



ENSIA

Dynamics of food preferences

A case study with chewing gums



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Dynamics of food preferences

- 2 aspects may be considered
 - “Long term” dynamics: repeated consumption, exposure, neophobia, learning, fashion... (see Köster, 2003)
 - “Short term” dynamics: evolution of the degree of liking during food consumption (Taylor & Pangborn, 1990)

Dynamics of food perception

- During the eating or drinking process, the perception of food products varies
 - Product changes (texture breakdown and flavor release)
 - Mouth conditions: chewing, saliva, temperature
 - Perceptual changes
 - Sensory adaptation
 - Drift of attention, fatigue...
 - Physiological changes due to food intake

How are dynamics aspects studied?

- Temporal aspects of hedonic response
 - Use of Time-Intensity to record the degree of liking (Taylor & Pangborn, 1990)
 - Subject to important biases
- Influence of the evaluation protocol
 - Swallowing vs. expectoration (Lucas & Bellisle, 1987)
 - Rapid measure vs. ad libitum consumption (Dailliant & Issanchou, 1991; Lähteenmäki & Tuorila, 1994)
- Experimental psychology experiments
 - Does duration matter in judgment and decision making? (Kahneman, Ratner & Kahneman, 1997; Ariely & Loewenstein, 2000)

Objectives of the study

- Assess the changes in liking with time and try to explain them if they occur
- Determine if it is possible to study the dynamics of preferences by means of hedonic tests with imposed durations?

Dealing with chewing gums



- An important market: chewing gums are consumed worldwide
- Easy to handle, cheap, simple... and complex enough
 - Many studies on encapsulation, flavor release, T.I. measurements (Guinard *et al.*, 1997; Duizer *et al.*, 1997; Davidson *et al.*, 1999)
 - But... no published sensory profiling study, nor preference tests

Samples

- 6 Dragée-like coated gums
- Mint flavor
- Sugar free



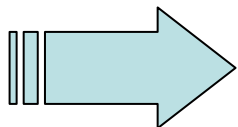
A	Hollywood " <i>Menthe polaire</i> "
B	Hollywood " <i>Ice fresh</i> "
C	Freedent " <i>Menthe forte</i> "
D	Freedent " <i>Menthe douce</i> "
E	Tonigum " <i>Menthe polaire</i> "
F	Stimorol " <i>Nordik mint</i> "

Samples look very similar



Hedonic testing

- 42 subjects recruited among students and staff
- 3 test durations (modality):
 - 1 minute *in sensory booth*
 - 5 minutes *in sensory booth*
 - 30 minutes *free*
- Monadic sequential evaluation
- Sessions were spaced by at least 1 hour
- Sessions were sorted by modality and the modality order (1-5-30 ; 5-1-30 ; 30-1-5...) was balanced over the panel
- Sample presentation order was balanced using a Williams' square design



All subjects participated in 18 sessions

Overall data analysis

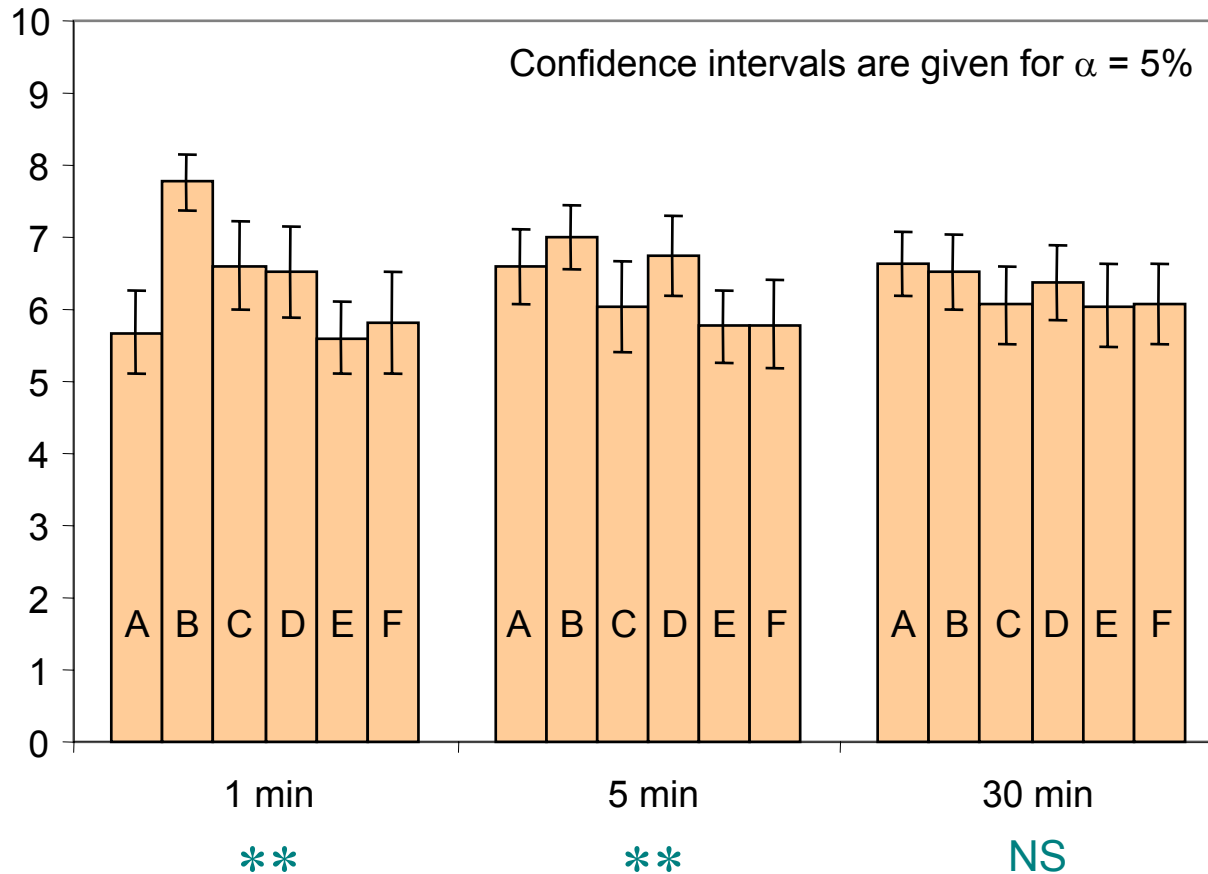
ANOVA with interactions ($F = 2.84$, $p < .0001$)

Source	DoF	SS	MS	F	p
<i>Judge</i>	41	560.51	13.67	6.42	< .0001
<i>Product</i>	5	139.01	27.80	13.06	< .0001
<i>Product*Judge</i>	205	816.76	3.98	1.87	< .0001
<i>Product*Duration</i>	12	75.41	6.28	2.95	0.0006

