How fast is a 'rapid method'?

An application of multivariate analysis to sensory & consumer data collected using 'Napping' – a novel rapid data collection method

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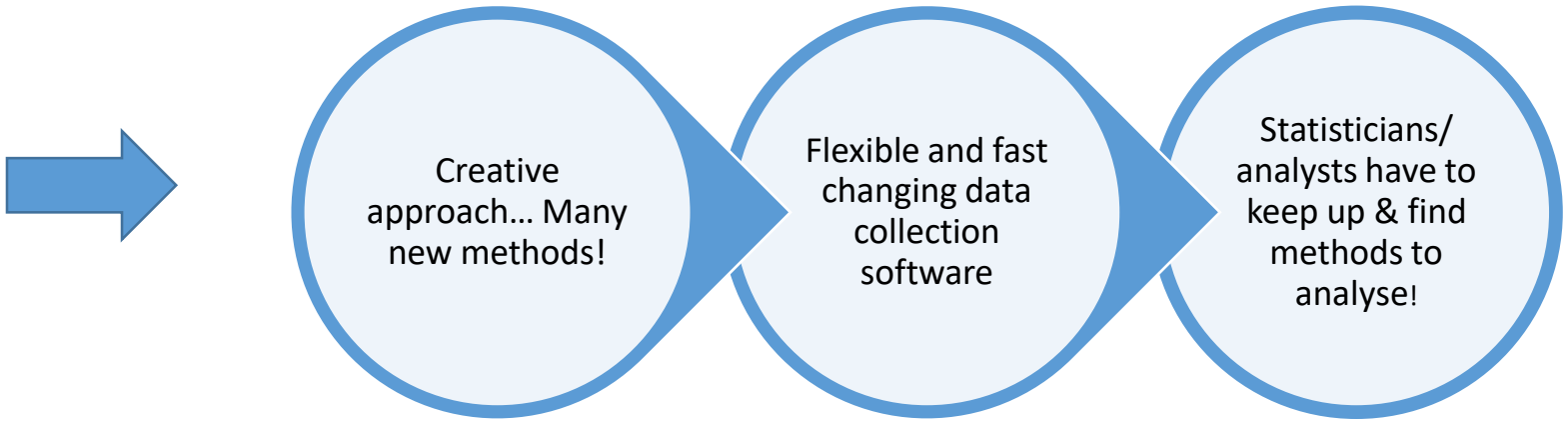
Gemma Hodgson

Introduction – why the sensory & consumer world may be different?

In the sensory and consumer world, companies often look for ways to collect data more quickly, with less burden on the testers – often consumers or "panels".



Often is analysed by non-statisticians

BUT…

- New methods deemed to be 'easy and quick' have been shown to be reliable even among consumers
- Now being used when profiling a product in order to save time training sensory panels.

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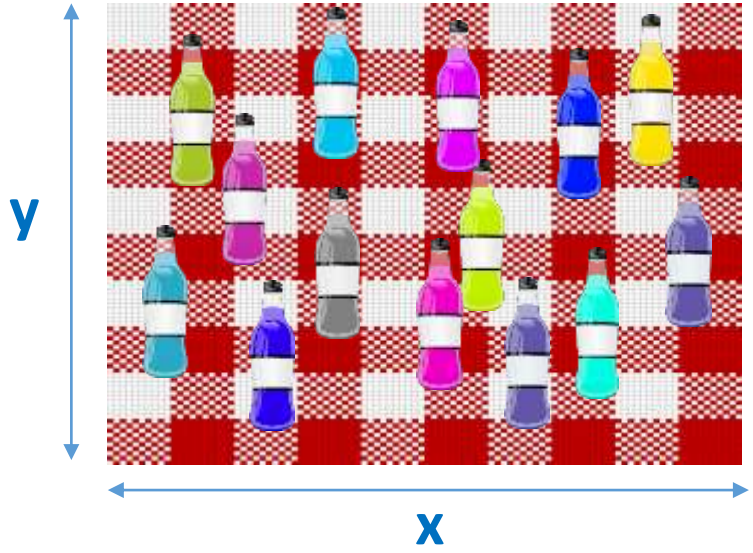
Overview of "Napping®"

- In one such rapid technique – **napping*** - panelists group the set of products on a 2-dimensional surface, according to how similar *they* perceive them to be.
- The surface represents the sensory space of a product set



Nappe = table cloth!

The products are then given x-y coordinates based on their positions and the coordinates from all the consumers 'nappes' are then analysed together to create an overall picture.

A consensus map is produced using a statistical method known as multiple factor analysis (MFA).

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*Pagès. J.(2003) Collection and analysis of perceived product inter-distance using multiple factor analysis: Application to the study of 10 white wines from the Loire Valley. Food Quality and Preference s, 16, 642-649.

Collection of Napping Data - Summary

- Each participant is presented with all samples simultaneously
- Each participant positions samples on the ‘nappe’
  - Usually directed by sensory modality
  - Products positioned close together are similar and different to those placed further apart – 2 dimensions available
- Results turned into numerical co-ordinates = data points

Sensory Data Collection Method

However….Rapid data collection ≠ Rapid data analysis!

BUT: The statistical tools in JMP make it ideal to analyse these new fast data collection methods.

This next example demonstrates how different people's personal opinions can be usefully combined in a JMP analysis to compare products.

The technique is not available as a standalone analysis in JMP (yet) however it can be done manually using a script in order to use the great JMP PCA graphical outputs to display the results.

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Sensory Data Collection Method – Napping skin creams

Real Study Example: Using 12 different skin creams, each consumer rubbed a blob of cream on their wrist to evaluate it and then placed it on the 'nappe' according to how they would group the products.

It is quick and simple for untrained consumers to do and creates a personal map.

	Cream	Consumer ID	X	Y
1	Dove Silky Body ...	1	20	19
2	E45 Lotion	1	44	30
3	Jergens Cocoa B...	1	32.5	41
4	Johnsons Baby n...	1	11.5	20.5
5	Nivea for men Hy...	1	53	45
6	Palmers Cocoa B...	1	19	27
7	Tesco Antibacteri...	1	66	45
8	Tesco Intensive ...	1	18	39
9	Tesco Pomegran...	1	27	40
10	Tesco Soft & Sm...	1	22	42.5
11	Tesco Soleil Sunc...	1	43.5	22
12	Tesco Vit E Moist...	1	13.5	14
13	Dove Silky Body ...	10	23.45	16.4
14	E45 Lotion	10	7.5	6.2
15	Jergens Cocoa B...	10	10.6	9.6
16	Johnsons Baby n...	10	26.1	19.8
17	Nivea for men Hy...	10	3.4	4.6

The coordinates from the product positions per consumer are shown here

i.e. consumer 1 placed the first cream at 20cm along and 19 cm up the cloth (x1, y1).

