# Preference mapping methods and applications

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# Objectives

## Preference mapping

- To **introduce** the basics of external preference mapping
- To **discuss** some limitations of the technique
- To **propose** the PrefMaX approach

## Applications

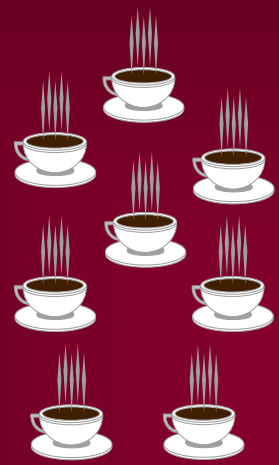
- **Car industry**: optimizing consumer feeling of braking efficiency
- **Tomato market**: a robust French sensory segmentation

# Context of Preference Mapping

**A consumer panel tastes each product in blind condition**

**A set of competitive products**

**A few panelists trained to quantitative descriptive sensory analysis**



**Statistical modelling**

**Preference scores**

**Sensory profiles Product mapping**

# A car study on braking perception

Safrane2.5dt

Espace

## 9 Pilots

112 consumers drove each car and gave a liking score of the braking sensation

## 18 braking attributes

Safrane2.2dt

Scenic1.6e

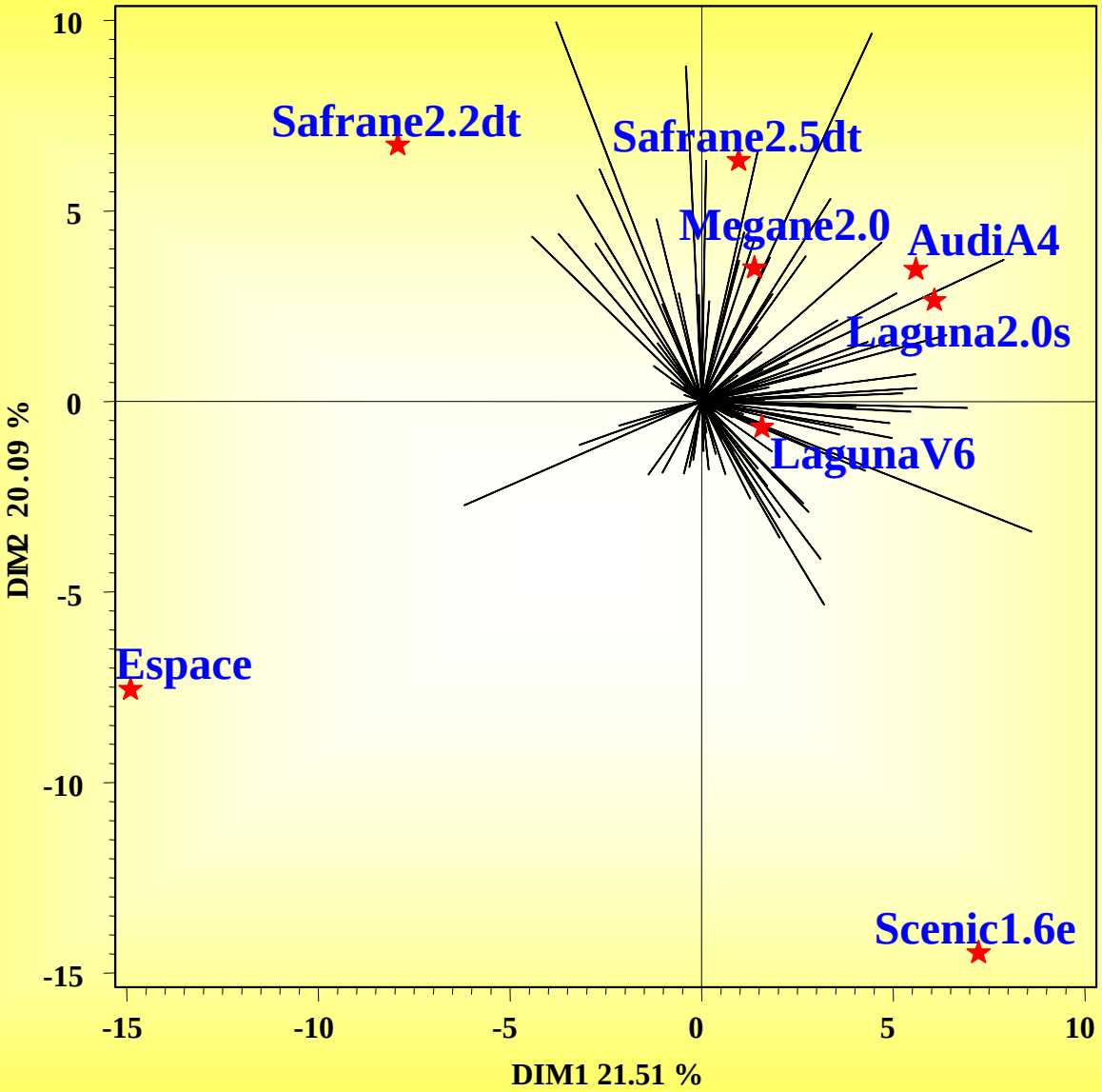
Megane2.0

AudiA4

Laguna2.0s

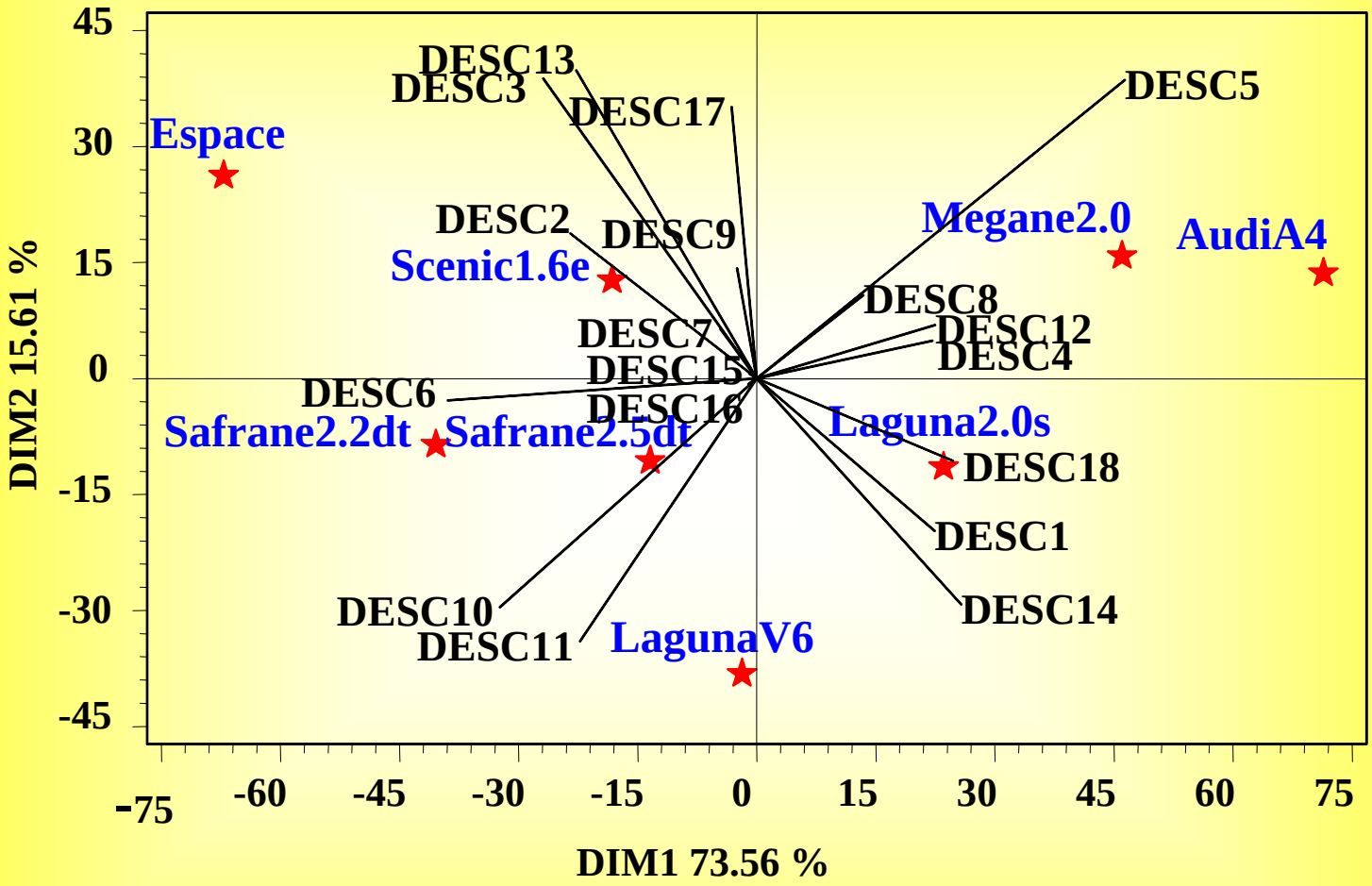
LagunaV6

# Internal Preference Mapping



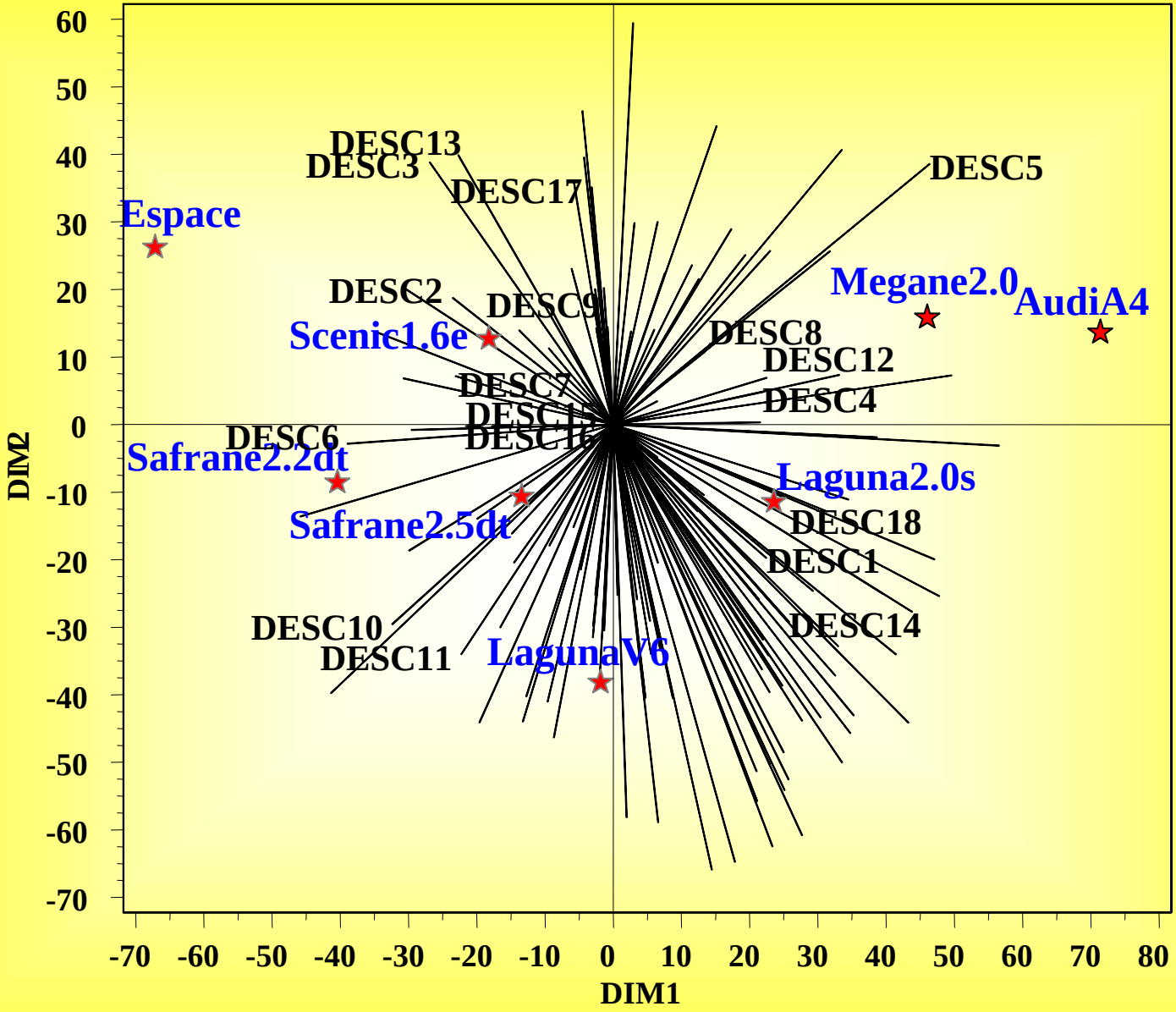

Just a PCA of the liking scores (product as observations and consumers as variables)
Highlighting here a rejection of Espace and a segmenting status of Scenic1.6e

