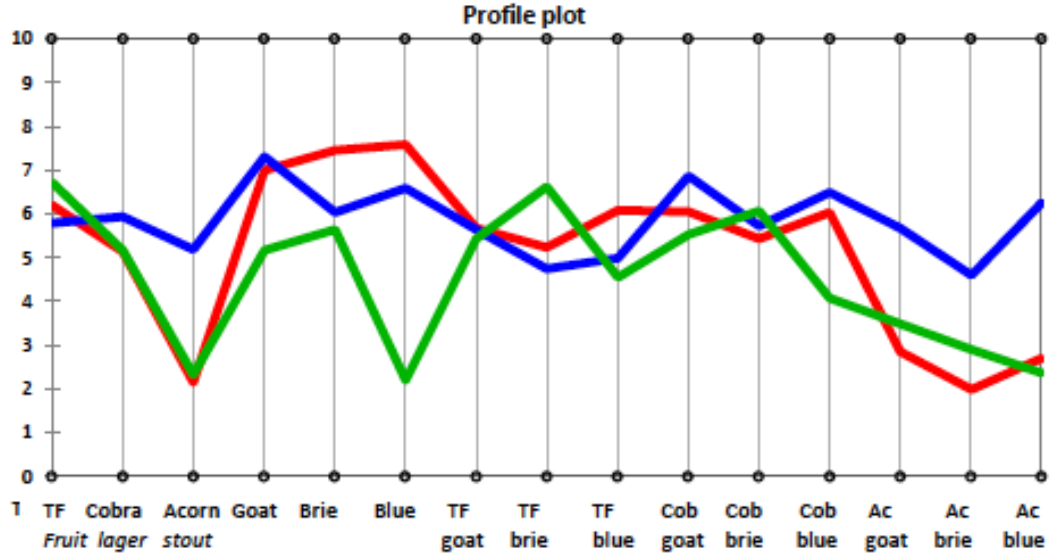


Results: Beer & Cheese Hedonic liking

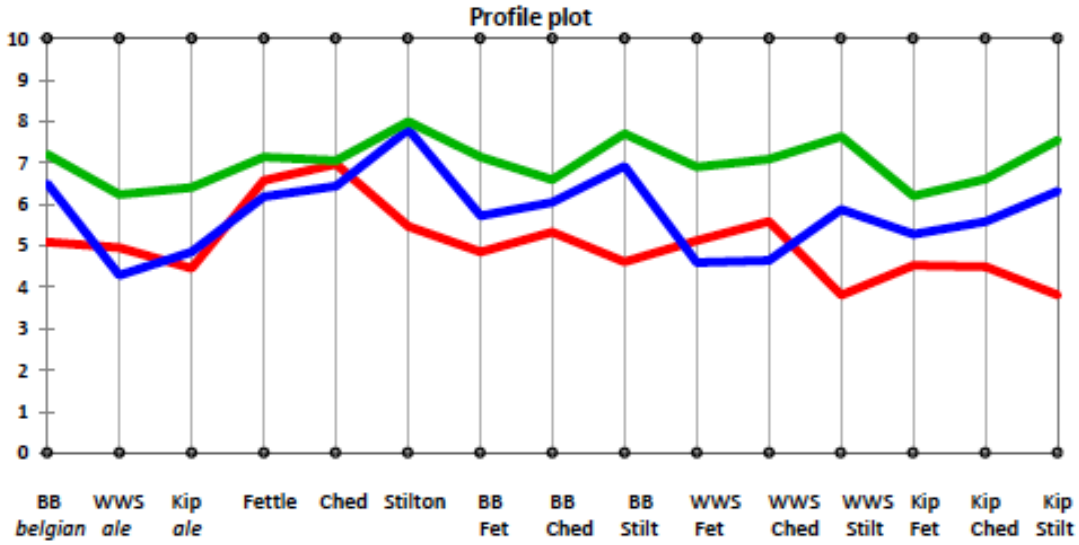
Beer	Cheese		
	Yellinsons Goat 6.71 ± 2.13	St Endellion Brie 6.37 ± 2.16	Peakland Blue 5.86 ± 2.79
Timmermans Framboise Lambic 6.13 ± 2.18	5.6 ± 2.28	5.33 ± 2.19	5.21 ± 2.27
Cobra (Helles) 5.51 ± 1.91	6.3 ± 1.77	5.71 ± 1.85	5.78 ± 2.04
Acorn Gorlovka (Imperial Stout) 3.59 ± 2.55	4.3 ± 2.2	3.4 ± 1.96	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
Thornbridge Kipling (Pale Ale) 5.12 ± 2.1	5.28 ± 1.74	5.51 ± 1.86	5.85 ± 2.08