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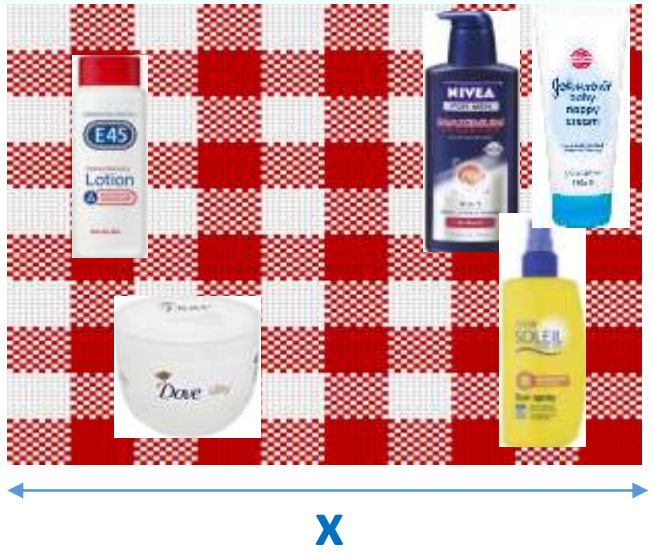
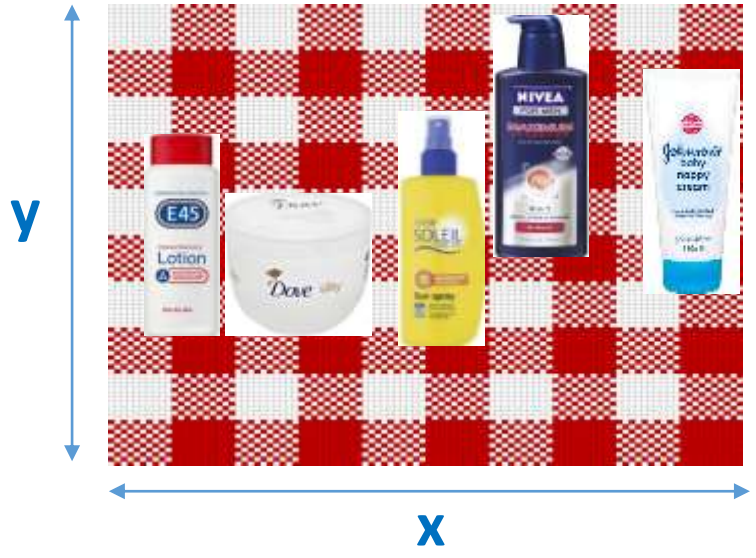
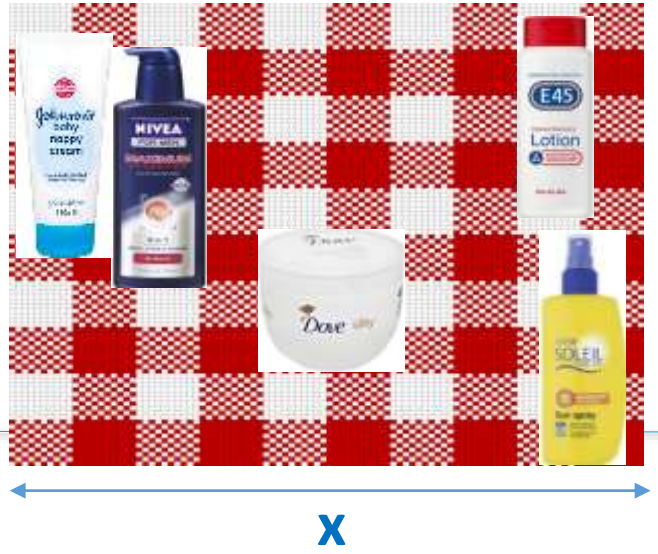
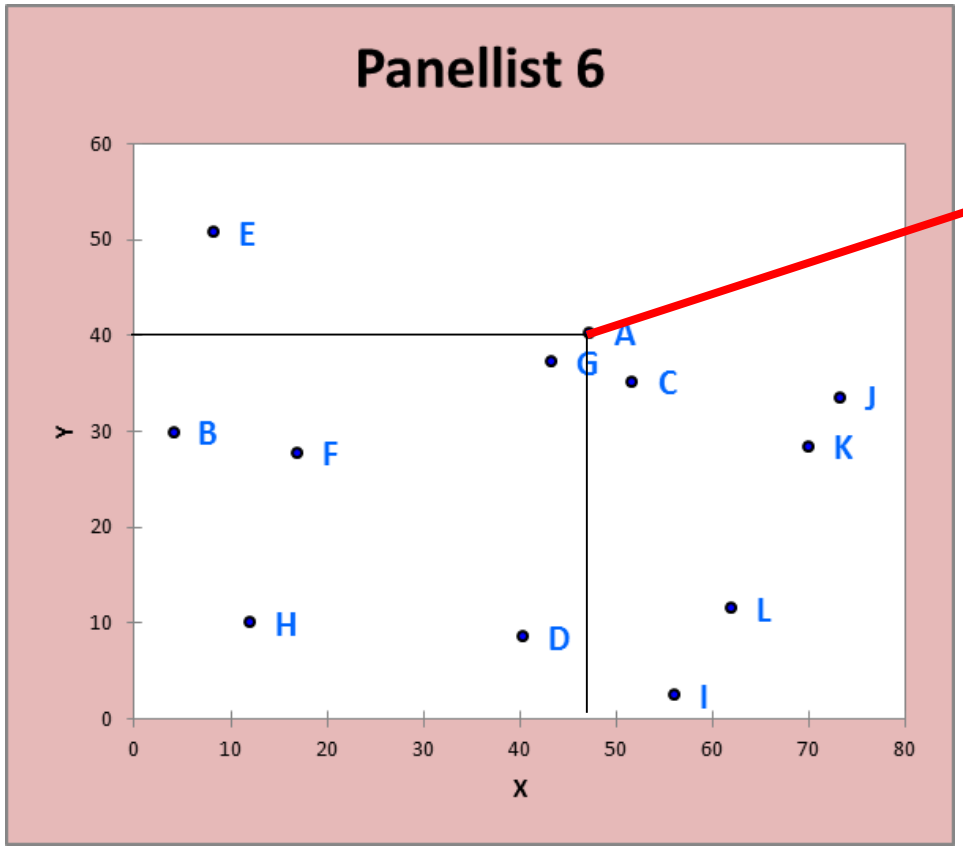
Data Collection - Examples of consumer 'Nappes'