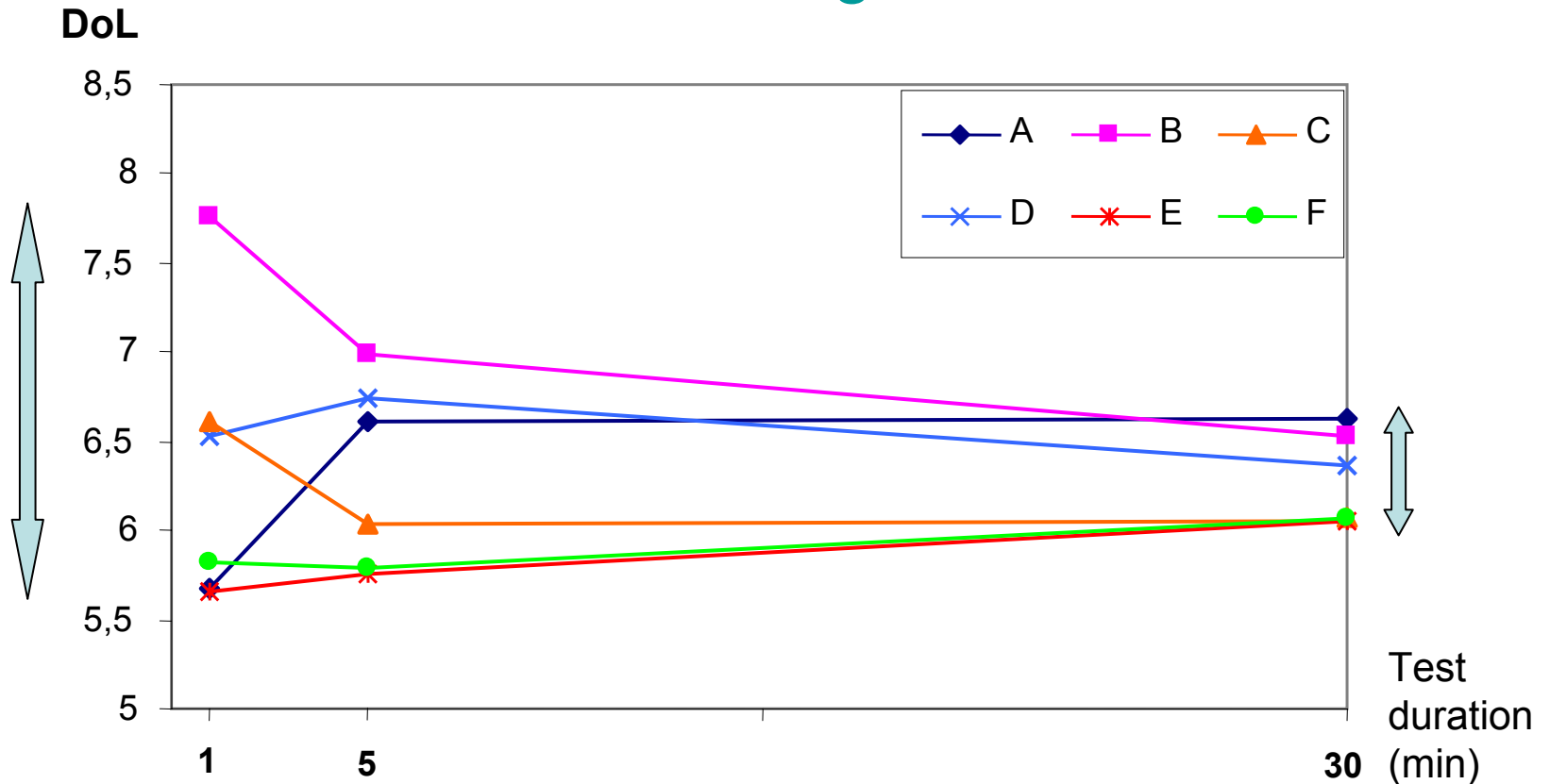
- ✓ Products are different in terms of liking
- ✓ Judges do not like the same products
- ✓ The liking varies with the test duration, depending on the product

Average liking pattern and test duration

Degree of Liking



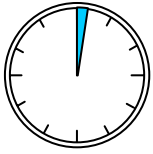
Influence of the test duration on the mean rating scores



- The average DoL for products **D**, **E** and **F** does not change much with time
- The liking decreases for products **B** and **C** when tested during 5 minutes and above
- The liking increases for product **A** when tested during 5 minutes and above

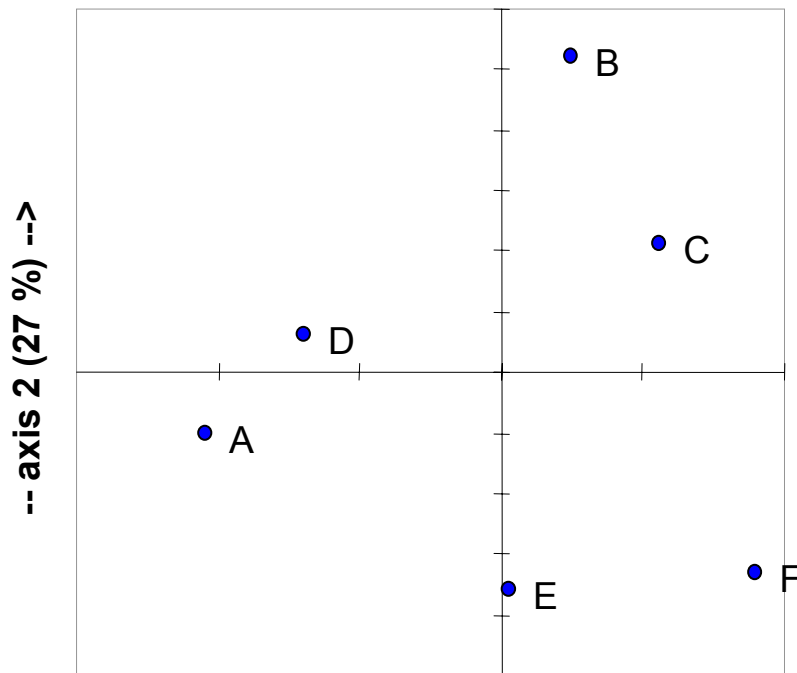
Is there a diminution of the differences in degree of liking when the test lasts longer?

- The preferences seem to be less marked when the gums are chewed during 30 minutes
- This effect could be due to a larger dispersion among the consumers (individual preferences are in fact more pronounced, but people do not like the same things)



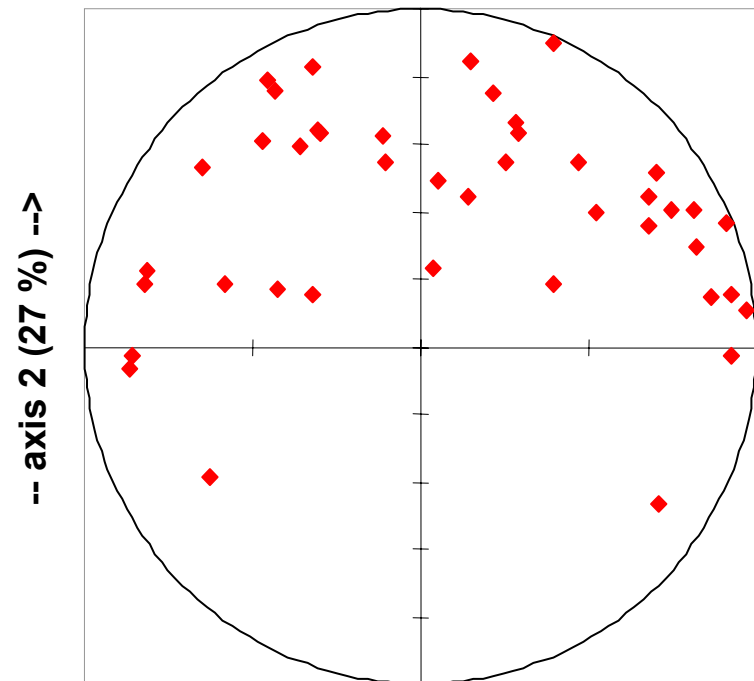
1 min – internal Preference Mapping

axes 1 et 2 account for 61% of total variance



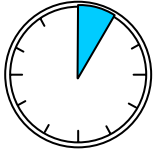
-- axis 1 (33 %) -->

Product map
(score plot)