# PCA of Braking Profiles by Professional Pilots



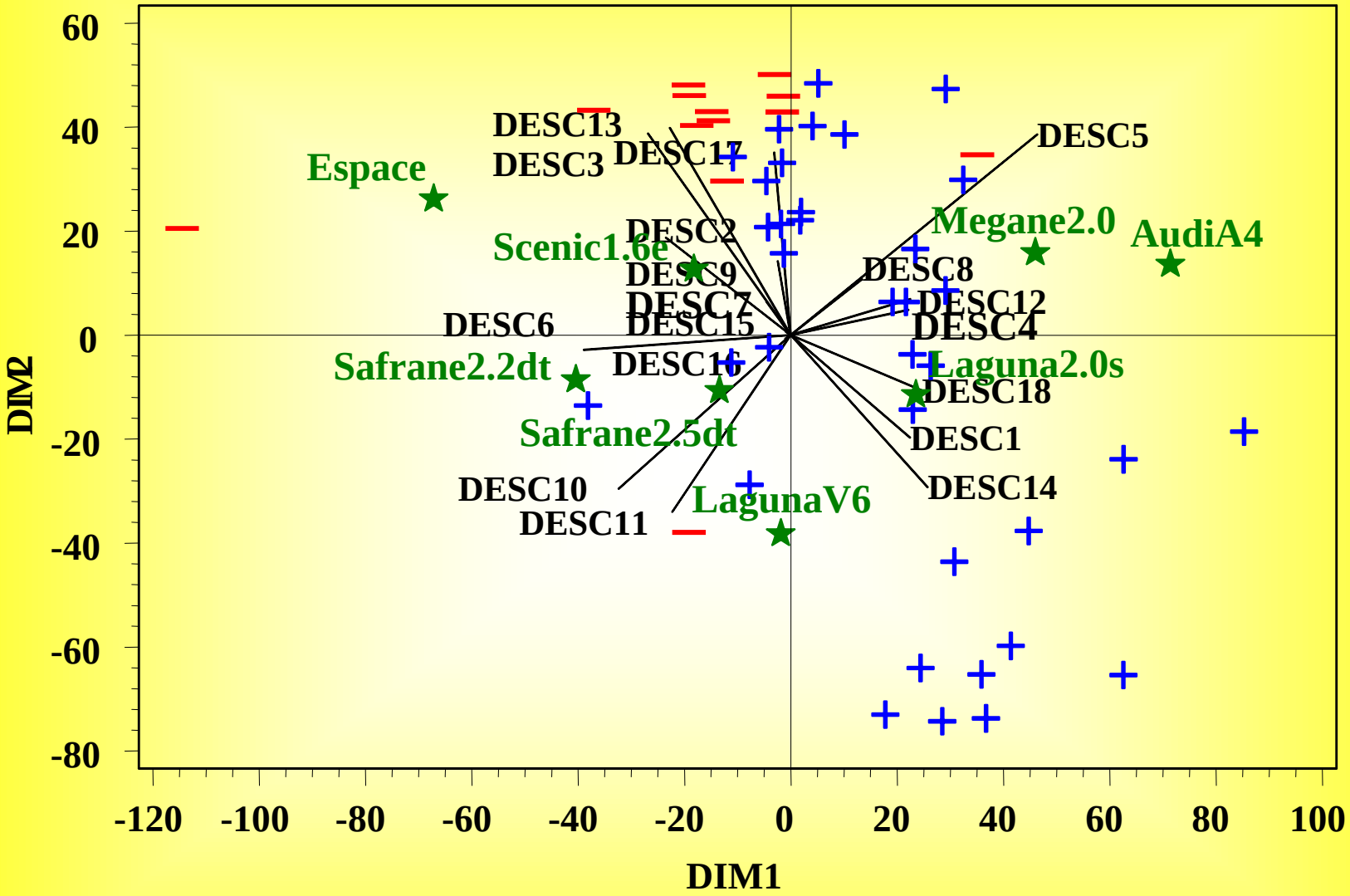

These 2 sensory dimensions (DIM1 and DIM2) are going to be regressors in individual modeling of consumer liking scores

# External Preference Mapping by Vectorial Model



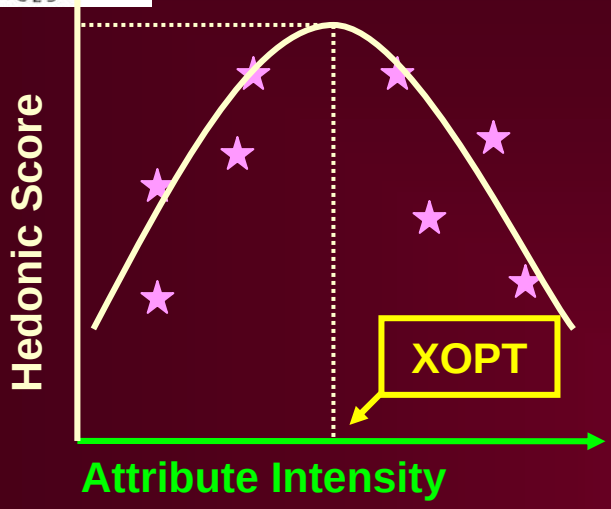

Each arrow indicates the optimal sensory direction for a given consumer
The length of the arrow is proportional to the quality of the fit

# External Preference Mapping by Circular Model



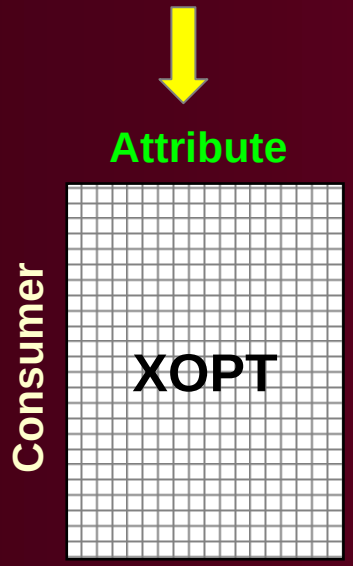

Each + sign (resp. - sign) locates the ideal car (resp. anti-ideal car) of a given consumer
Consumers with non significant regression are not represented

# PrefMaX Method

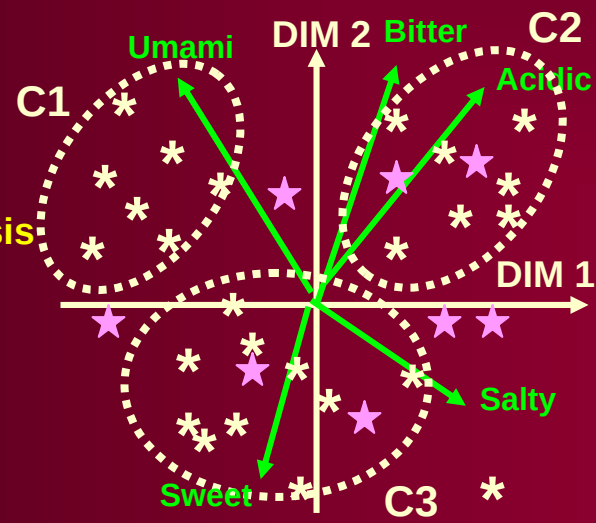



For each pair of consumer/attribute:

1. Fit a quadratic regression of hedonic scores on attribute means
2. Define optimal intensity (XOPT)
3. Store all XOPT into a *consumer x attribute* matrix
4. XOPT matrix is the input of subsequent analyses
5. In these analyses, weight each XOPT by the $R^2$ from the corresponding quadratic regression