Results: Beer & Cheese cluster analysis

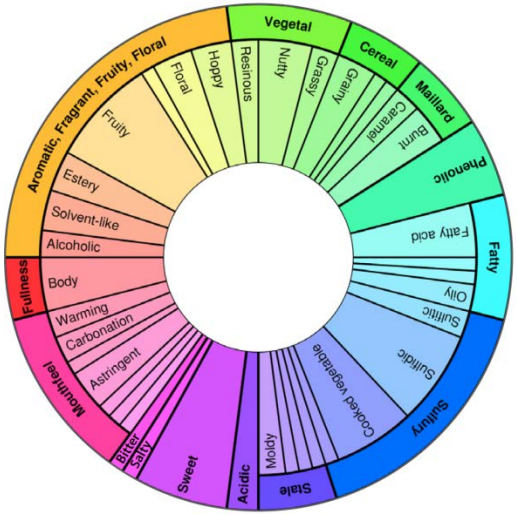


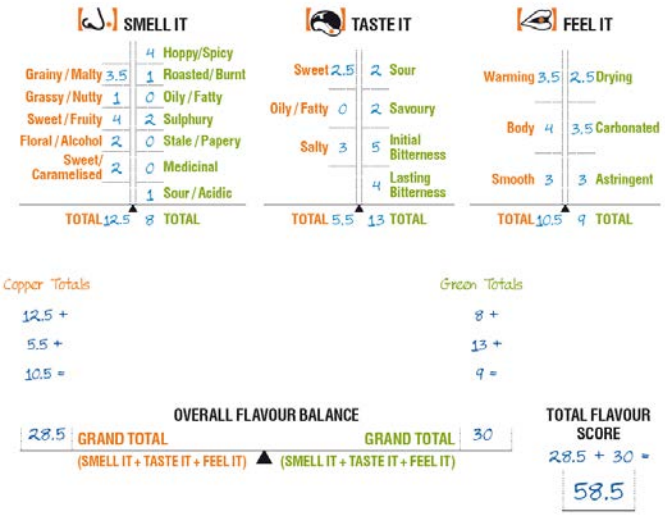
Cluster 1 (40):<40yrs, lager
Cluster 2 (61): ↑male, ↑>50yrs, ↑freq beer consumption, ale/bitter/stout
Cluster 3 (31): <30yrs, ↑Asian, ↓freq beer consumption, ↓consumption blue/brie cheeses



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

Conclusions: Communication progression

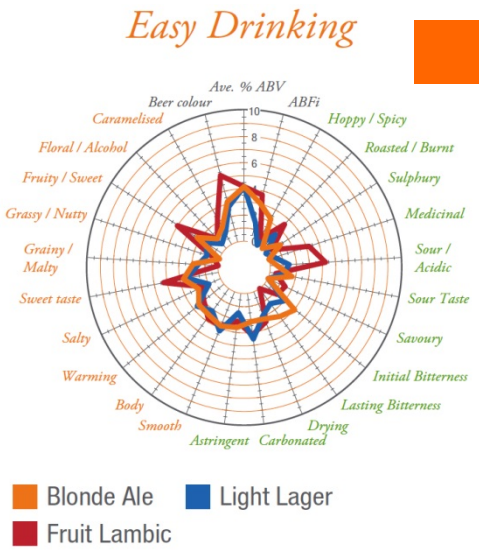


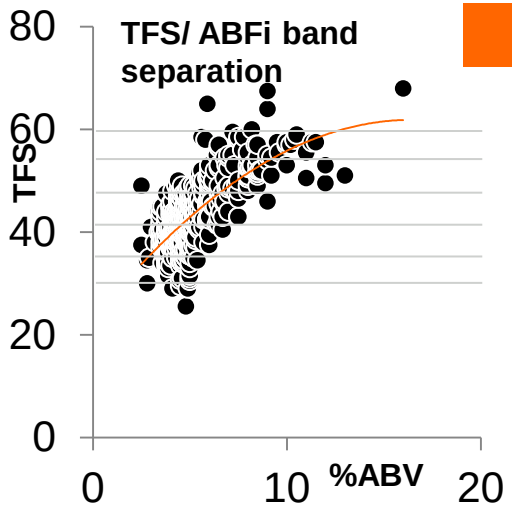


- Flavor wheel is well-established & utilized
- ABFN allows intensity score of flavor characteristics

& relative balance for each sense

Conclusions: Communication progression



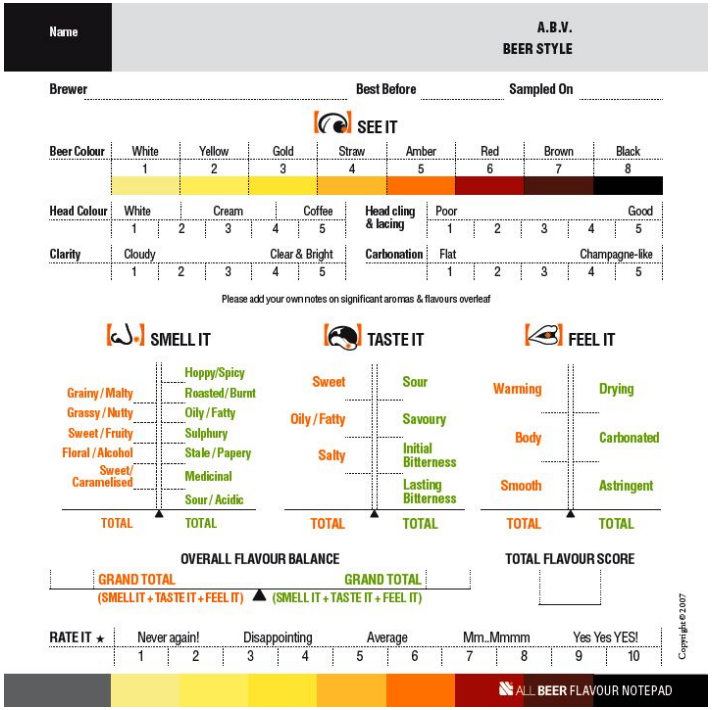


TFS	Descriptor	ABFi rating
< 32	Ultra Light	**1**
32.5 - 36	Light	**2**
36.5 – 40.5	Light Medium	**3**
41 - 46	Medium	**4**
46.5 – 50.5	Full Flavoured	**5**
51 – 54.5	Strong	**6**
> 55	Intense	**7**

- 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



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

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Thank you for your attention

Q&A?

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