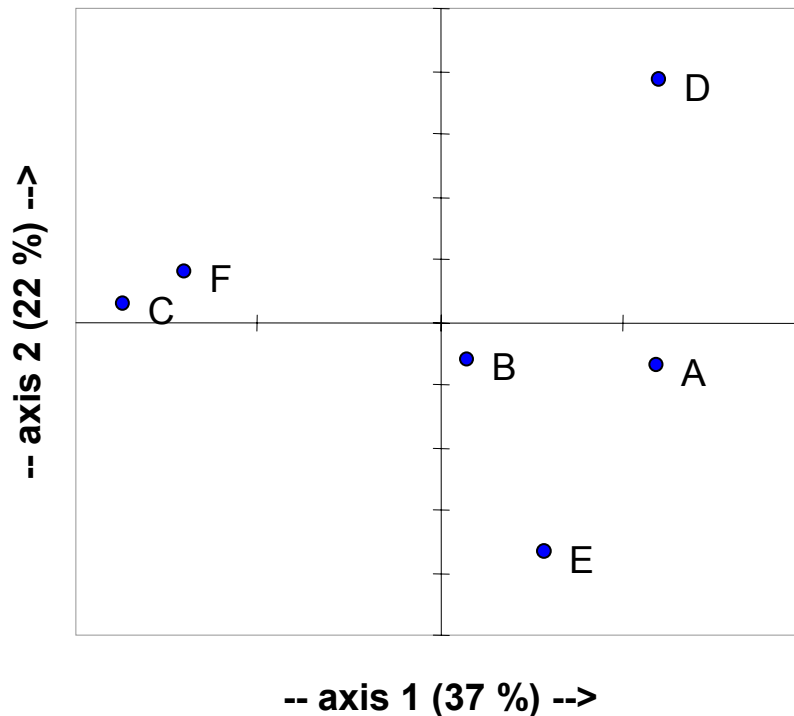
-- axis 1 (33 %) -->

Directions of preference
(loading plot)

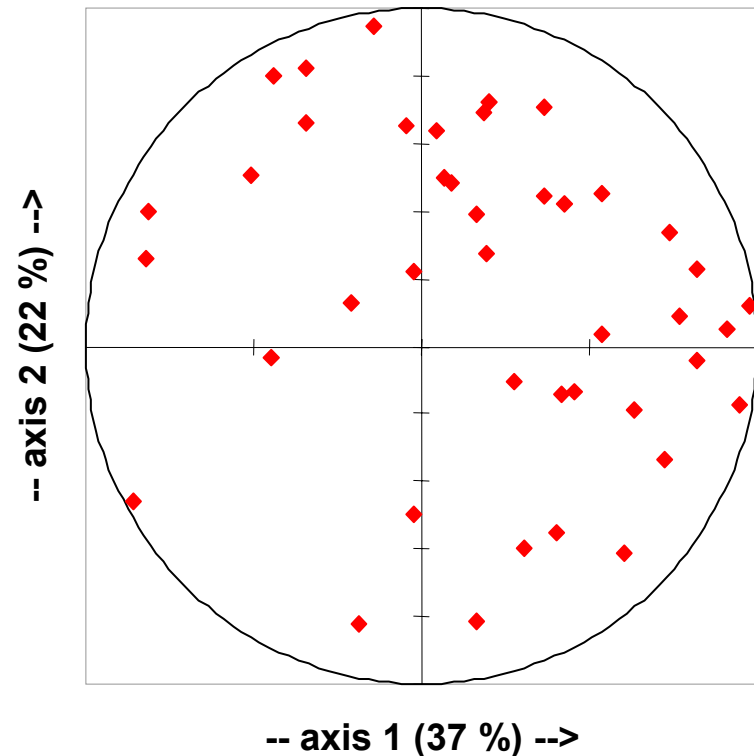


5 min – internal Preference Mapping

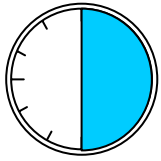
axes 1 et 2 account for 59% of total variance



Product map
(score plot)

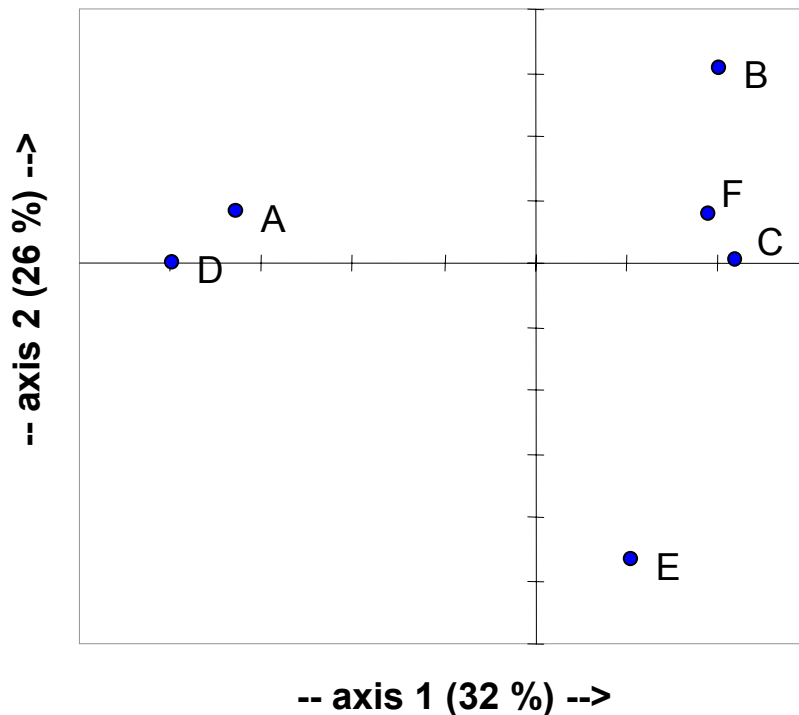


Directions of preference
(loading plot)