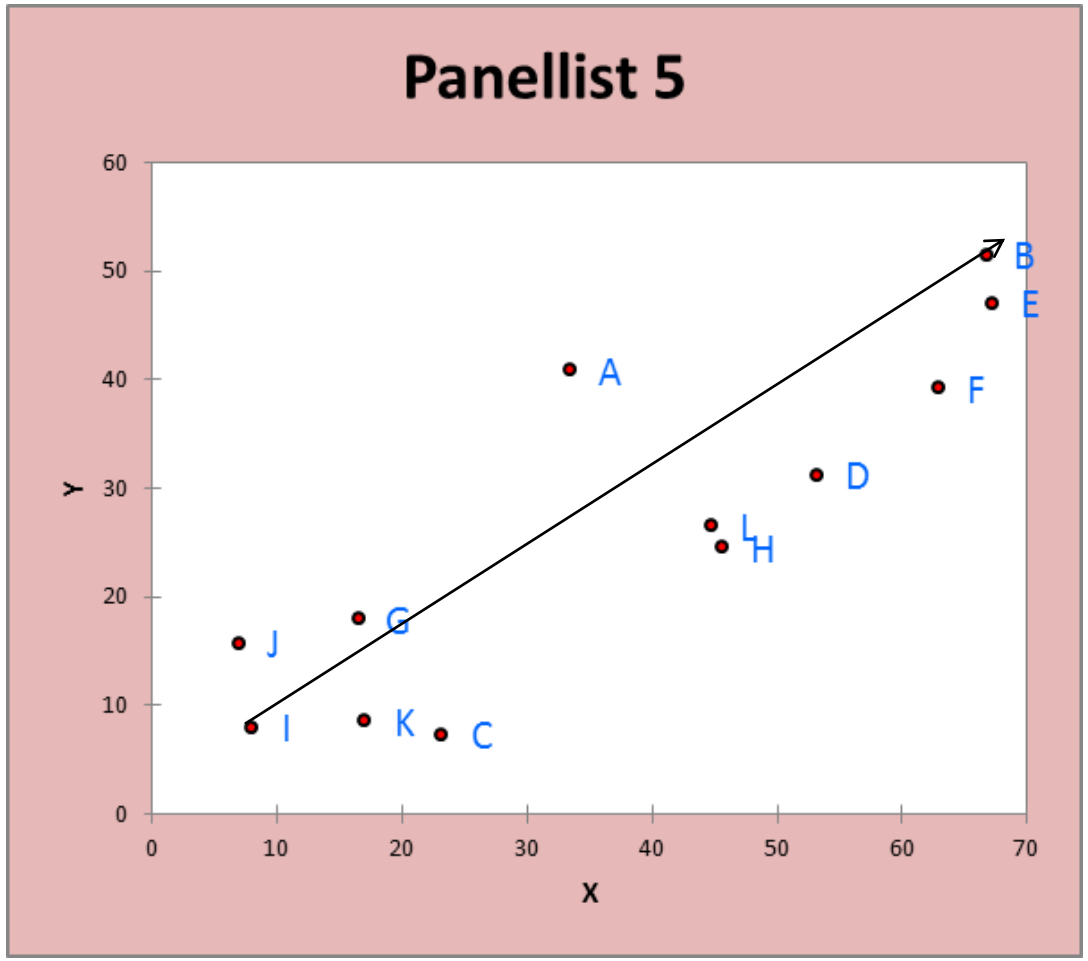
Example - NAPPE from Panellist 6



	PANELLIST 6	
	X	Y
A	47.2	40.2
B	4.1	29.9
C	51.7	35.1
D	40.4	8.5
E	8.2	50.7
F	17	27.7
G	43.3	37.2
H	12.1	10
I	56	2.4
J	73.2	33.5
K	70	28.4
L	62	11.5

Panellist 6 is using the full area well and has a few clear groupings

Example - NAPPE from Panellist 5



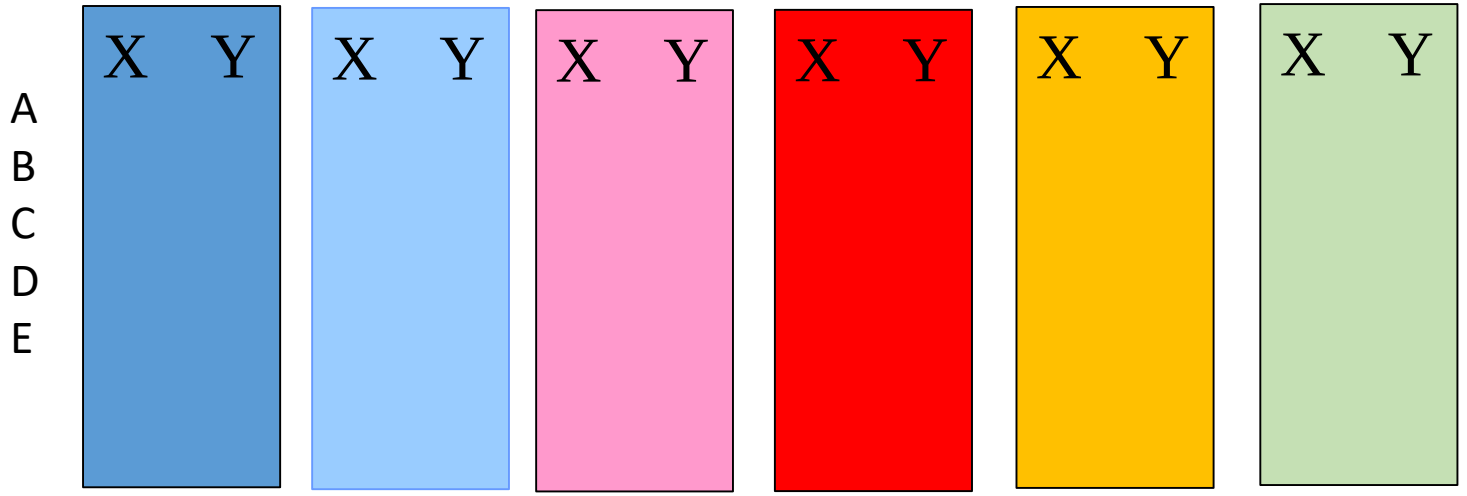
Although pannelist 5 is varying along both X and Y axes they are fact very unidimensional

Statistical Analysis

- Each person will give a different configuration of products
- Is there enough similarity in the individual configurations to derive a single aggregated consensus map?
- We hope so!
- Analysis can be done using two mapping techniques
  - Generalised Procrustes (GPA)
  - Multiple Factor Analysis (MFA)
- Here we will use MFA, as it is the most widely used and modern method

