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*A new approach for analyzing  
hierarchical sorting task data*

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# Introduction

- ★ Sensory analysis:
  - ★ Egoroff, 2005
  - ★ Blancher *et al.*, 2008
  - ★ Santosa *et al.*, 2010
- ★ Hierarchical sorting task consists in asking subjects to perform successively several nested sorting tasks
- ★ Used to understand the process during a sorting task

# Data

- ★ Binary hierarchical sorting
- ★ 22 subjects
- ★ 16 advertisements concerning an orange juice
- ★ Construction according to a  $2^{5-1}$  fractional factorial design



# Data: factors of the design

## ★ Background color

Green

White



# Data: factors of the design

## ★ Figurative

With

Without



# Data: factors of the design

★ Catchword: "It's winter... Are you feeling weak? Give your body vitamins!"

With

Without



# Data: factors of the design

★ Allegation: “Rich in vitamins A, C, B1 and B6”

With

Without



# Data: factors of the design

- ★ Realization of a performance' test: "90% of women who tested it, felt the difference in 2 weeks"

With

Without





# Hierarchical sorting of subject 3

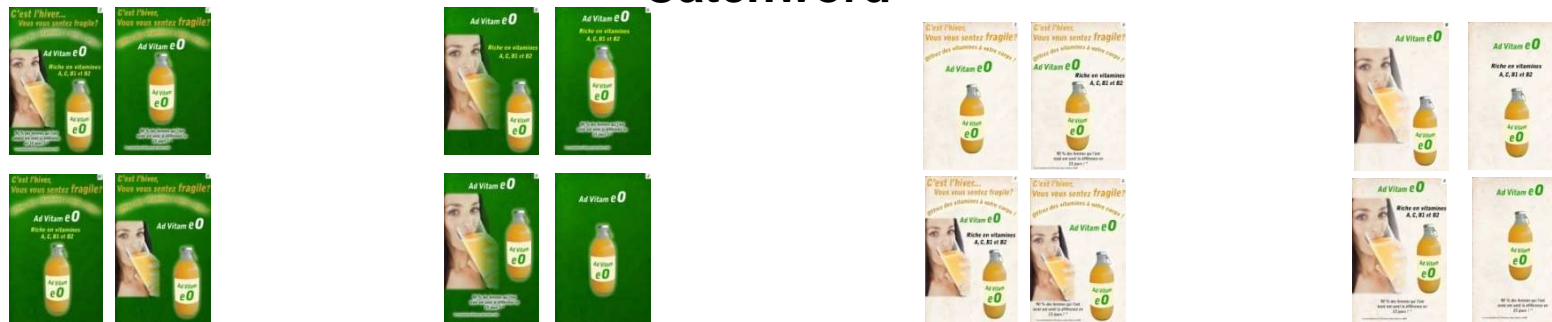
L1

Color



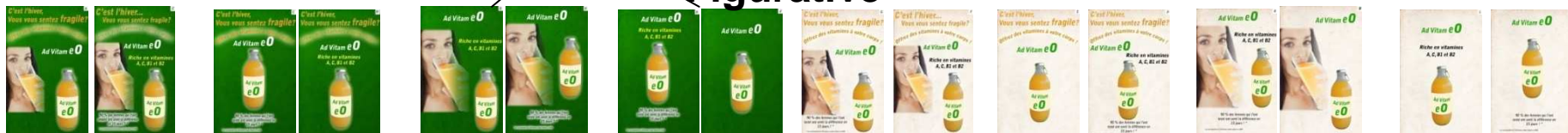
L2

Catchword



L3

Figurative



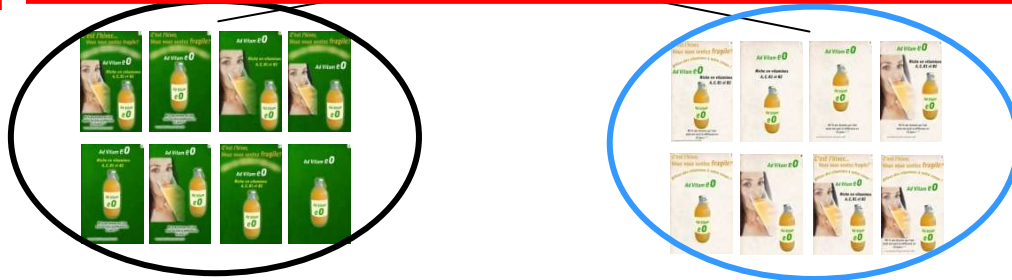
# The data gathering

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How the data can be gathered in a data table?