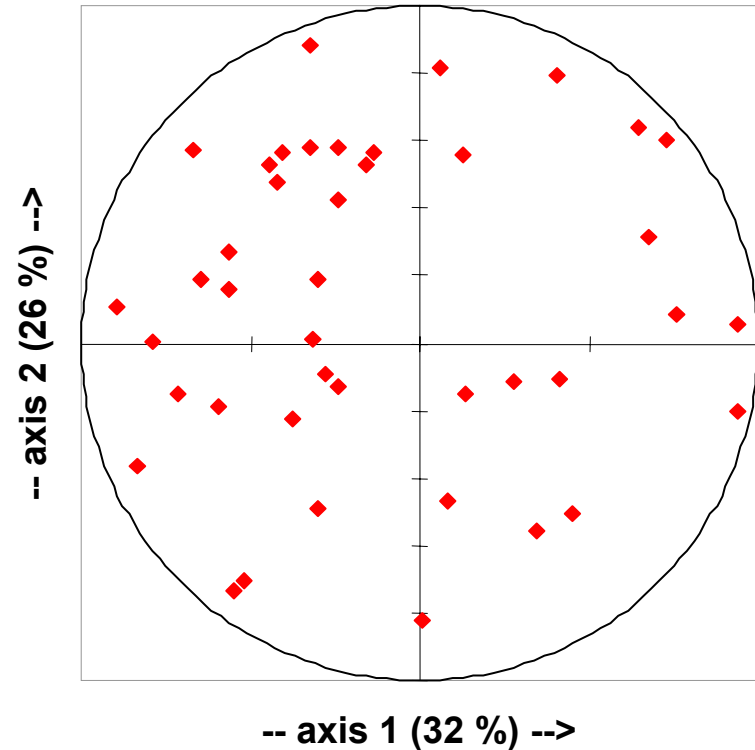


30 min – internal Preference Mapping

axes 1 et 2 account for 58% of total variance



Product map
(score plot)



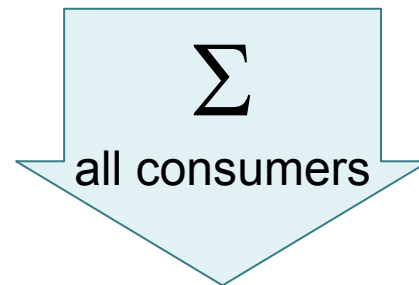
Directions of preference
(loading plot)

Visualizing the score distribution for each product

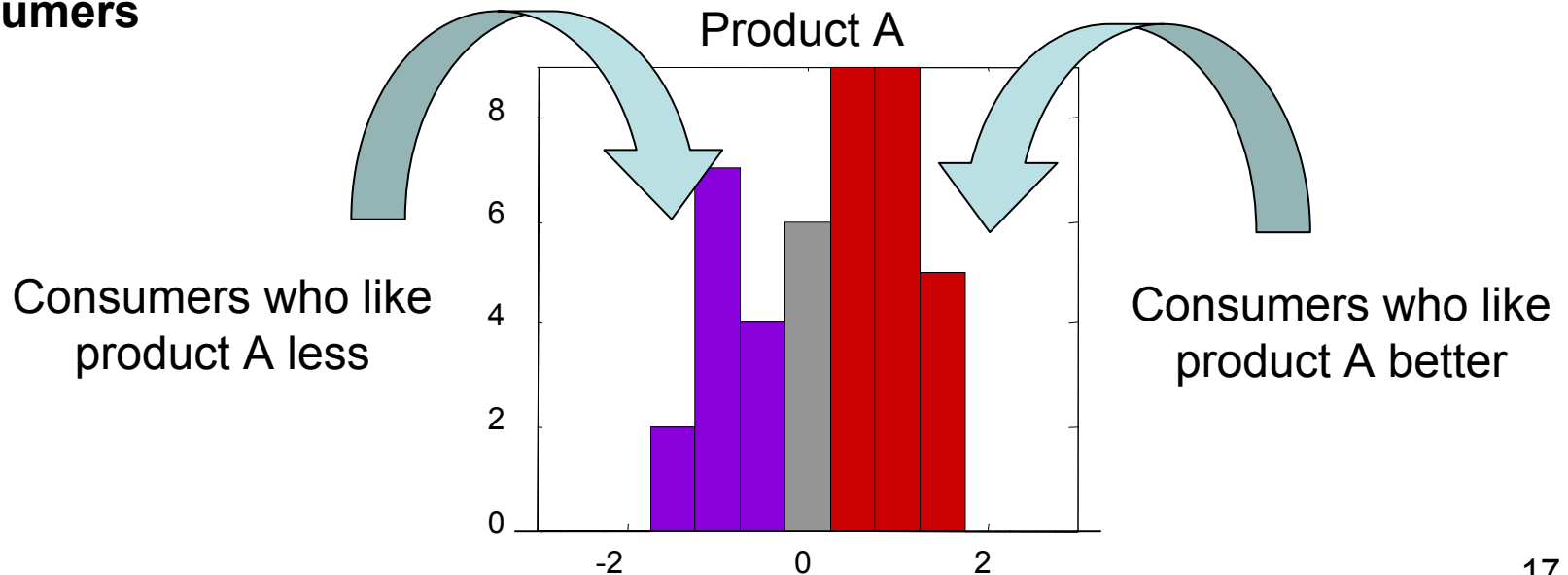
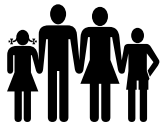
For 1 consumer



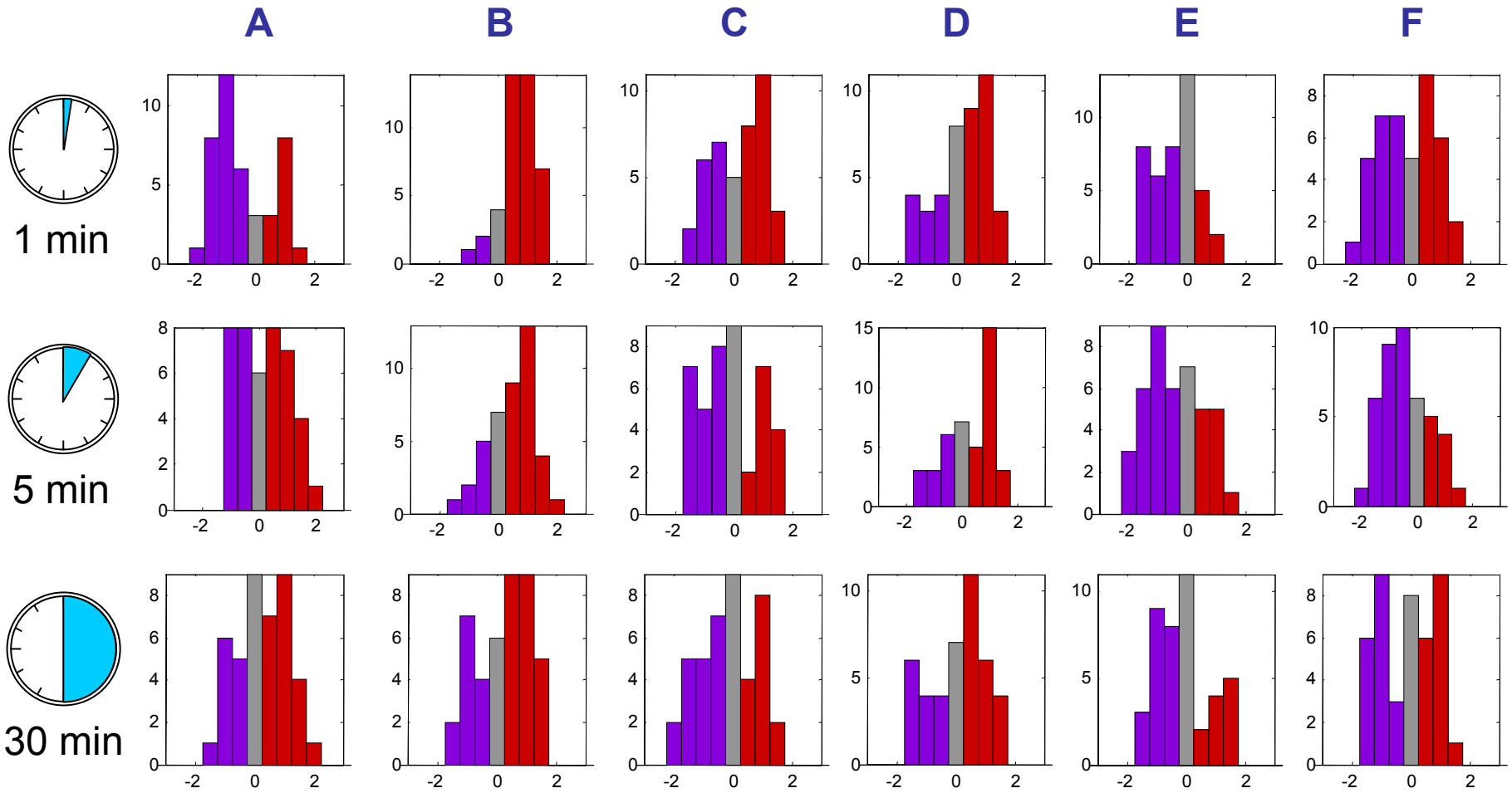
Centering and reduction of the scores of all products
Gives the **relative liking score** of each product