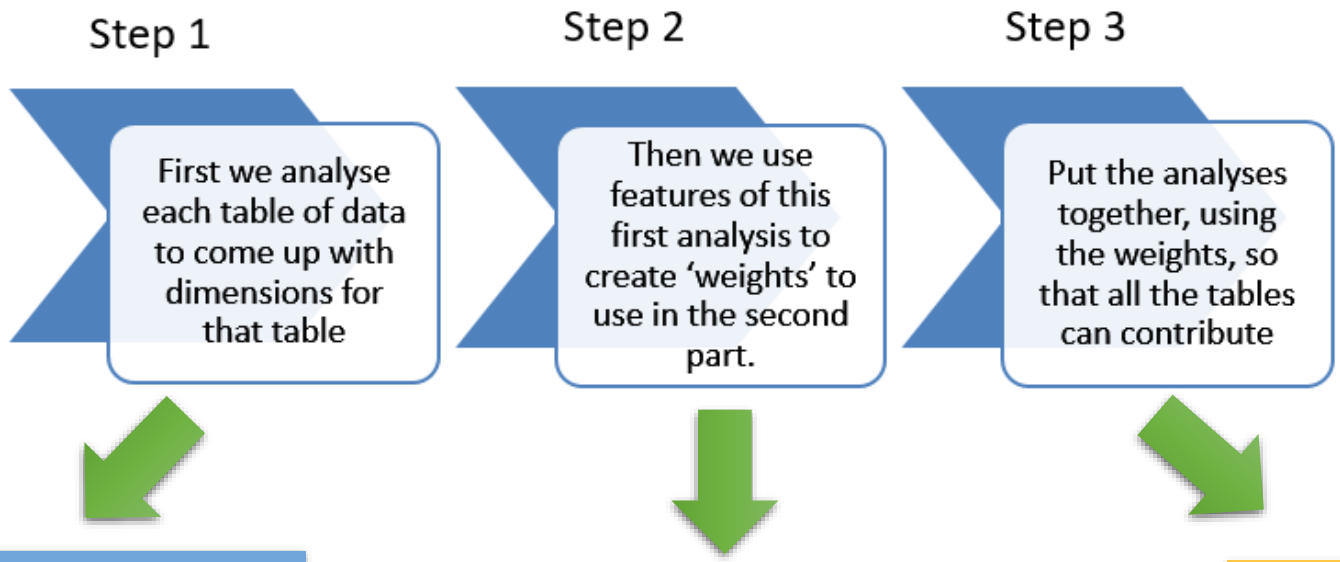
Multiple Factor Analysis

- Technique for overlaying many data tables (on same products but tables can have different types of variables –both quantitative and qualitative)



- Weighted Principal Component Analysis of combined data - tables weighted so that big tables do not dominate analysis

Analysis Method



We run a PCA for each persons set of data (nappe).

We get the principal component scores out and the eigenvalues.

We divide each of the principal component scores by the square root of the first eigenvalue (for each person)

We combine these new values (X_{new} and Y_{new}) for each consumer across all tables and run a PCA over them all (i.e. we are running a weighted PCA)

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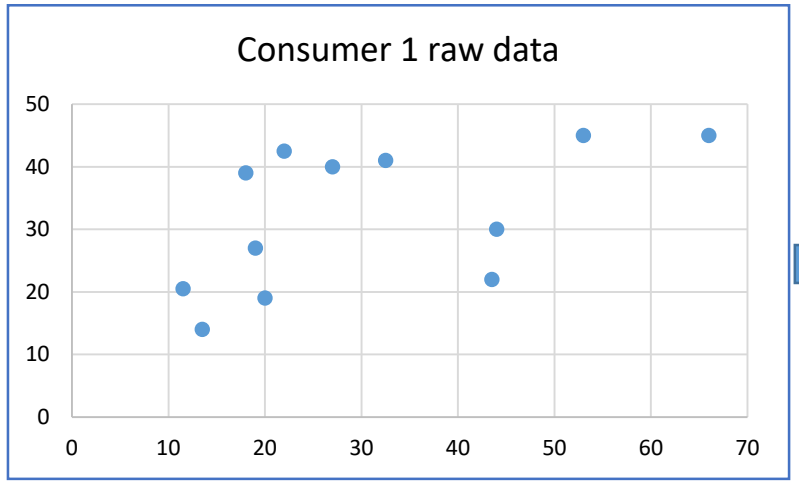
Method in detail – to read later!

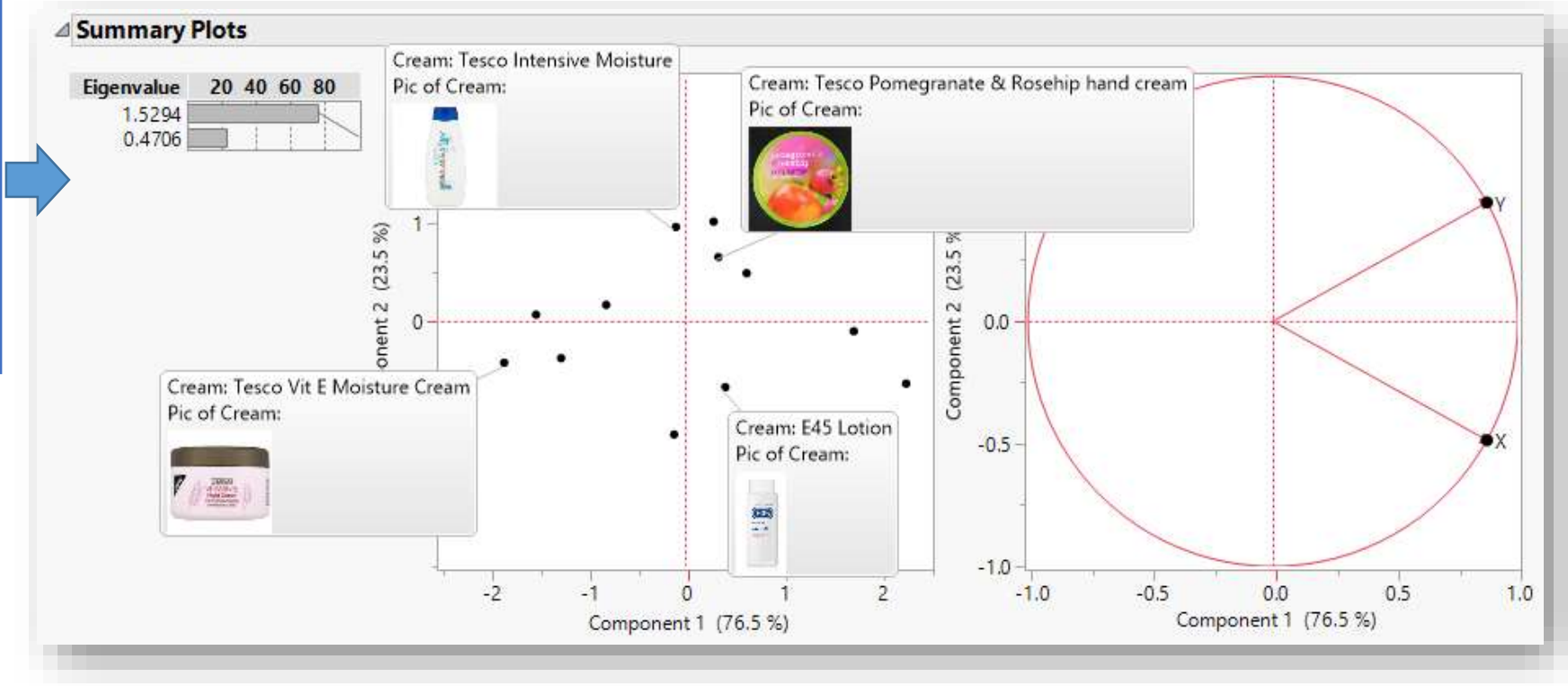
1. We successively run for each table (consumer) a PCA or an MCA (according to the type of the variables of the table) – just a transformation of the orientation of the table cloth from the X, Y co-ordinates input to the first axis of principal variation for each consumer.
2. The 'square root of the first eigenvalue' of each analysis is used to weight each of the tables in the second part of the analysis. This weight measures the standard deviation of the rows on the first principal component
3. The principal component scores (columns) in each table for each consumer are first divided by the weight to normalise the tables
4. Then a PCA on the columns of all the tables is performed. (If the data are tables of qualitative variables these are handled separately first to convert into a numeric format)
5. The weighting of the tables makes it possible to ensure the tables with more variables not weight too heavily in the analysis.