Cov PCA
Cluster Analysis



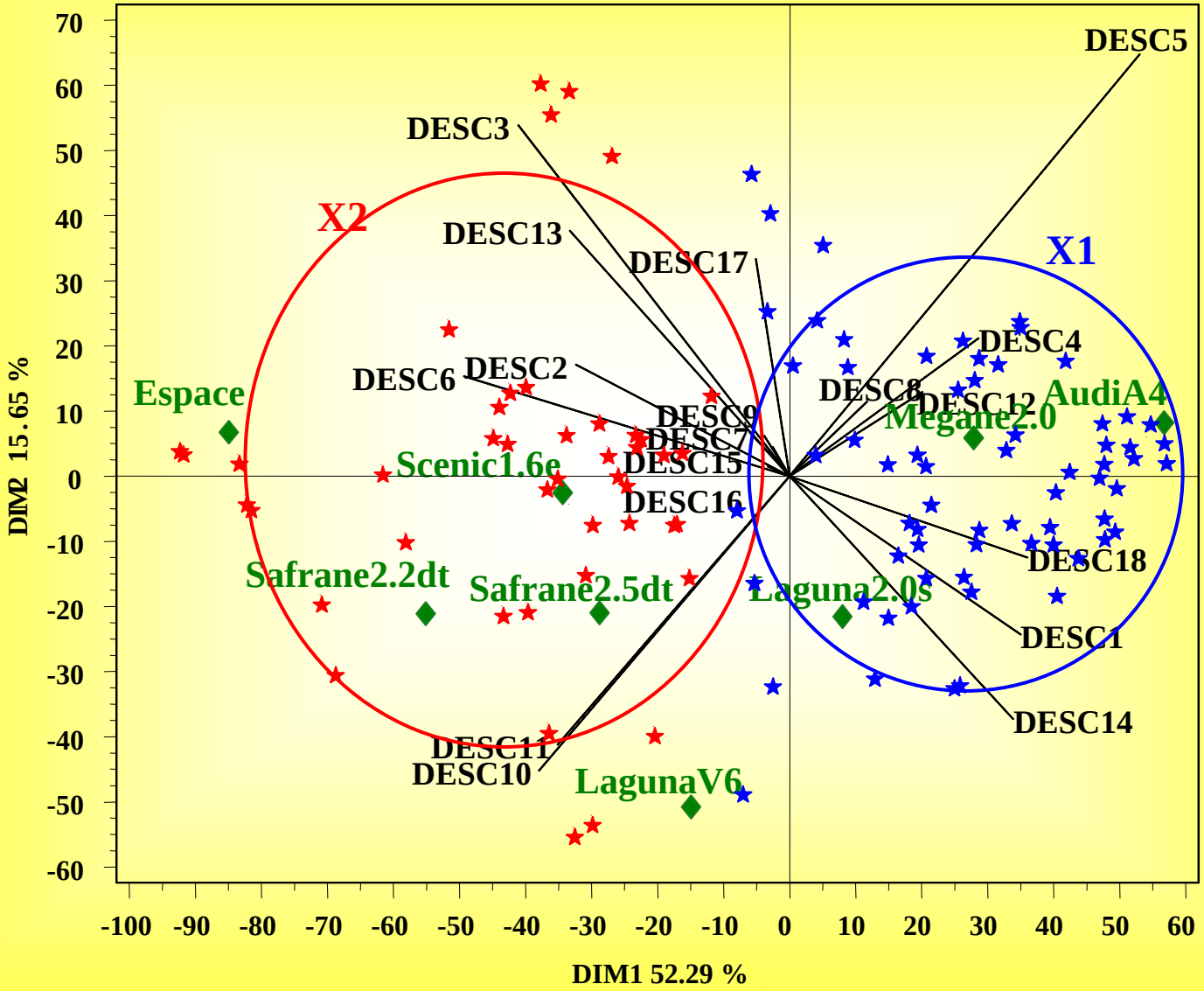

**Optimal Sensory Recipes by Consumer Segment**

| Attribute | C1 | C2 | C3 |
|---|---|---|---|
| Acidic | 0 | + | - |
| Bitter | 0 | + | - |
| Salty | - | 0 | 0 |
| Sweet | 0 | - | + |
| Umami | + | 0 | 0 |

Each white star is the ideal point of a consumer

Each violet star is a product projected onto the map as a supplementary point using its attribute mean intensities