Relative scores
of all consumers



Score distribution for each product



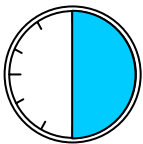
The influence of the duration depends on the product



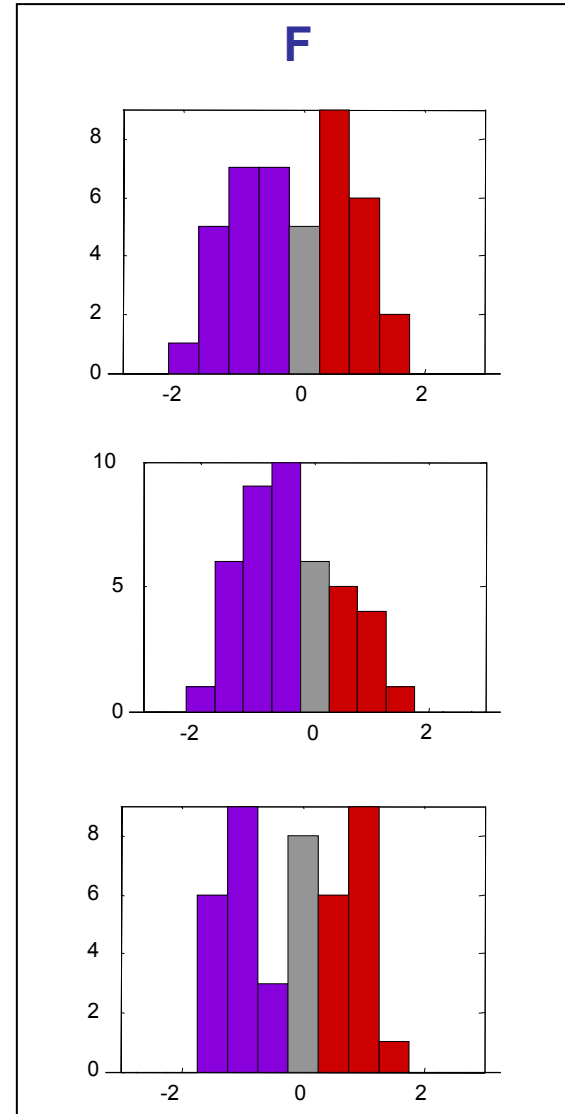
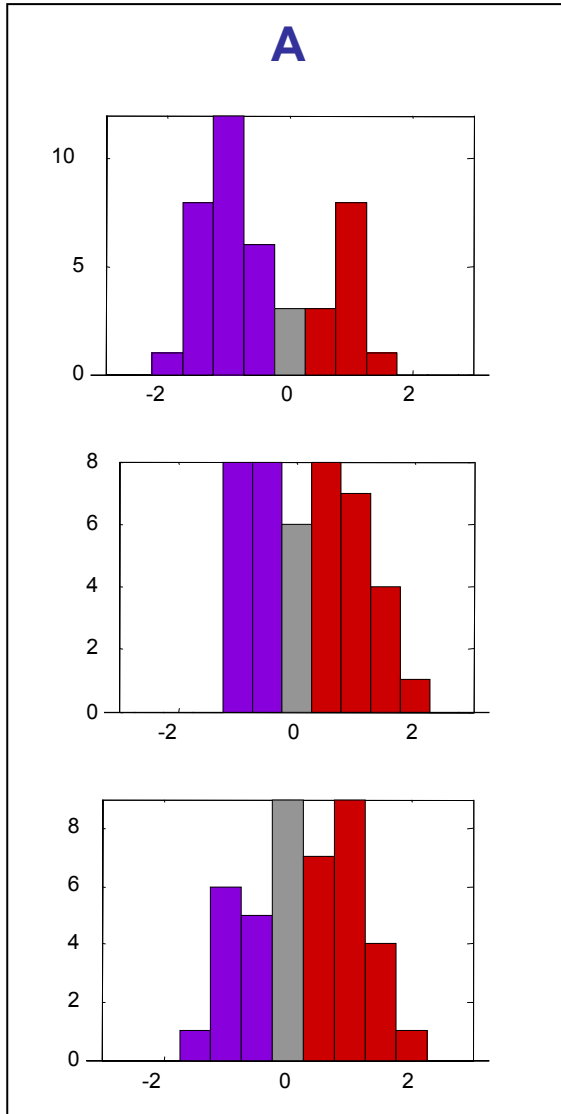
1 min



5 min



30 min



Summary of the findings of the preference study

- The liking changes with the test duration
- The agreement between the consumers also changes
- Consumer liking after 30 minutes can not be predicted by a 1 minute nor by a 5 minute test

Can we explain observed changes by the product sensory characteristics?