Results of step 1 – Consumer 1

For each person we use JMP to create a PCA map of their configuration of all the products



Consumer 1



a transformation of the orientation of the table cloth co-ordinates to the PC axes - where most variation is shown

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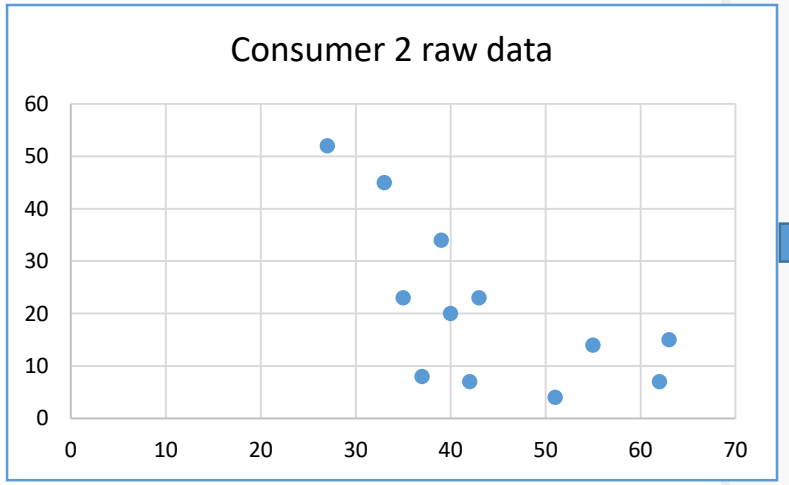
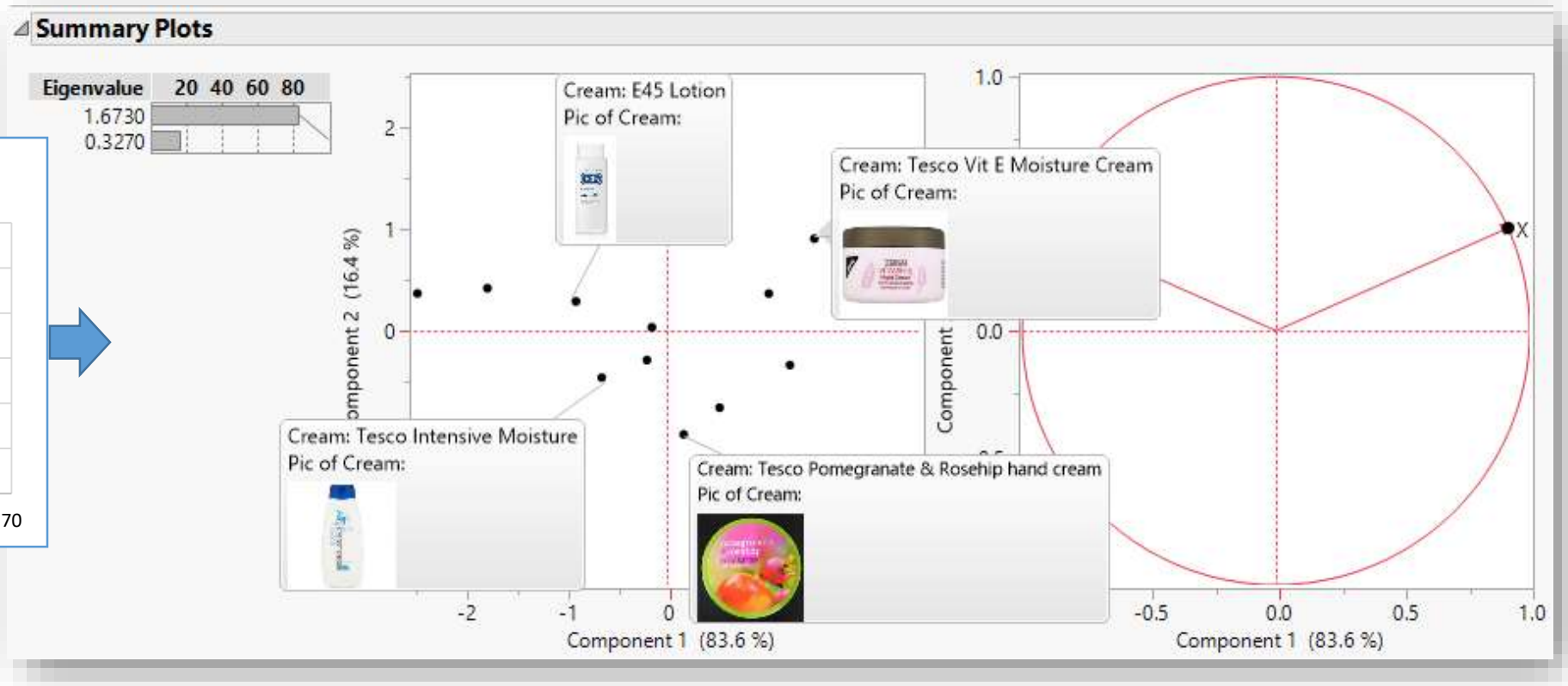
Results of step 1– Consumer 2

Consumer 2





So with 12 consumers there are 12 different product configurations!