# Data coding: subject 3

L1



	L1
A	G2
B	G1
C	G1
D	G2
E	G1
F	G2
G	G1
H	G2
I	G2
J	G1
K	G1
L	G2
M	G1
N	G1
O	G2
P	G2

# Data coding: subject 3

L1



L2



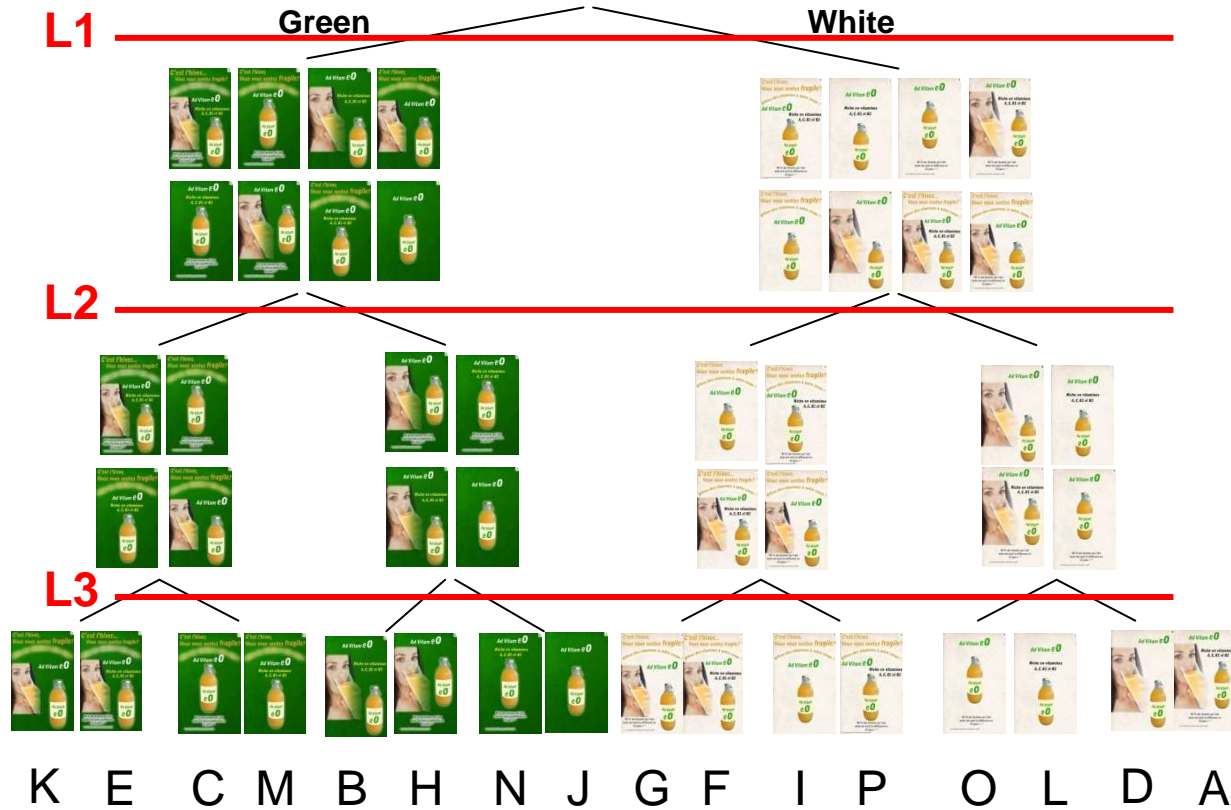
	L1	L2
A	G2	G4
B	G1	G2
C	G1	G1
D	G2	G4
E	G1	G1
F	G2	G3
G	G1	G3
H	G2	G2
I	G2	G3
J	G1	G2
K	G1	G1
L	G2	G4
M	G1	G1
N	G1	G2
O	G2	G4
P	G2	G3

# Data coding: subject 3



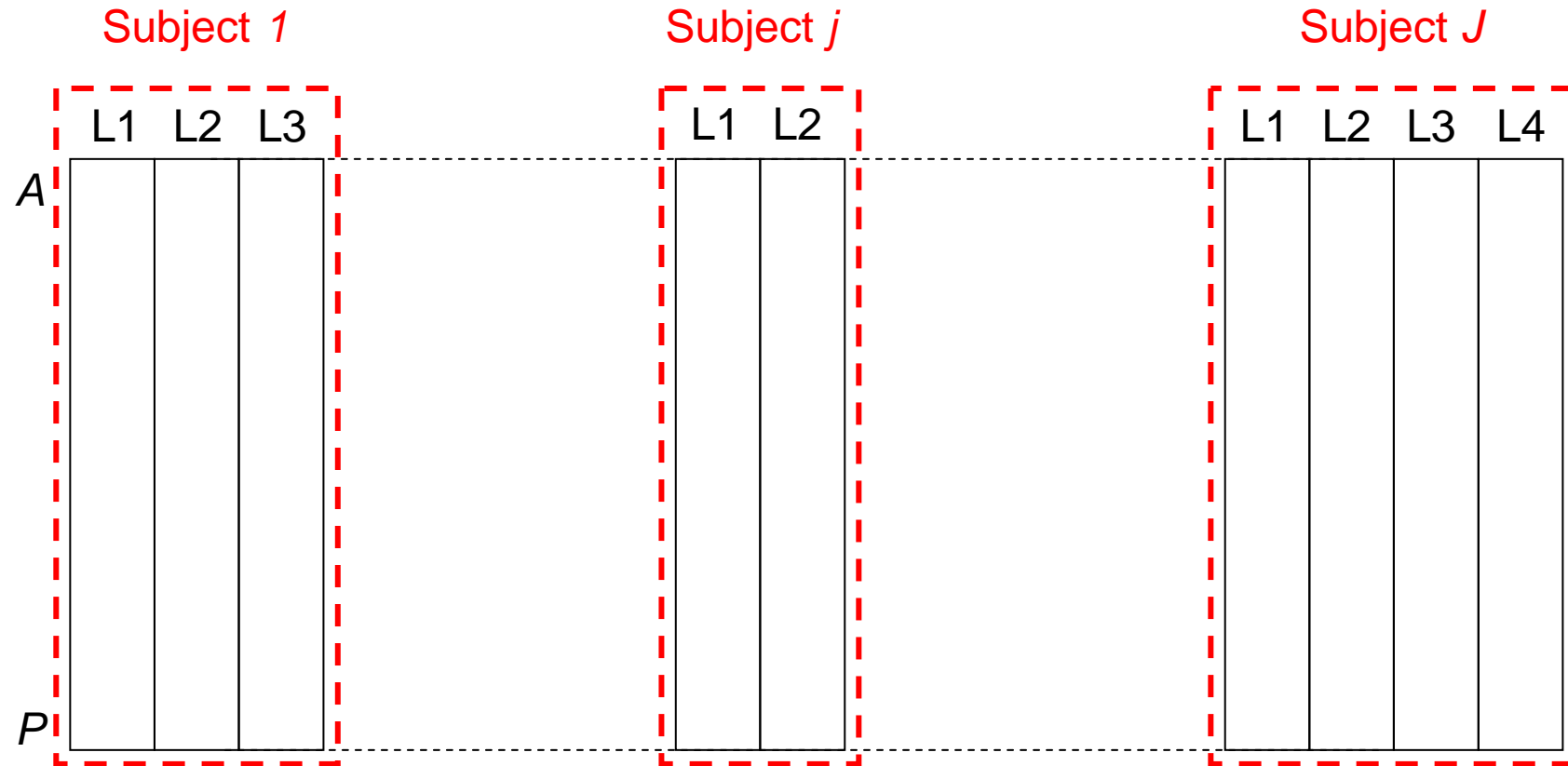
	L1	L2	L3
A	G2	G4	G8
B	G1	G2	G3
C	G1	G1	G2
D	G2	G4	G8
E	G1	G1	G1
F	G2	G3	G5
G	G1	G3	G5
H	G2	G2	G3
I	G2	G3	G6
J	G1	G2	G4
K	G1	G1	G1
L	G2	G4	G7
M	G1	G1	G2
N	G1	G2	G4
O	G2	G4	G7
P	G2	G3	G6