A quick sensory profiling

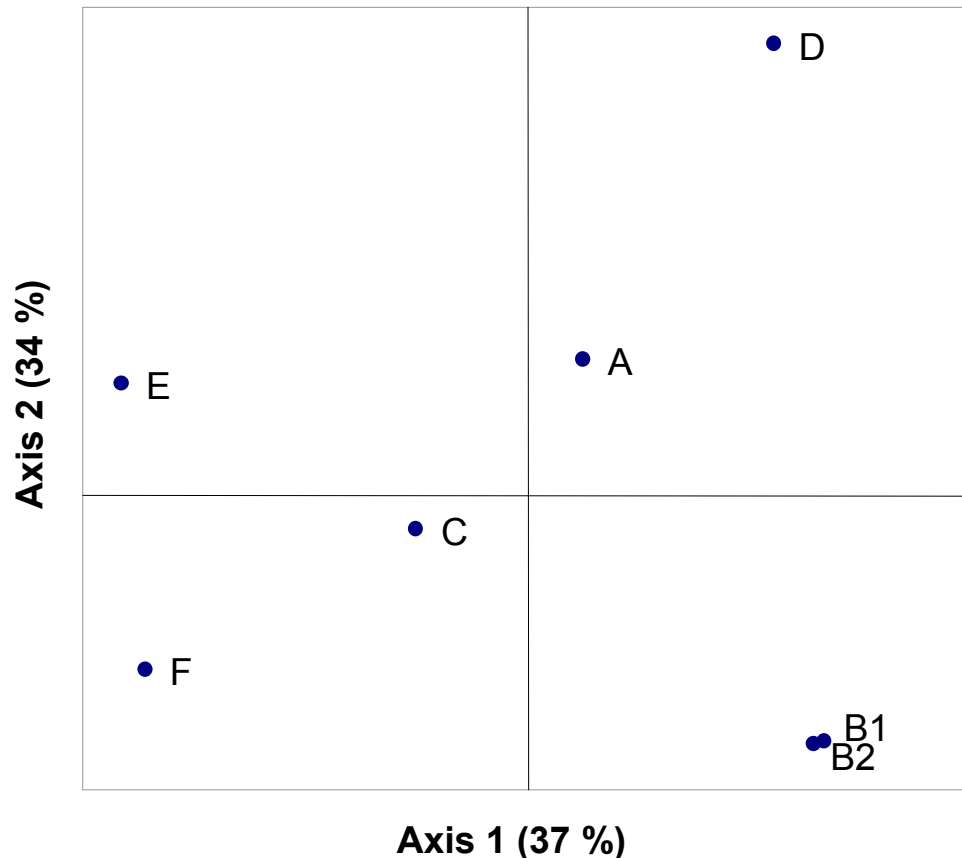
Consensus product map

Axes 1 and 2 account for 71% of total variance

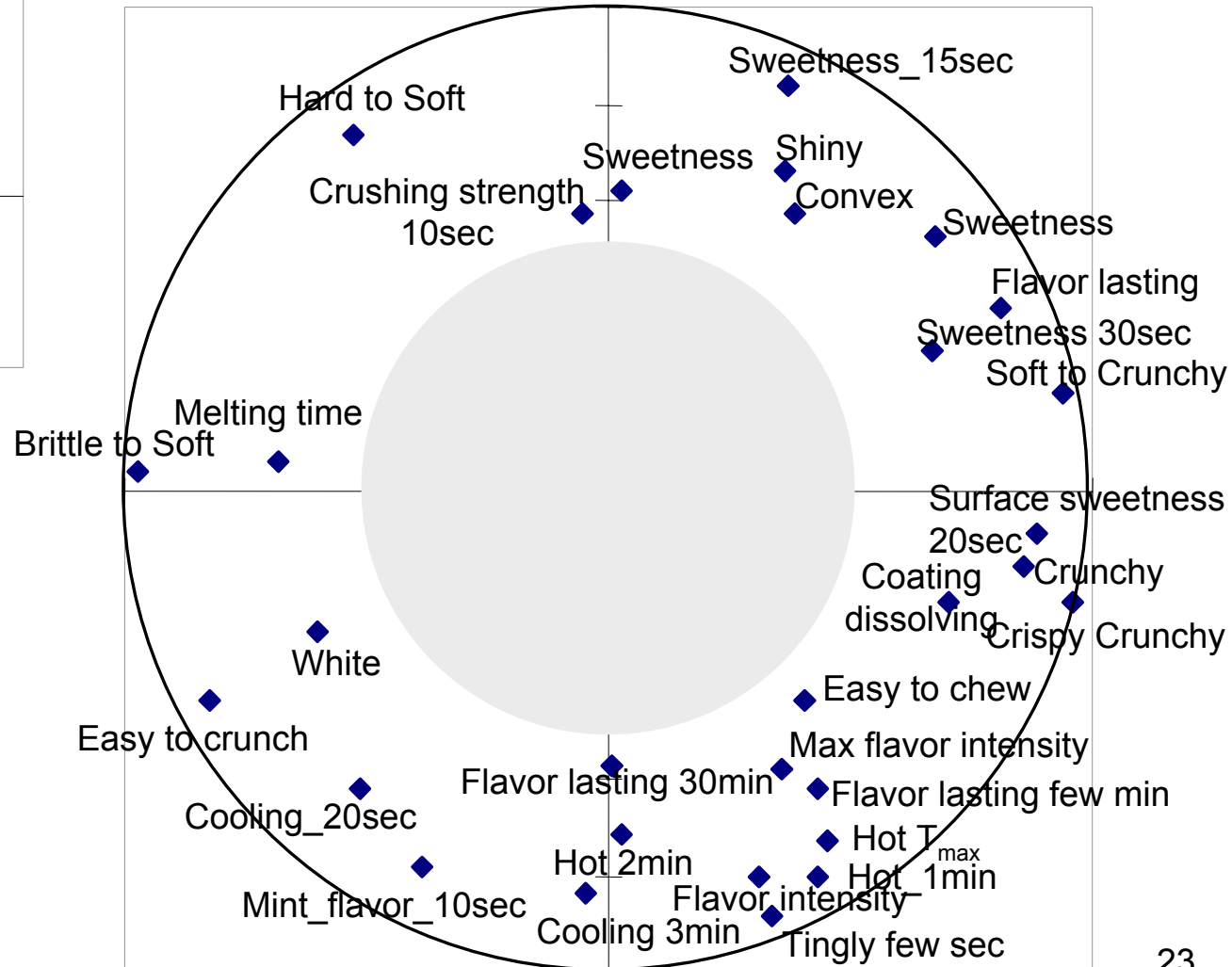
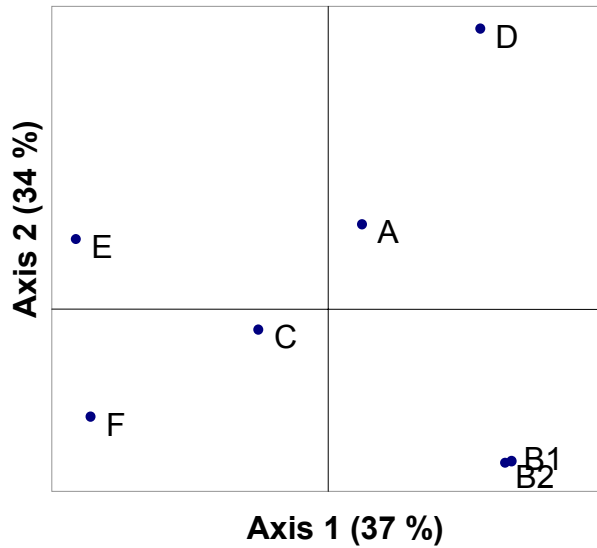
Flash Profile

(Sieffermann, 2000)