Too hard to come to a concensus by “discussion”…

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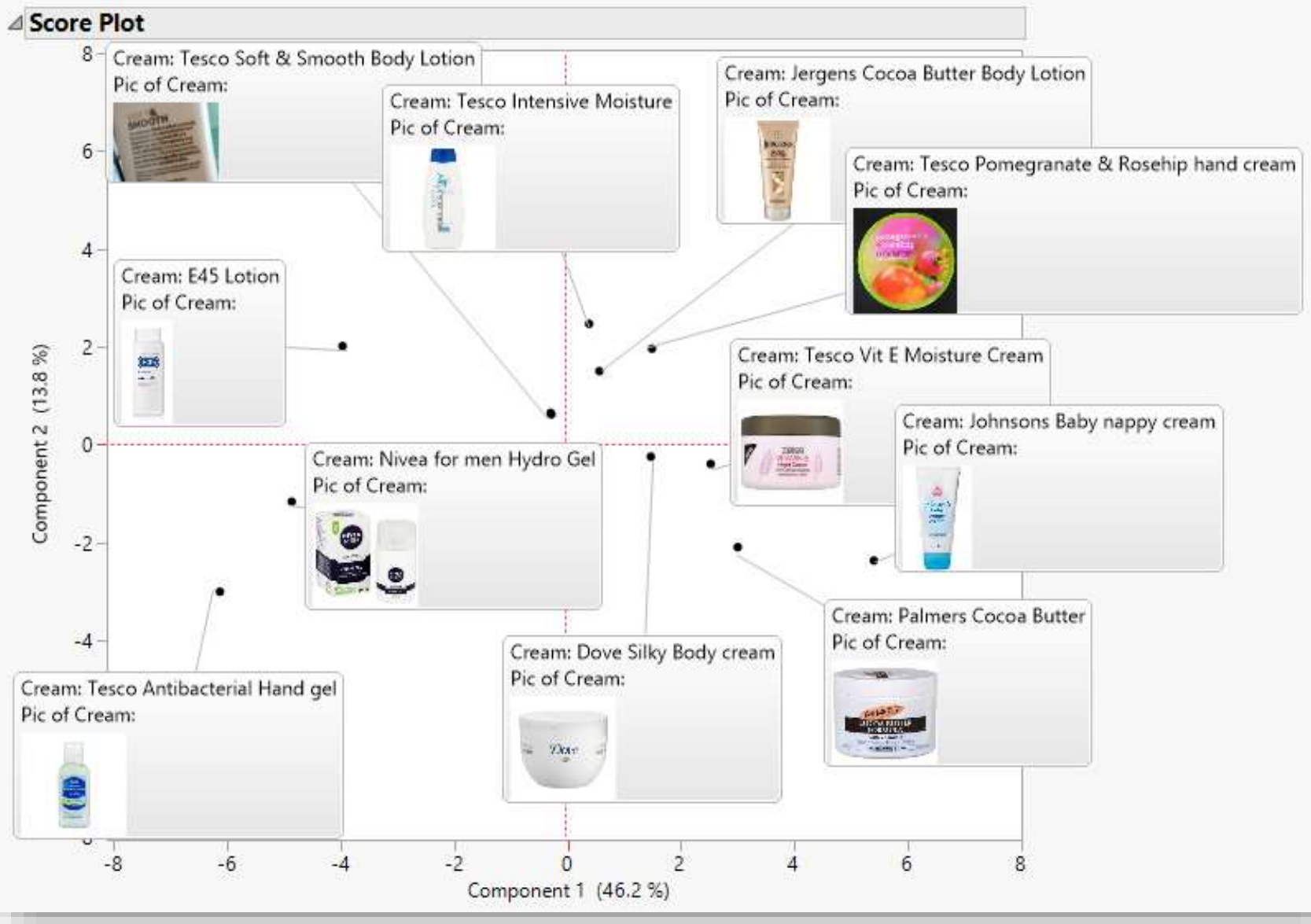
Results – Ultimate Aim = Concensus Map

Need a combined map that objectively combines **all** the consumers mapped layouts.

MFA provides an easy way to do this.



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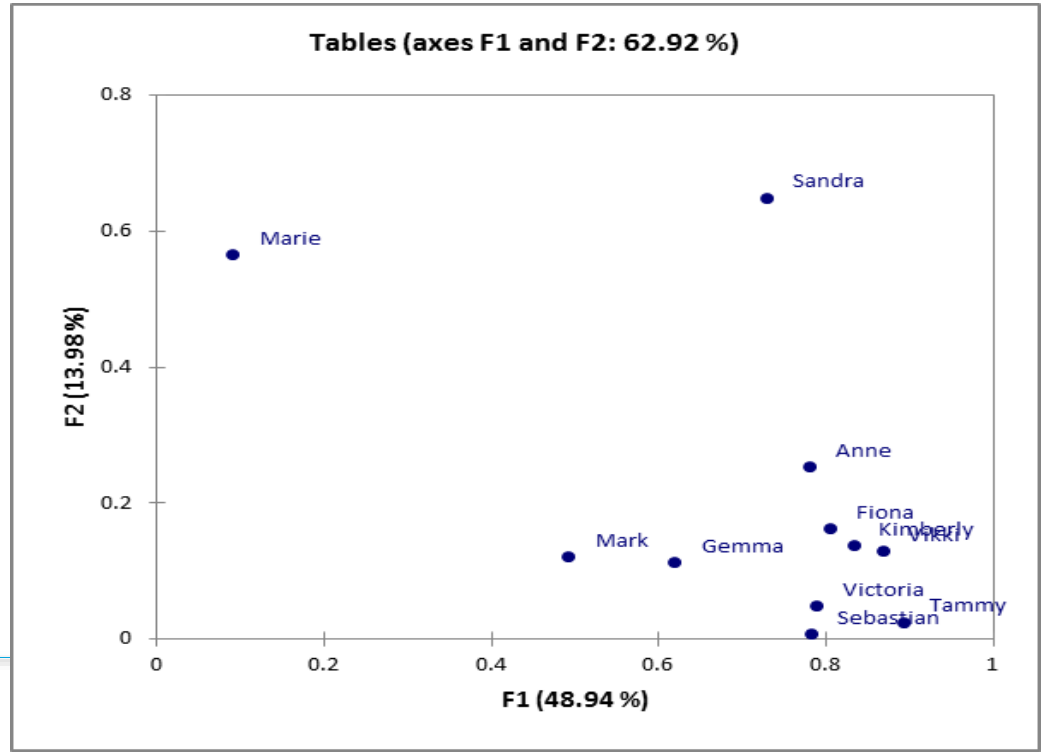
'Typical' MFA Outputs – What else to look for!