# PrefMaX Segmentation in 2 groups



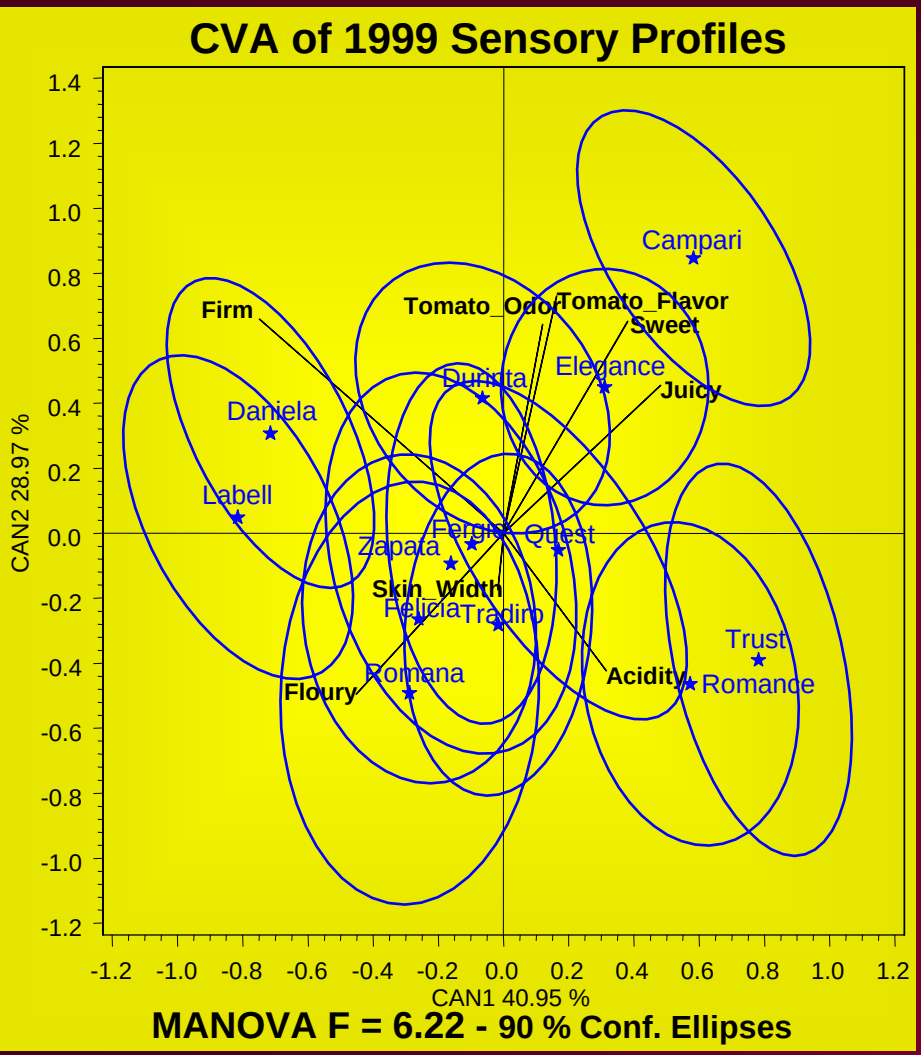

Each star locates the ideal car of a given consumer

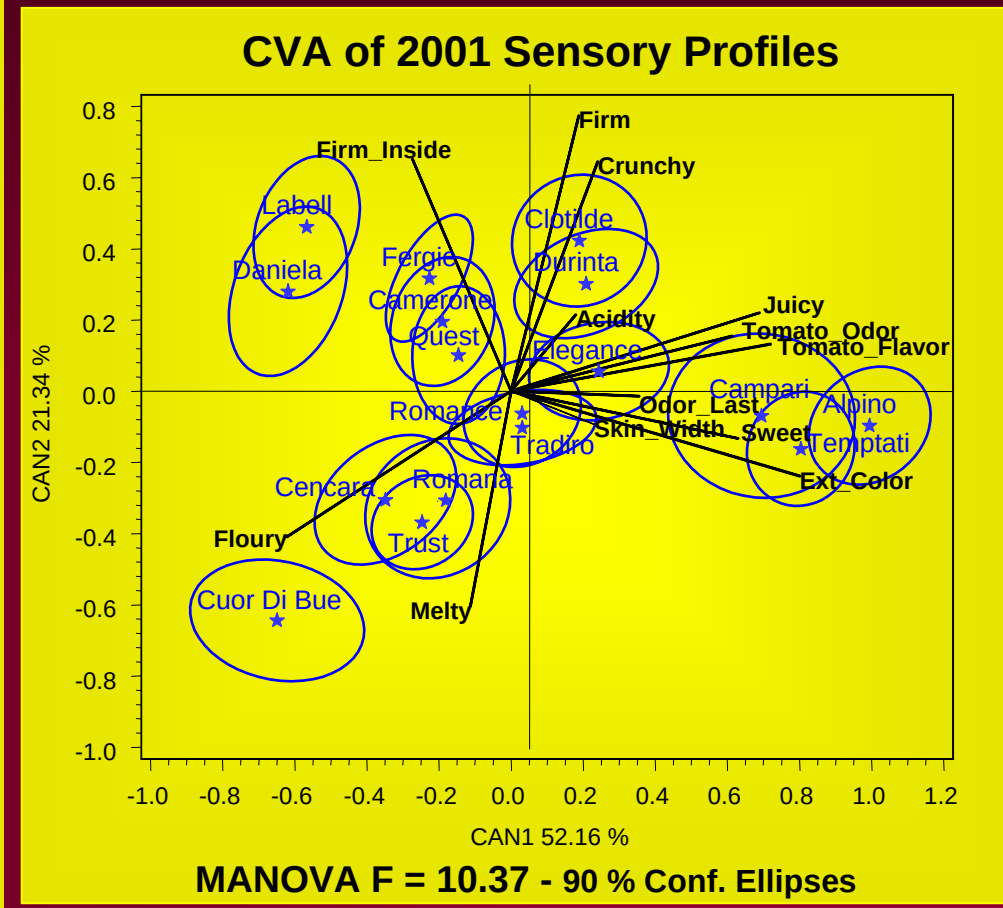
Blue and red segments contains respectively 66 and 44 consumers

# Tomato experiments

| Material & Methods | 1999 experiment | 2001 experiment |
|---|---|---|
| Tomato varieties | 13 varieties<br>served raw with nothing else | 17 varieties<br>11 from 1999 plus 6 others |
| Sensory panels | 13 trained panelists<br>profiled each variety in duplicate | 14 trained panelists<br>profiled each variety in duplicate |
| Sensory profiles | 8 attributes | 13 attributes<br>the 8 from 1999 plus 5 others |
| Consumers | 215 consumers | 361 consumers<br>different from 1999 |
| Hedonic scoring | Complete design in 2 sessions<br>Texture, taste and overall liking | Incomplete design in a single session<br>10 out of 17 varieties<br>Overall liking only |
| U&A questionnaire | 83 questions | 83 questions |