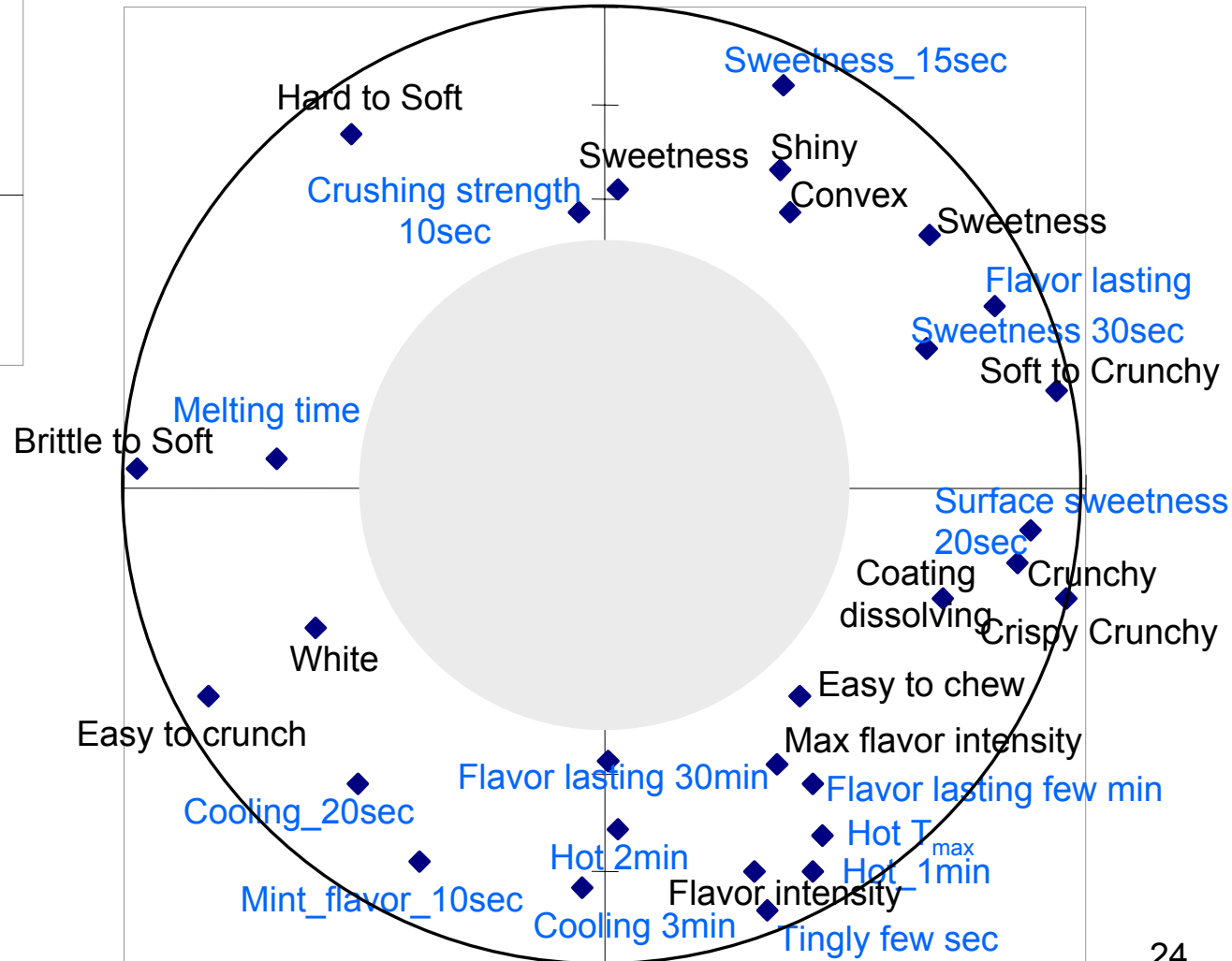
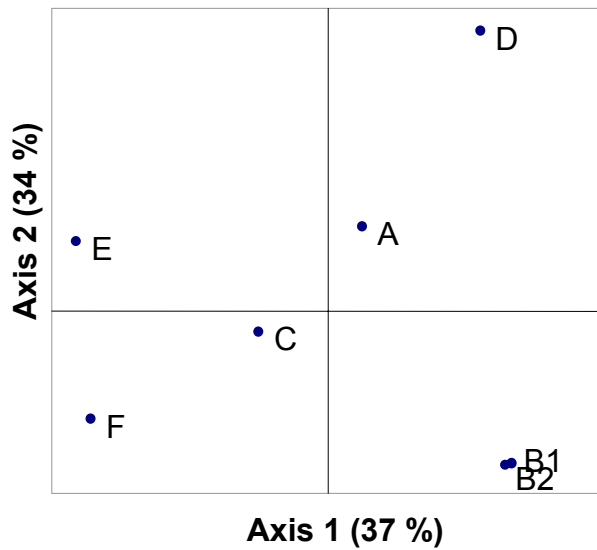
- ✓ Free Choice Profiling + Comparative evaluation
- ✓ 6 experienced judges
- ✓ Judges could take the samples with them for evaluation of “long term” attributes



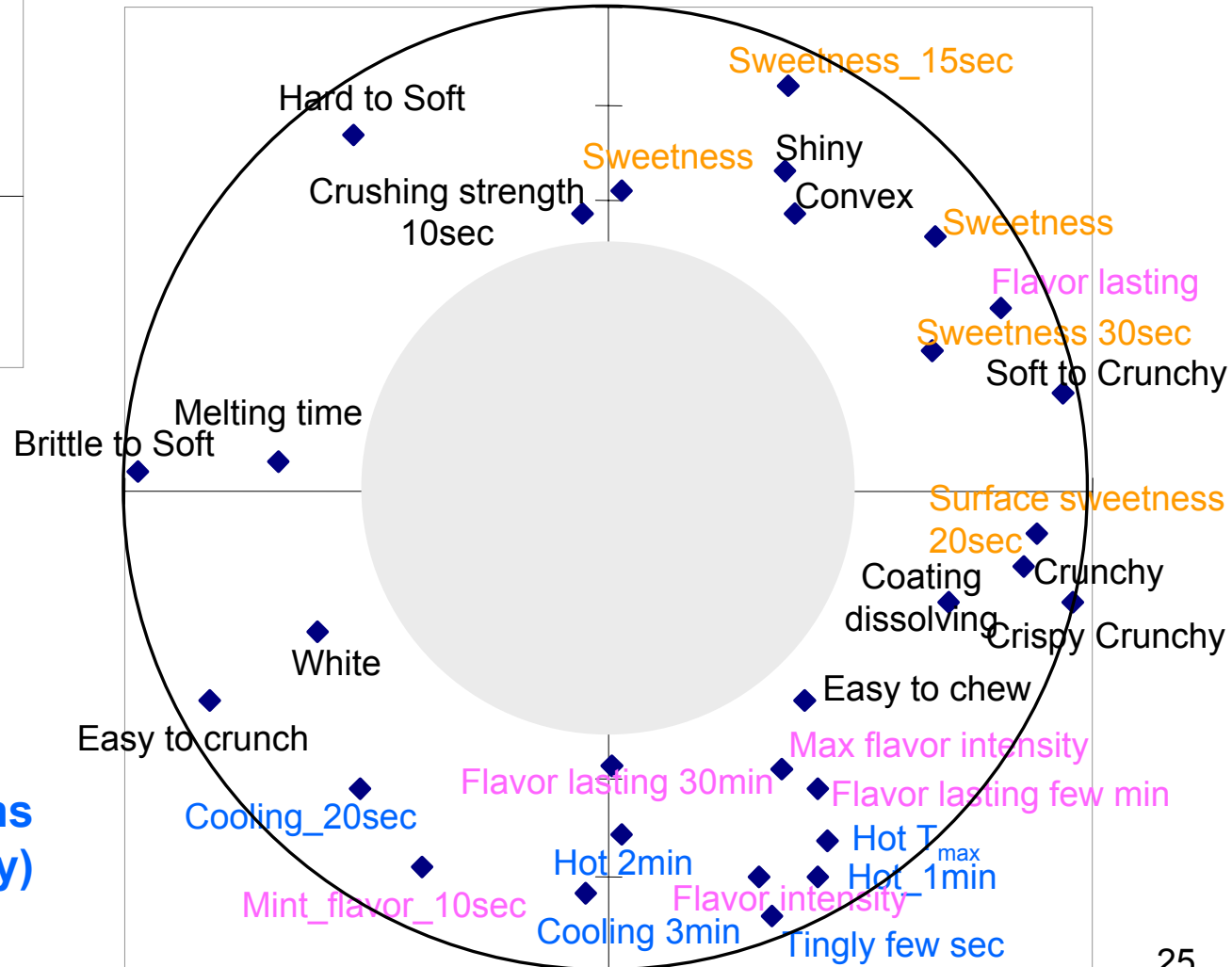
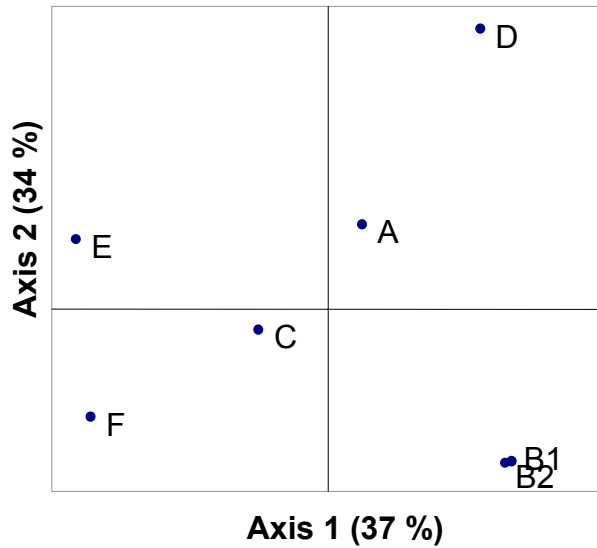
Some descriptive insights?