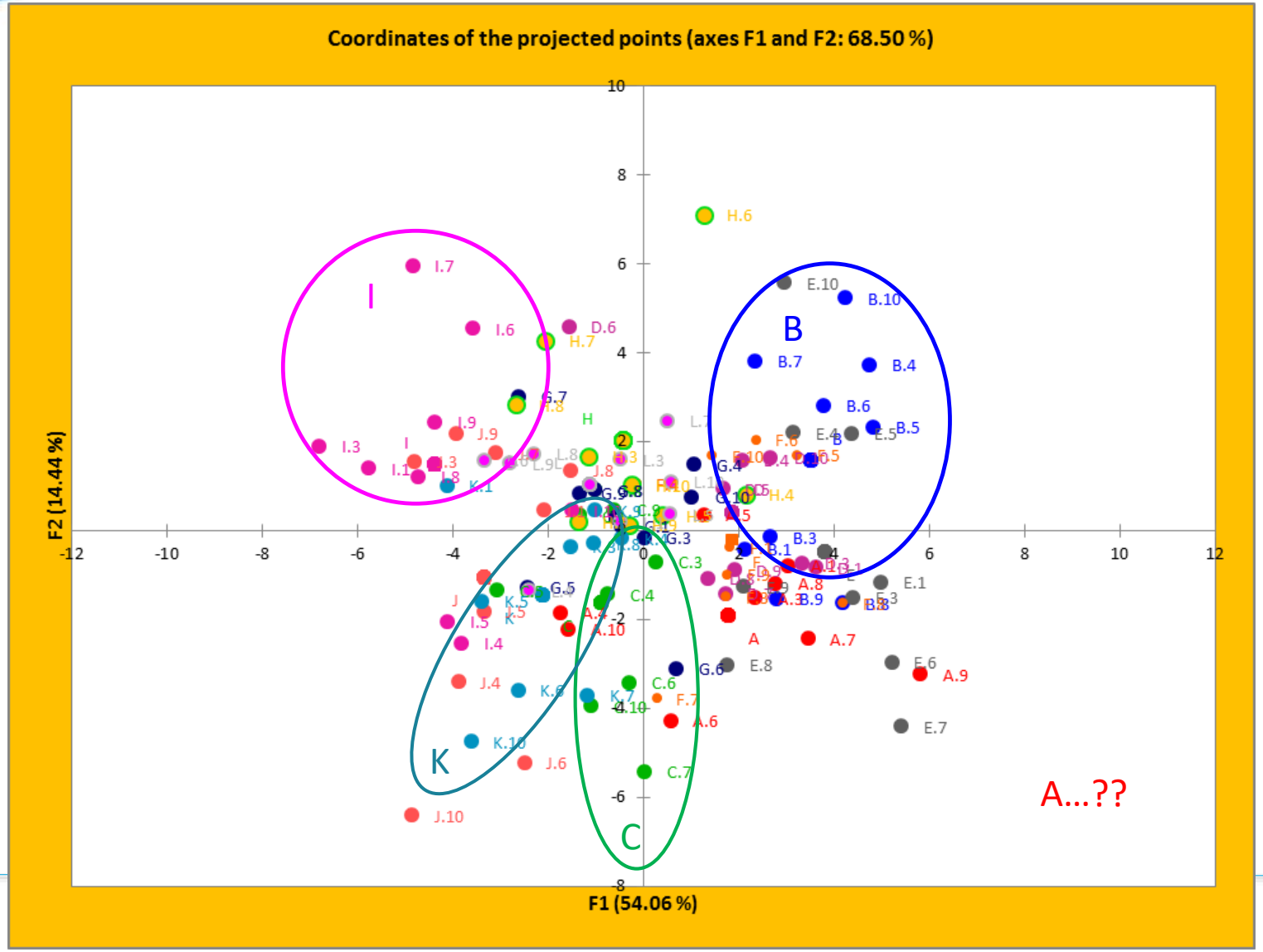
- Map of assessors – Identify problem assessors
- RV Coefficients - The RV coefficients are a multivariate analogue of the correlation coefficient (varies between 0 and 1). Give us a measure of the "correlation" between data tables (peoples sets of coordinates in this case).

RV coefficients:

	Anne	Fiona	Gemma	Kimberly	Mark	Marie	Sandra	Sebastian	Tammy	Victoria	Vikki	MFA
Anne	1.000	0.678	0.357	0.511	0.276	0.130	0.408	0.767	0.662	0.628	0.595	0.777
Fiona	0.678	1.000	0.305	0.531	0.719	0.094	0.568	0.501	0.580	0.565	0.631	0.800
Gemma	0.357	0.305	1.000	0.630	0.169	0.118	0.330	0.509	0.642	0.374	0.450	0.639
Kimberly	0.511	0.531	0.630	1.000	0.356	0.150	0.489	0.631	0.724	0.524	0.523	0.791
Mark	0.276	0.719	0.169	0.356	1.000	0.123	0.377	0.201	0.295	0.273	0.423	0.548
Marie	0.130	0.094	0.118	0.150	0.123	1.000	0.160	0.023	0.080	0.131	0.053	0.307
Sandra	0.408	0.568	0.330	0.489	0.377	0.160	1.000	0.330	0.421	0.396	0.568	0.677
Sebastian	0.767	0.501	0.509	0.631	0.201	0.023	0.330	1.000	0.774	0.515	0.608	0.751
Tammy	0.662	0.580	0.642	0.724	0.295	0.080	0.421	0.774	1.000	0.648	0.677	0.840
Victoria	0.628	0.565	0.374	0.524	0.273	0.131	0.396	0.515	0.648	1.000	0.464	0.719
Vikki	0.595	0.631	0.450	0.523	0.423	0.053	0.568	0.608	0.677	0.464	1.000	0.780
MFA	0.777	0.800	0.639	0.791	0.548	0.307	0.677	0.751	0.840	0.719	0.780	1.000



Critical Evaluation – Overlay of Individual maps



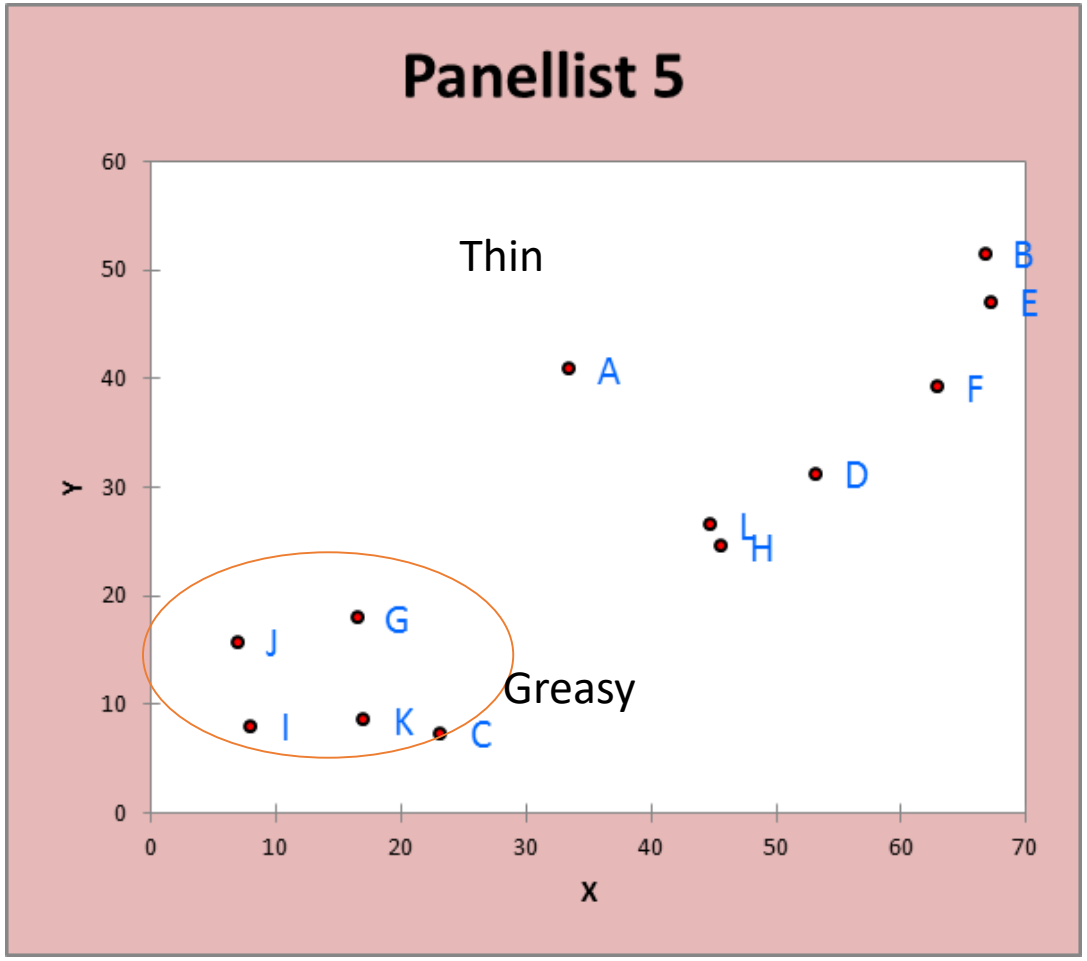
Red dots = product A for each consumer 1 to 10

Blue dots = product B for each consumer 1 to 10

Etc.