# Data coding: subject 3



	L1	L2	L3
A	white	G4	G8
B	green	G2	G3
C	green	G1	G2
D	white	G4	G8
E	green	G1	G1
F	white	G3	G5
G	green	G3	G5
H	white	G2	G3
I	white	G3	G6
J	green	G2	G4
K	green	G1	G1
L	white	G4	G7
M	green	G1	G2
N	green	G2	G4
O	white	G4	G7
P	white	G3	G6

# Data coding: $J$ subjects



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# The data analysis

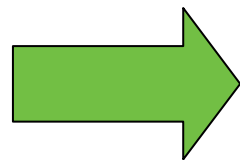
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How the data table can be analyzed?



# Data analysis

- ✱ With these data, we are interested in different representations
- ✱ To obtain these representations, we want to:
  - ✱ Balance the influence of each subject
  - ✱ Keep the information provided by each subject



Multiple Factor Analysis (MFA) in which 1 subject = 1 group

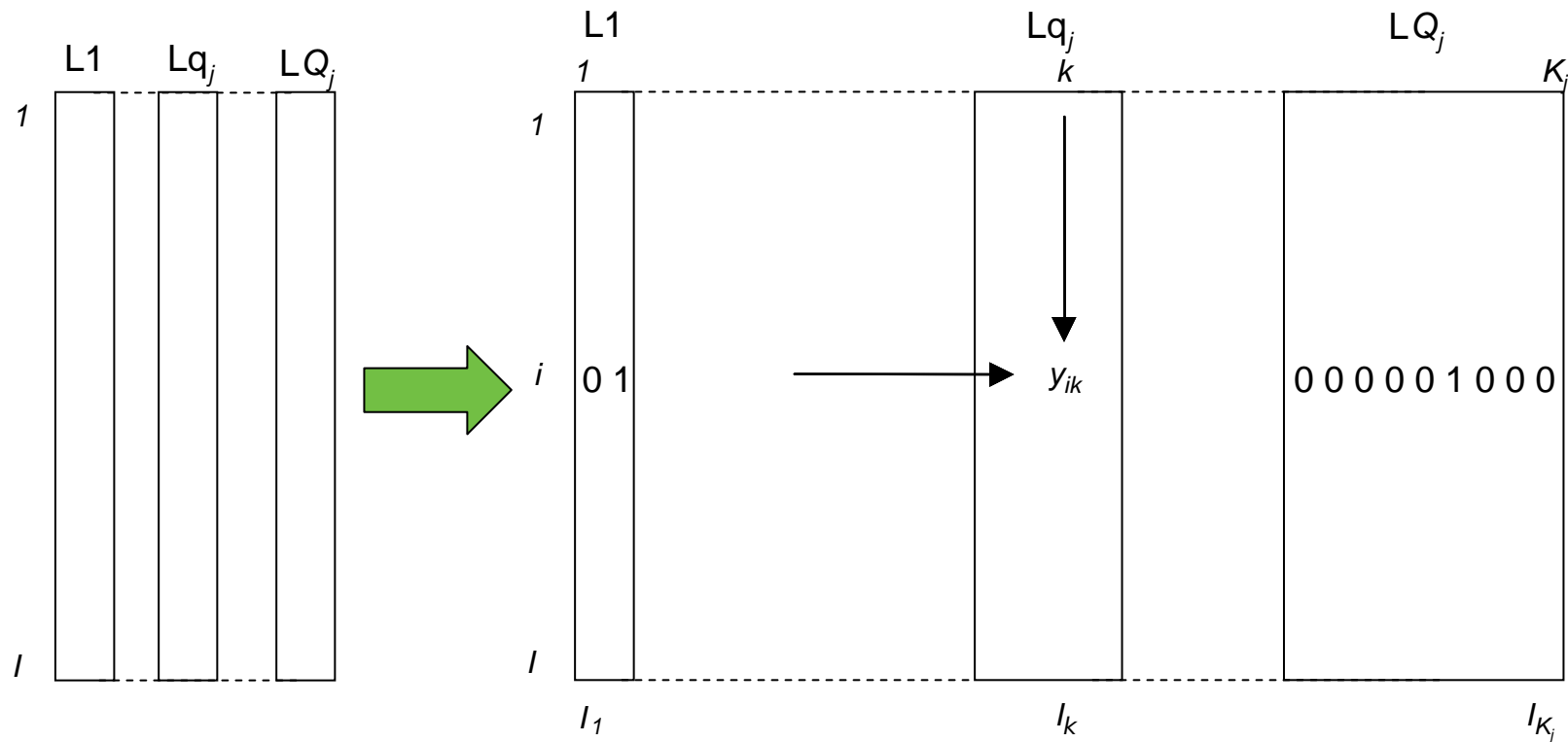
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# Data analysis

- ✱ MFA is looking for:
  - ✱ Objects oppositions provided by several subjects
  - ✱ Objects oppositions provided at upper levels
  
- ✱ MFA provides different representations:
  - ✱ An objects representation
  - ✱ A subjects representation
  - ✱ A levels representation

# Disjunctive data table associated with subject $j$

- Each level is represented by a set of dummy variables



# Objects representation

- Distance between 2 objects  $i$  and  $l$ :

$$d^2(i, l) = \sum_j \sum_{k \in K_j} \frac{1}{Q_j} \frac{I}{I_k} (y_{ik} - y_{lk})^2,$$