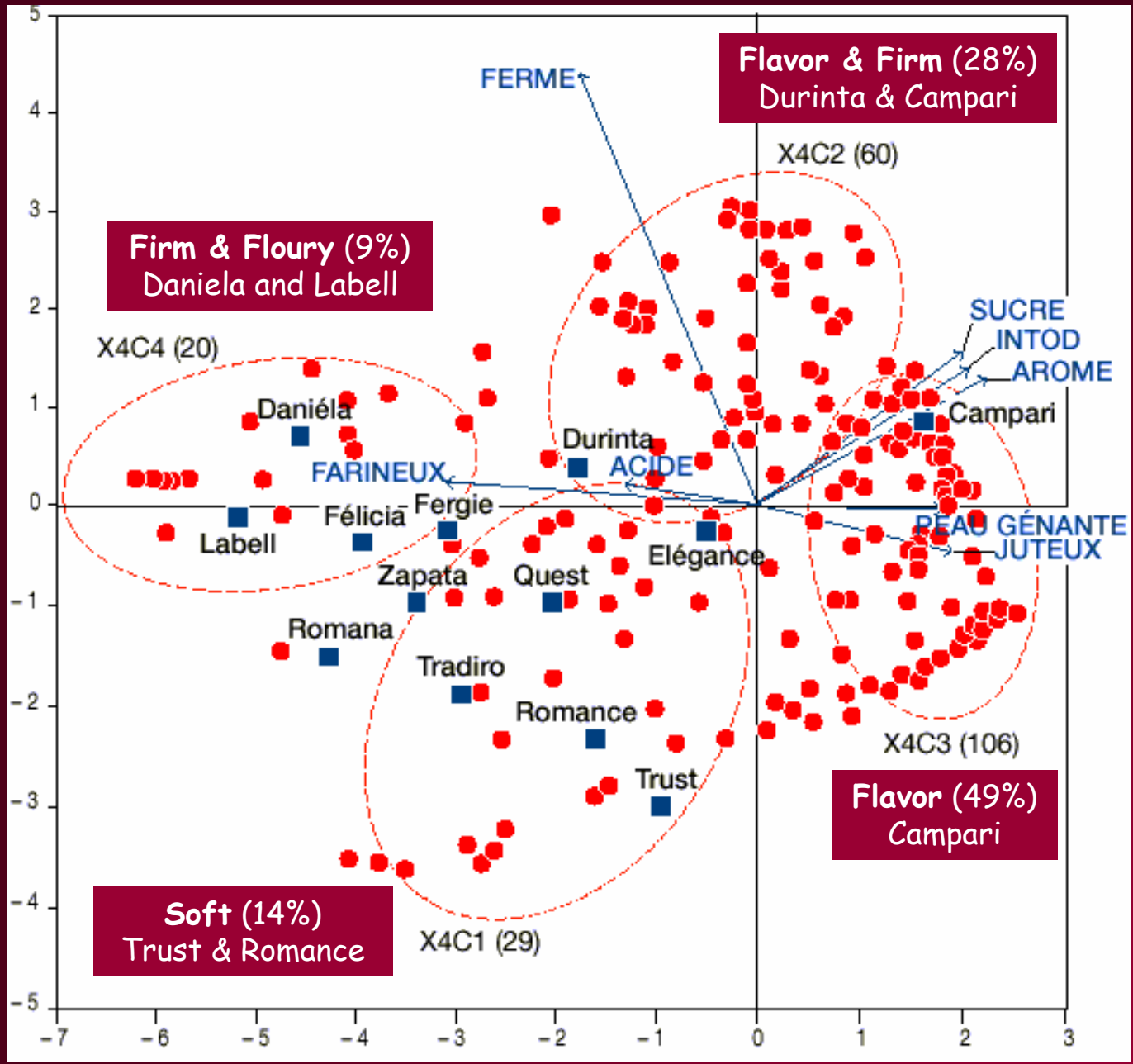
# Comparing sensory profiles from 1999 and 2001