Many attributes are explicitly time-dependent

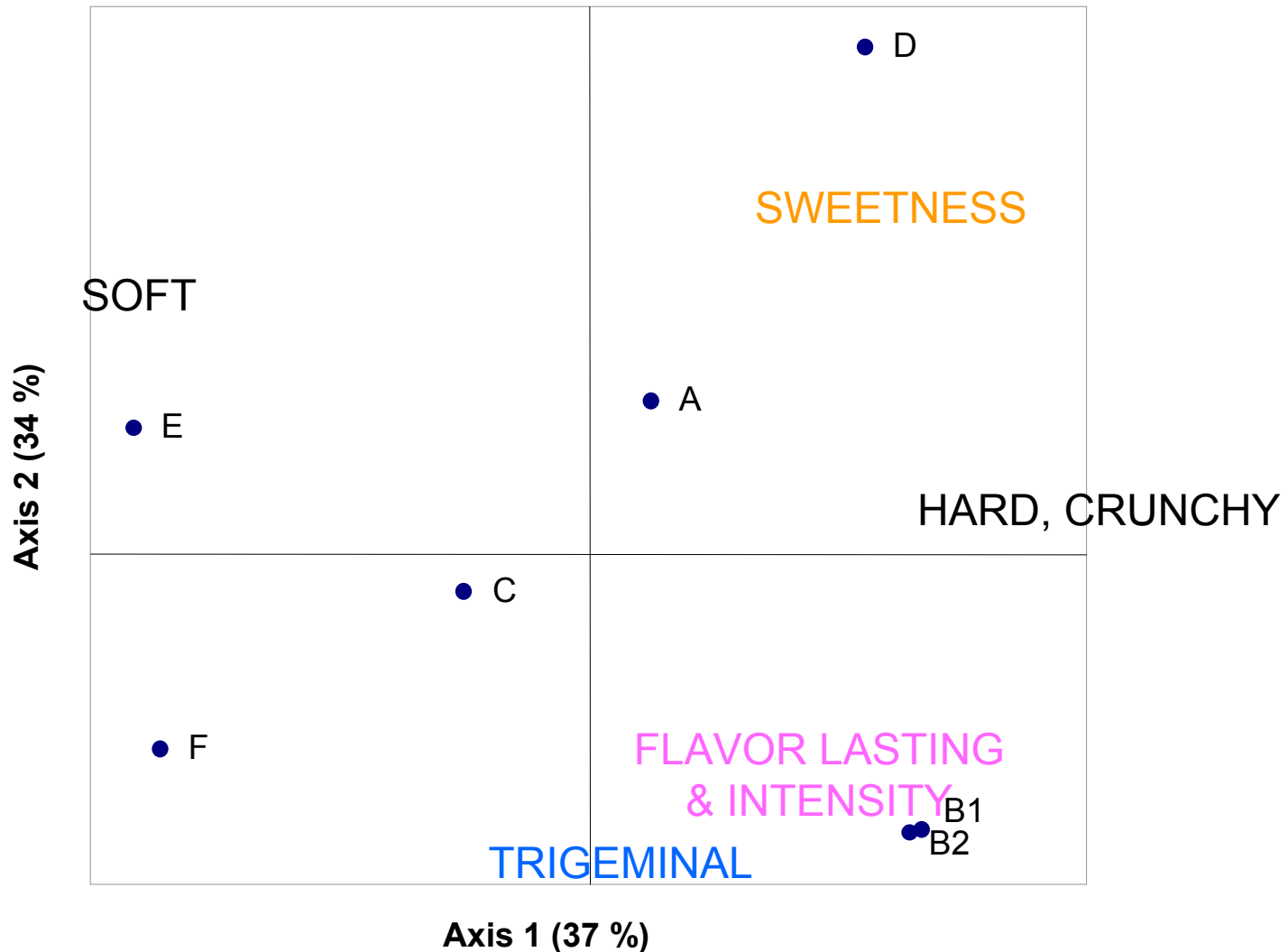


Some descriptive insights?



- **Sweetness**
- **Flavor lasting or intensity**
- **Trigeminal sensations (cooling, “hot”, tingly)**
- **Texture**

Broad summary of the product sensory characteristics



Conclusions

- We found that the liking for chewing gums was strongly time-dependent and may be subject to impressive changes with test duration.
- The changes in the degree of liking differs among judges
- Temporal effect was assessed with a simple method that proved to be efficient.
- Attempts to explain those changes were not completely satisfactory and would need thorough investigations.

Future prospects

- Future work on gums should include consumption habits
 - some people chew for only few minutes whereas others chew for hours; some take two gums in one go...
- We will probably improve our knowledge of sensory perception and of preferences when taking into account dynamics aspects.
- This issue may be even more relevant and challenging for non-food products (cars, ambiances, fragrances, cosmetics, fabrics...)

Acknowledgements

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