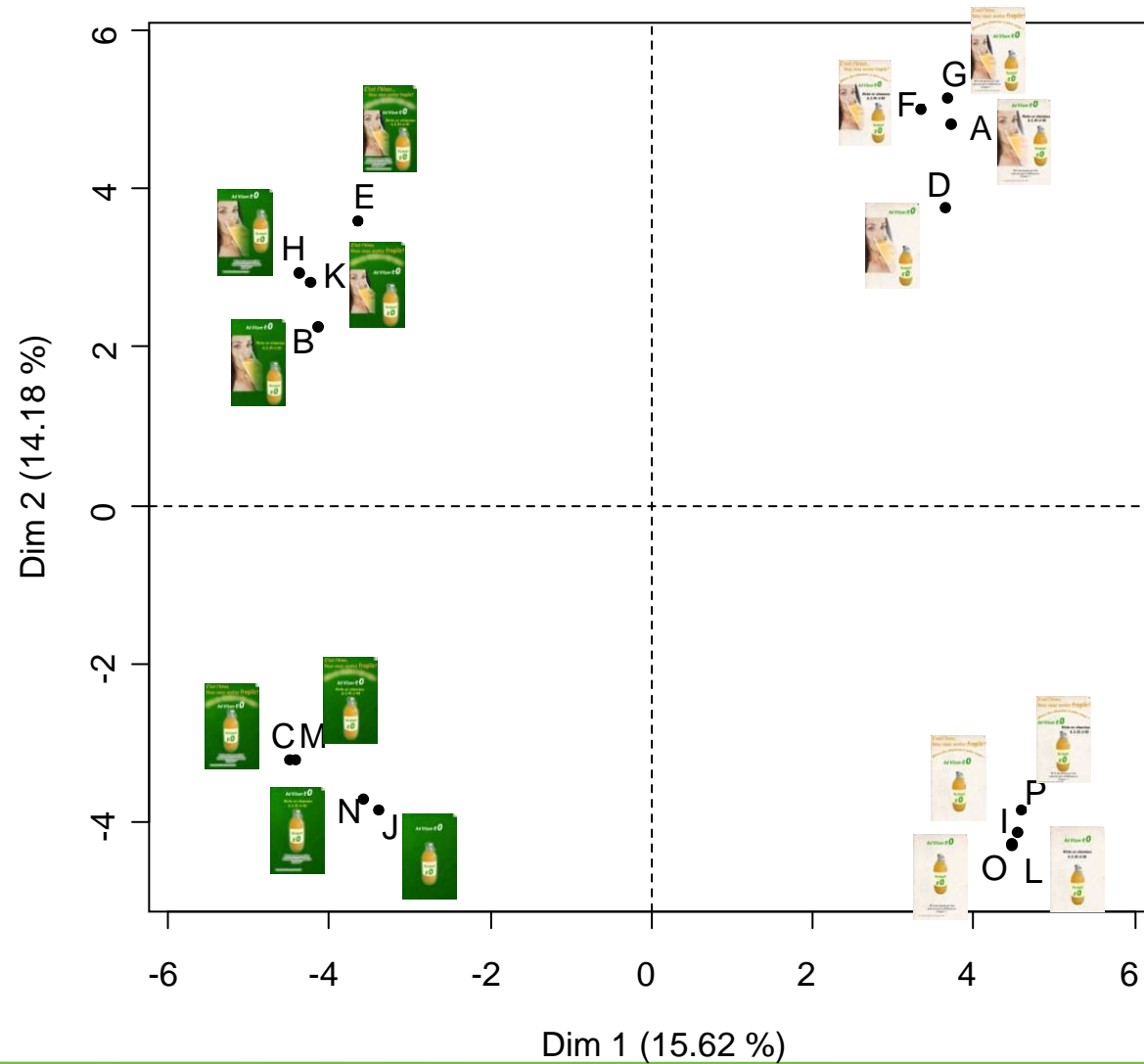
with  $Q_j$  the number of level of subject  $j$

$I$  the number of objects

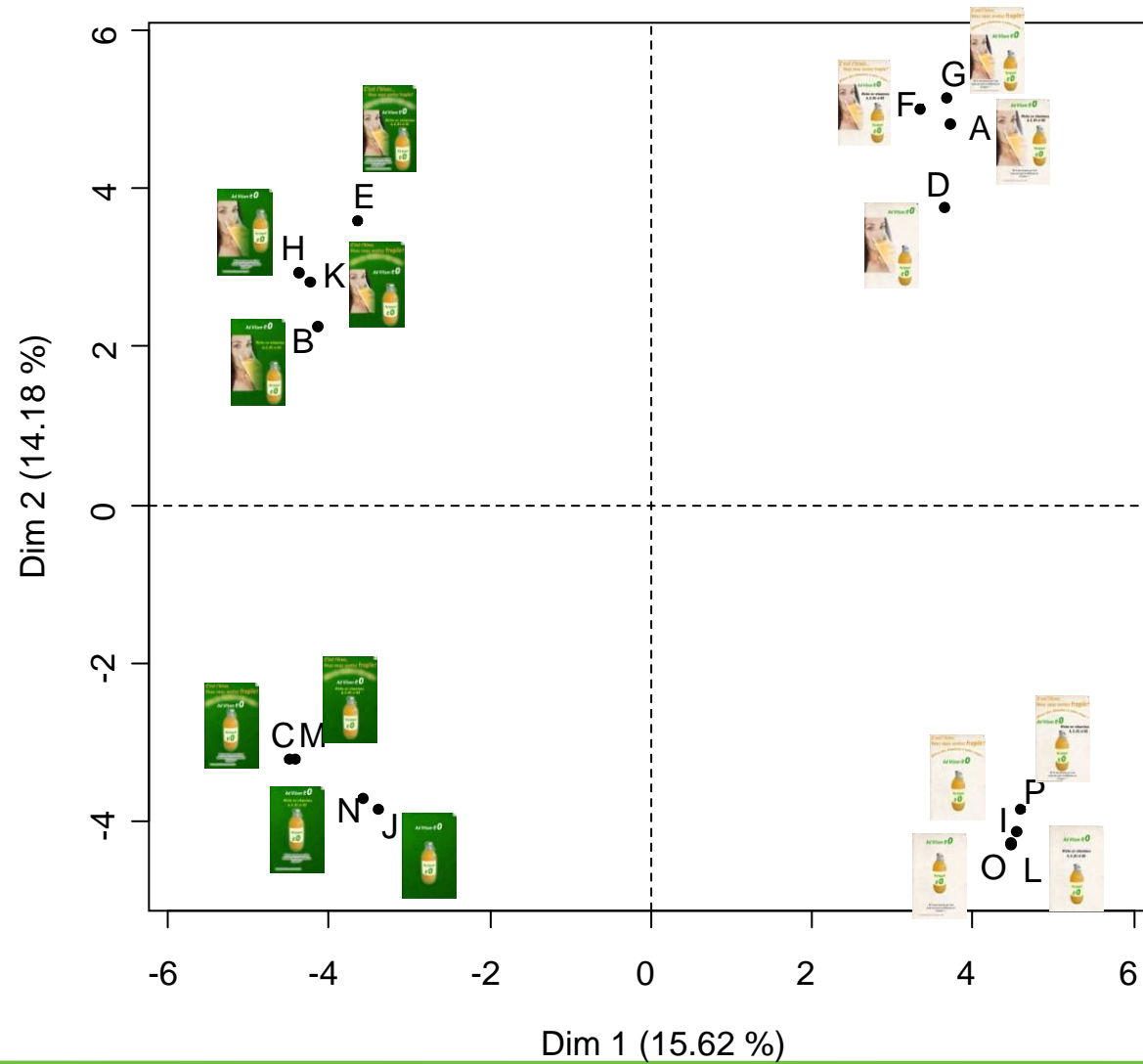
$I_k$  the number of objects into the group  $k$