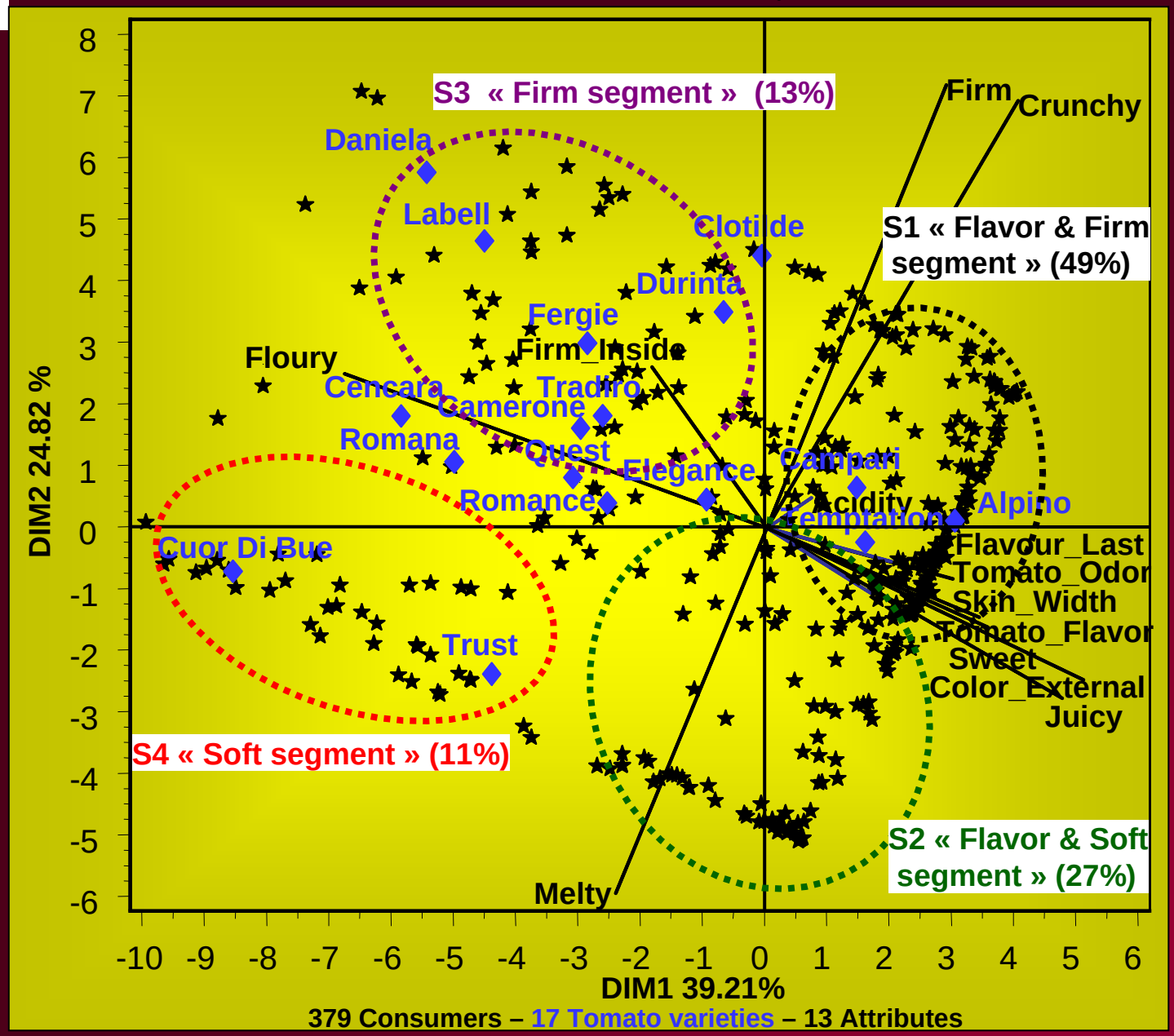

Yes, training can dramatically improve a sensory panel over time !

# 1999 Tomato PrefMaX



# In 2001, each consumer tested only 10 among the 17 varieties using a MOLS design

# 2001 Tomato PrefMaX



# Optimal sensory recipes by 2001 consumer segments

**$R^2$ weighted-average of PrefMaX optimal sensory levels by segment**

| Attribute | F Segment | ALL (n=379) | S1 (n=185) | S2 (n=104) | S3 (n=49) | S4 (n=41) |
|---|---|---|---|---|---|---|
| **Juicy** | 305.6 | 7.57 | **8.08** | **8.12** | 5.28 | 5.03 |
| **Color_External** | 45.72 | 7.09 | **7.69** | **7.38** | 5.37 | 4.81 |
| **Sweet** | 92.00 | 6.10 | **6.48** | **6.27** | 4.70 | 4.25 |
| **Tomato_Flavor** | 96.92 | 7.43 | **7.77** | **7.56** | 6.30 | 5.36 |
| **Tomato_Odor** | 147.8 | 7.02 | **7.34** | **7.09** | 5.98 | 5.27 |
| **Odor_Last** | 133.9 | 5.84 | **6.08** | **5.94** | 5.06 | 4.71 |
| **Skin_Width** | 41.44 | 5.92 | **6.13** | **6.13** | 5.09 | 4.94 |
| **Crunchy** | 247.3 | 5.31 | **6.30** | 3.61 | **6.11** | 2.49 |
| **Firm** | 224.4 | 4.94 | **5.85** | 3.34 | **6.05** | 2.87 |
| **Acidity** | 12.61 | 4.95 | **5.11** | 4.70 | 4.91 | 4.52 |
| **Melting** | 161.8 | 5.70 | 4.65 | **6.82** | 4.50 | **7.19** |
| **Floury** | 172.7 | 1.52 | 0.71 | 1.13 | **4.10** | **4.94** |
| **Firm_Inside** | 58.23 | 5.42 | 5.19 | 4.96 | **6.76** | **6.18** |

Pseudo-F for VARCLUS partitions from 2 to 8 segments respectively:
317, 301, **399**, 376, 328, 323, 384

# The tomato sensory segmentation

# Conclusion

## Prefmap

- Predicting consumer liking by sensory description brought to sensory analysis its practical **justification** and its **development beyond food**
- **PrefMaX** improved the classical techniques,
  others valuable developments exist (using PLS for instance)

## Car study

- Demonstrated the value of the sensory approach in the car industry
- Predicting **subjective perception** of **objective properties**

## Tomato study

- The sensory segmentation discovered is currently used for **communication**
- Producing the missing « **soft fully aromatic variety** » is on the way…