Like to see in new JMP output!

Adding sensory descriptions



Allow participants to write words by groups of products.

We want to then overlay these sensory words on our concensus map somehow!

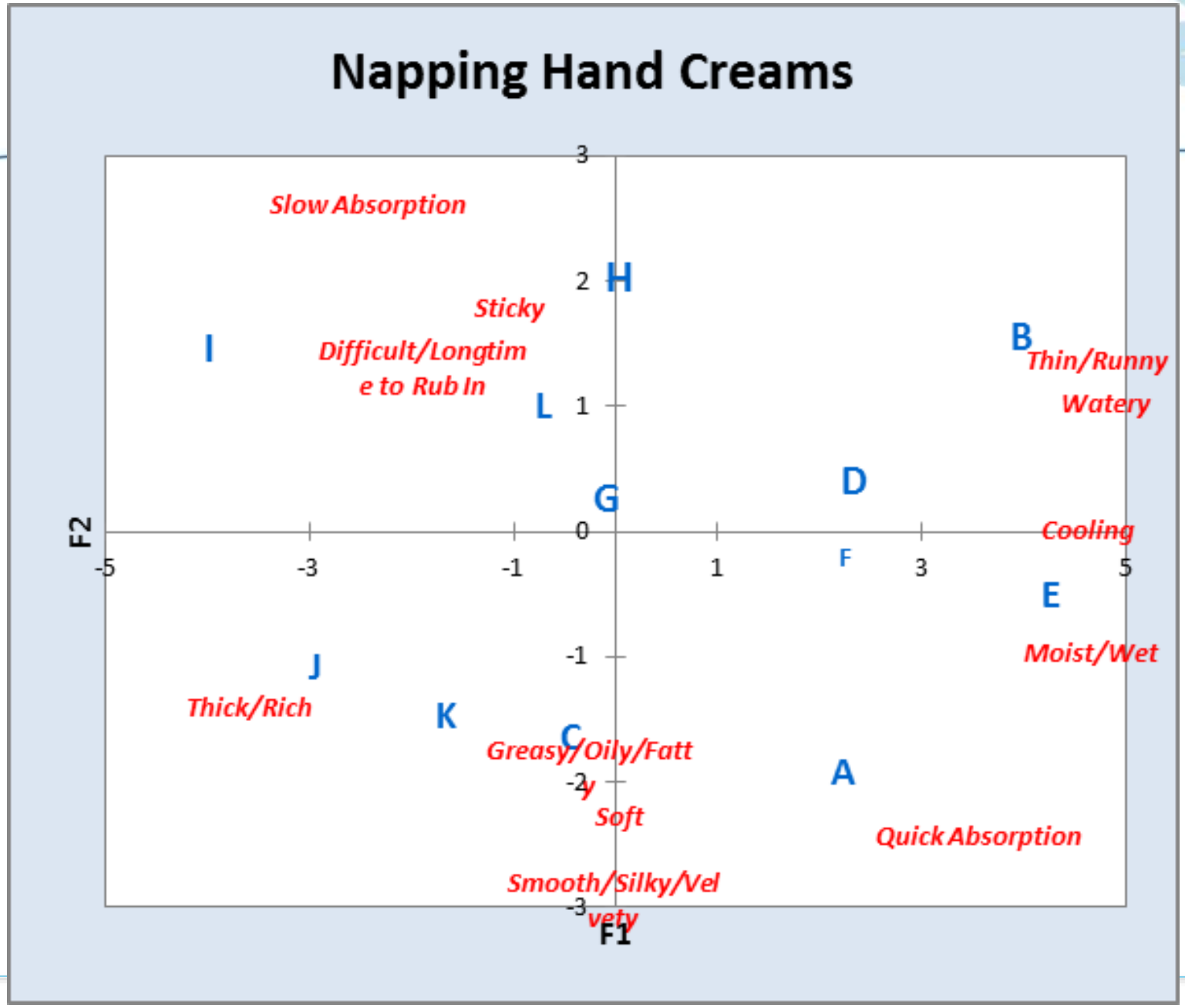
Adding Sensory words

Data is counts of number of times words by product (with some editing and grouping of terms by panel leader)

	Greasy/Oily/Fatty	Thick/Rich	Quick Absorption	Slow Absorption	Thin/Runny	Watery	Cooling	Smooth/Silky/Velvety	Sticky	Moist/Wet	Difficult/Longtime to Rub In	Soft
A	5	5	5	1	3	0	1	2	1	2	0	1
B	3	0	4	2	7	7	3	1	0	1	0	1
C	5	5	6	1	1	0	2	4	2	0	1	2
D	3	1	2	3	6	3	4	1	2	3	1	0
E	1	0	2	0	5	8	8	0	0	2	1	0
F	4	2	7	0	6	5	2	1	1	1	0	0
G	7	5	4	2	1	0	1	2	0	0	0	1
H	2	2	1	4	2	1	1	1	3	0	1	0
I	2	9	0	9	1	0	0	1	2	0	3	0
J	6	8	0	4	0	0	0	1	1	0	1	0
K	4	6	4	3	0	0	0	4	0	0	1	2
L	6	4	0	6	2	0	1	0	2	1	1	1

Incorporating Sensory data

- Sensory data overlaid in MFA as a “Supplementary Table”
- Either treating counts as scores and using PCA or as true counts using a technique called correspondence analysis
- This supplementary addition does not alter product configuration , as only overlaid, but adds sensory dimensionality.
- Essentially we are plotting the product scores and the sensory word correlations on the same graph (with rescaling of correlations so they fit in same display as product scores map)



Can better understand and define axes

Take home points!

- This technique is now an accepted sensory & consumer method. (Various papers have looked at how robust it is over time, with different product classes, with sensory vs consumer etc. etc.)
- Other similar techniques – Free Choice Profiling also use MFA.
- Main disadvantage up until recently has been how to analyse these data as quite complex and time consuming to do manually – only in R, XLSTAT.

  Rapid method is not so FAST as we think!

- **The graphics in the JMP PCA platform allow better representation of product spaces formed when using rapid grouping techniques.**
- Overlaying words as supplementary variables would allow easier identification of the axes
- Looking forward to seeing MFA outputs in next JMP release!

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Thank you for listening!

gemma@qistatistics.co.uk direct: +44 (0)7708 700503

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Qi Statistics Ltd. Contact Details:

Tel: 01189 345 722

Email: info@qistatistics.co.uk

Website: http://www.qistatistics.co.uk

Penhales House,
Ruscombe Lane,
Ruscombe,
Reading,
Berkshire
RG10 9JN