$y_{ik}$  the element of the disjunctive data table which is equal to 1 if the object  $i$  belong to group  $k$  and 0 in the opposite case

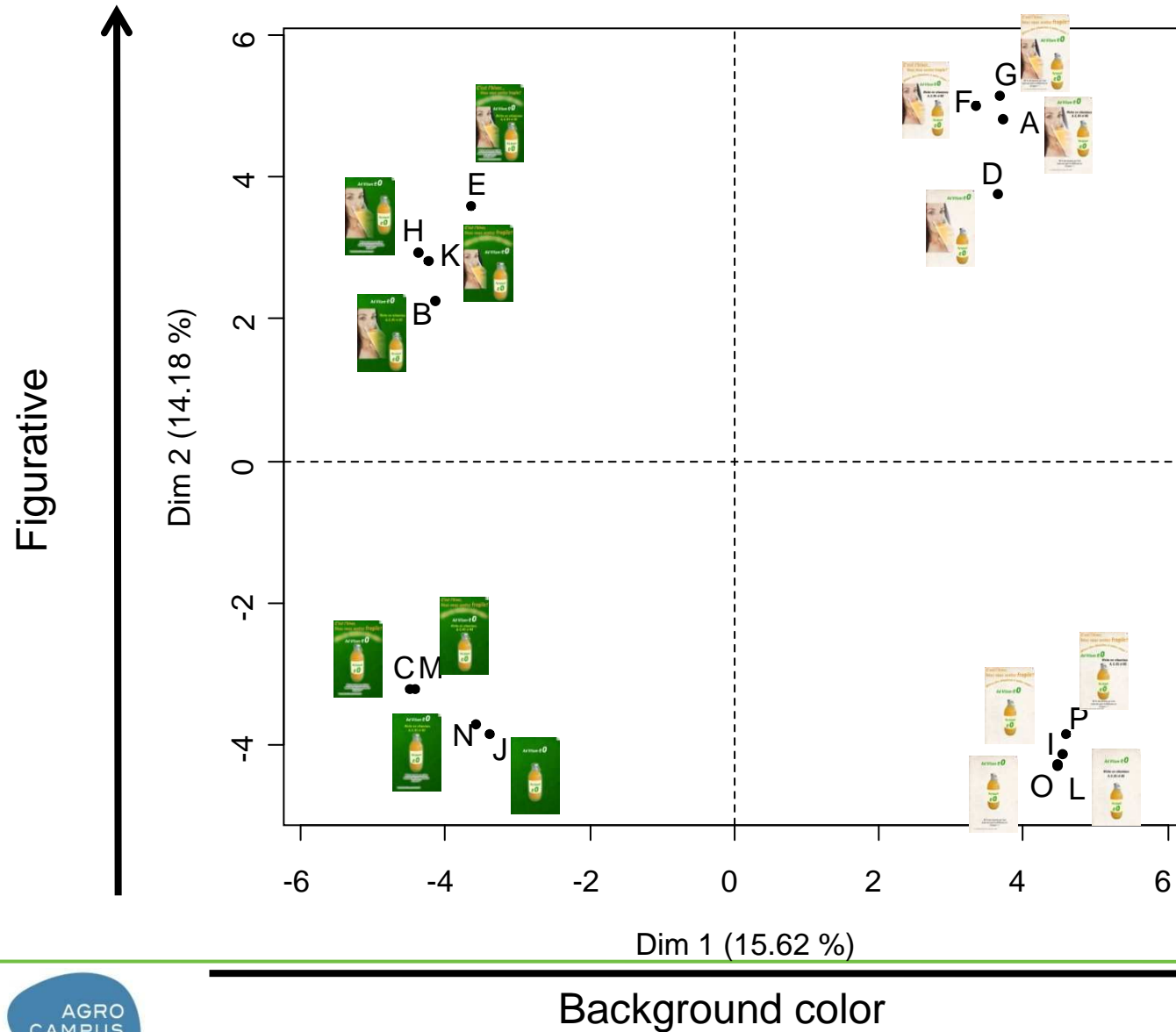
# Advertisements representation



# Advertisements representation



# Advertisements representation



# Subjects representation

- Coordinate of subject  $j$  on axis  $s$ :

$$\frac{1}{Q_j} \sum_{k \in Q_j} \eta^2(z_s, V_k),$$

with  $Q_j$  the number of level of subject  $j$

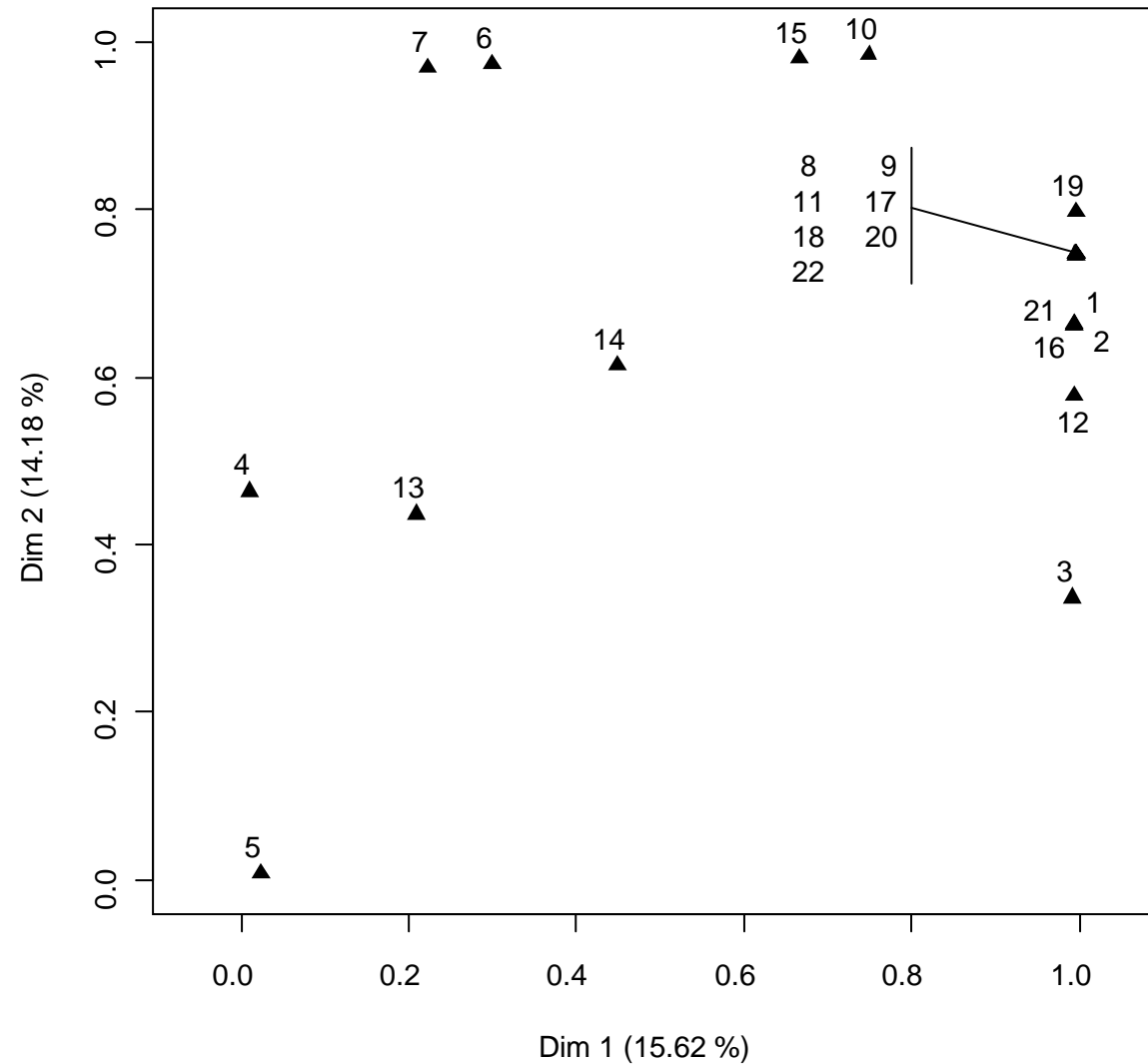
$z_s$  the axis  $s$

$V_k$  the qualitative variable

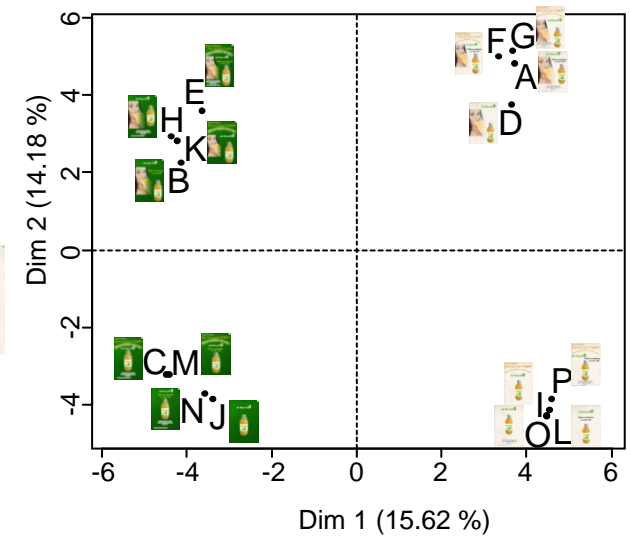
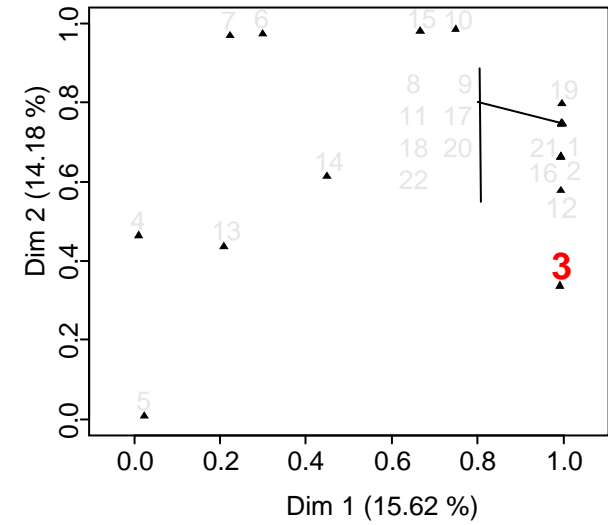
A subject will have a coordinate all the more important than he saw the objects positions highlighted by the dimension at an upper level



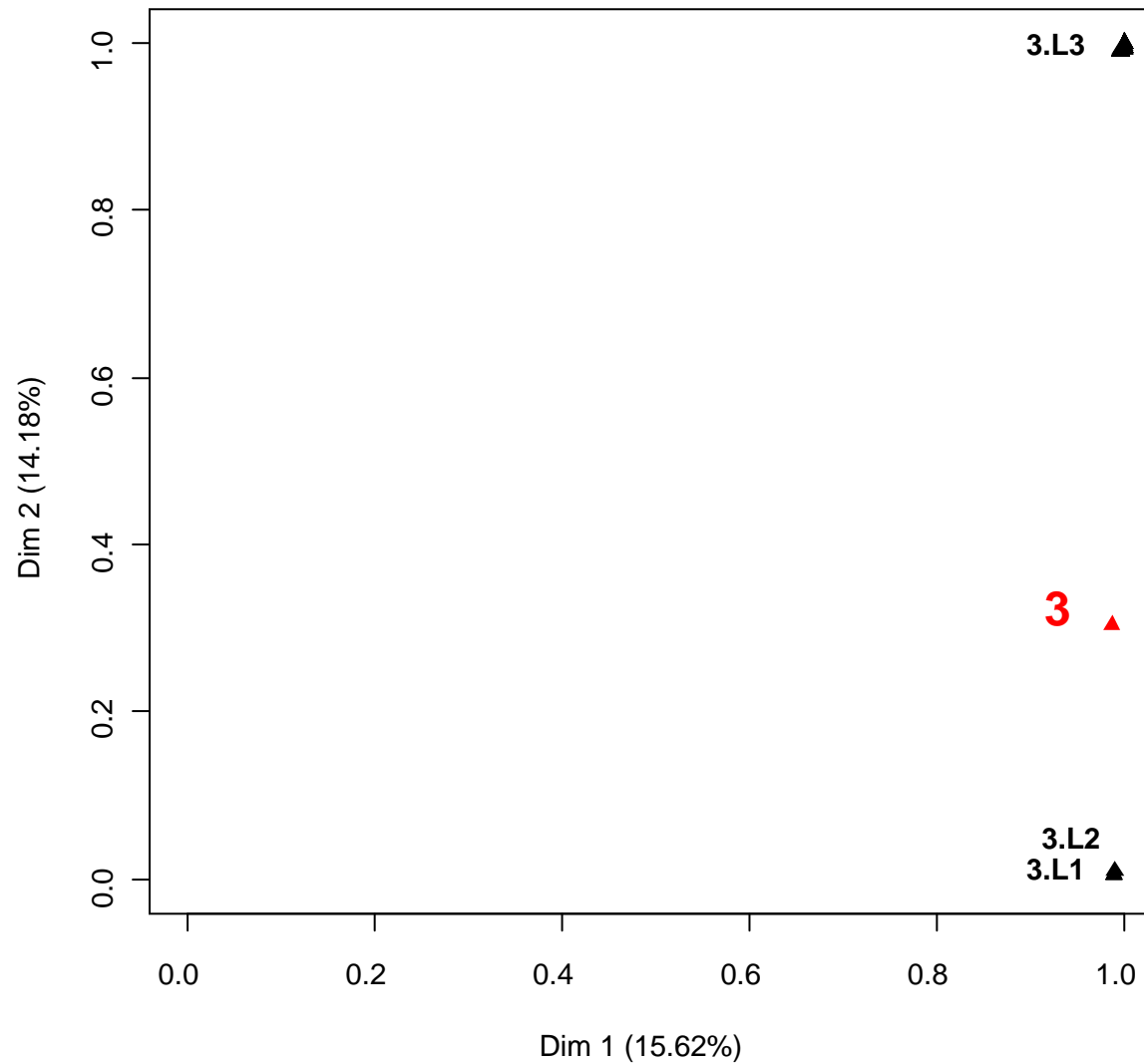
# Subjects representation



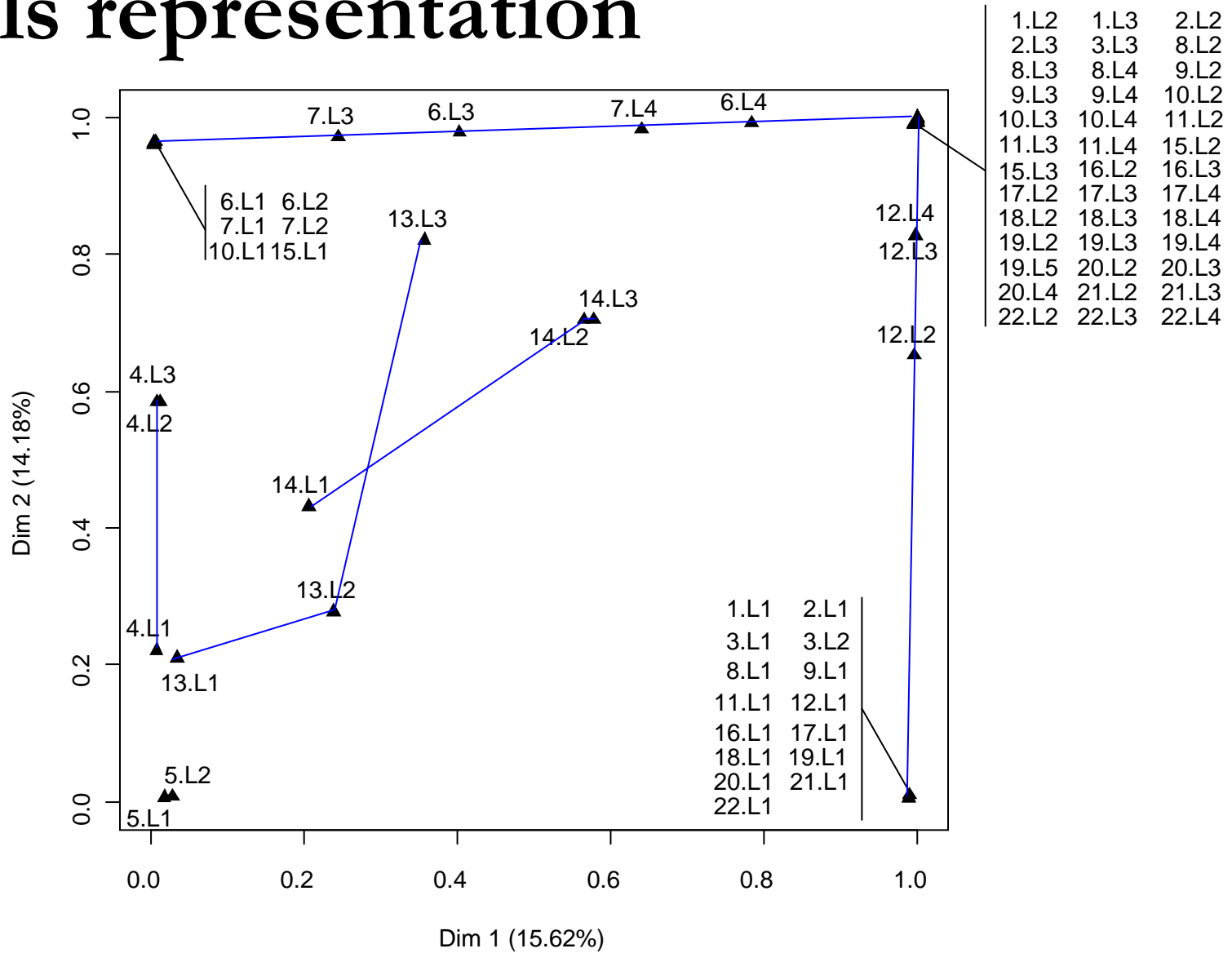
# Subject 3



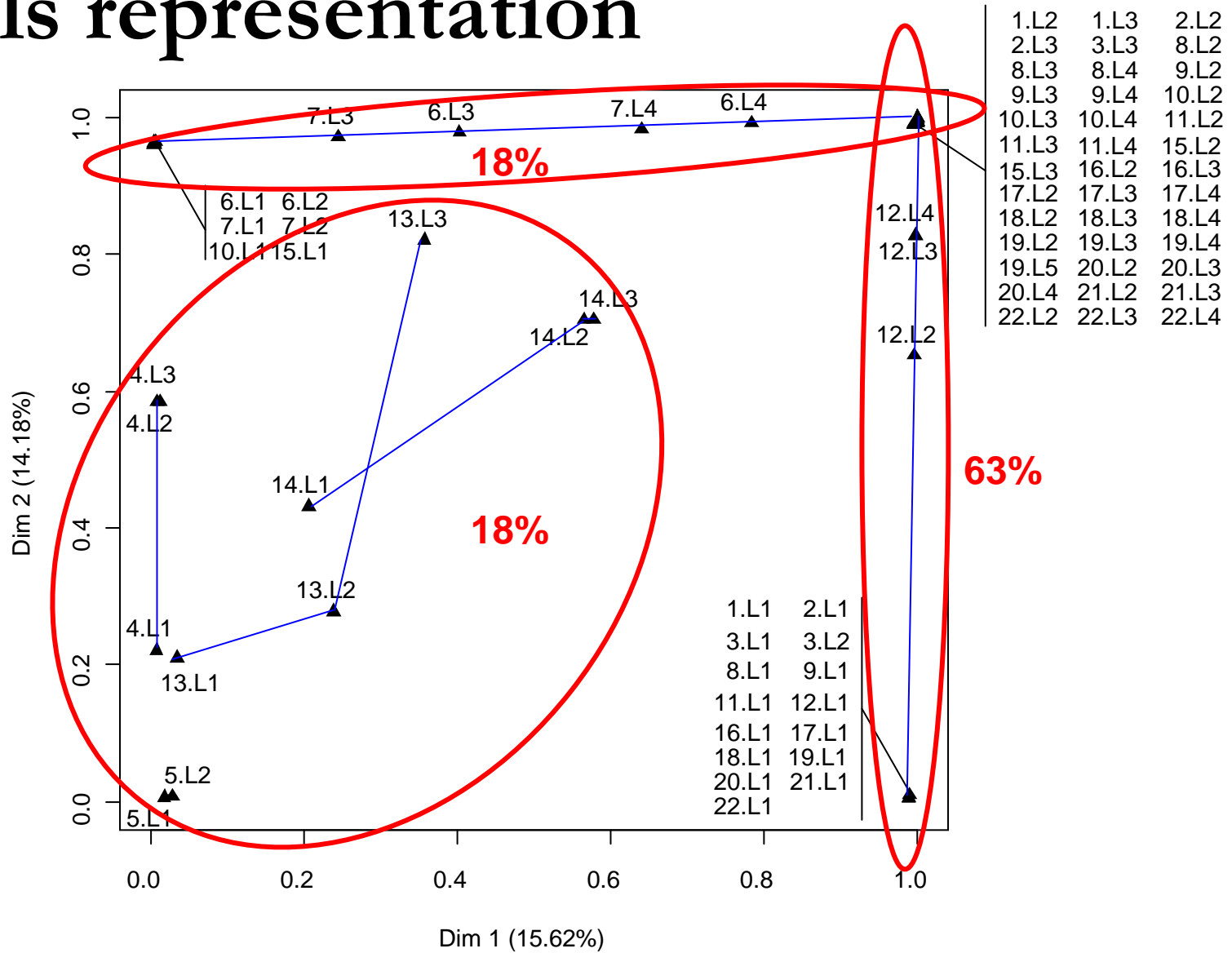
# Levels representation of subject 3



# Levels representation



# Levels representation



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# Conclusion

- ✿ Allows the simultaneous taking into account of hierarchies of partitions in a same analysis
- ✿ Methodology providing rich and interpretable results
  - ✦ Allows also a words representation
- ✿ Another application:
  - ✦ *Poster 33: Analysing trees issued from a hierarchical sorting task using HMFA*

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# Conclusion

- ✱ Observing consumers performing napping, sorting and hierarchical sorting lead us naturally to consider what we have called a **“free holistic approach”** where the assessors are free to use the holistic approach they feel more comfortable with
- ✱ To be analyzed with HMFA...

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# SensoMineR

<http://sensominer.free.fr>

*Journal of sensory studies* **SensoMineR** a package for sensory data analysis

# FACTOMINER

<http://factominer.free.fr>

*Journal of statistical software* **FactoMineR**: an R package for multivariate analysis