



FACULTY OF ECONOMICS, BUSINESS AND TOURISM

**DEPARTMENT OF ECONOMICS AND BUSINESS
MANAGEMENT**

POSITIONING — Perceptual Mapping Lab

<https://uah-marketing-lab-posicionamiento.netlify.app/>

Teaching guide and technical manual

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FOREWORD

This manual was created with the purpose of offering a modern, accessible and methodologically rigorous tool for the teaching of perceptual analysis applied to higher education in marketing. The growing digitalization in training environments requires materials that combine conceptual clarity, statistical soundness, the ability to improve the learning process and an eminently practical approach.

In this context, the POSITIONING — Perceptual Mapping Lab constitutes an innovative contribution. It is a lightweight, interactive tool aimed at applied learning. In addition, it has the ability to integrate theory, practice and visual analysis in a single teaching resource.

This manual presents a complete didactic sequence from the conceptual foundations of positioning to the advanced interpretation of perceptual maps generated through the application of POSITIONING — Perceptual Mapping Lab. It also includes simplified examples, complete case studies, reflection exercises, evaluation rubrics and a teaching guide that facilitates its implementation in the classroom.

The objective of this manual is to serve as a reference on the use of the app and positioning analysis, applying them to typical marketing topics, such as market analysis, consumer behavior and product strategy, contributing to the strengthening of teaching innovation at the University of Alcalá.

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The authors wish to express their gratitude to **Professor Miguel Santesmases Mestre**, whose pioneering work in the development of the previous version of the perceptual positioning tool constitutes the conceptual and technical basis on which this new application has been built.

His contribution has been a fundamental reference in the teaching of perceptual analysis and a continuous source of inspiration for the evolution of this project.

Likewise, the authors are grateful for the participation of the professors of the Marketing Area of the Department of Economics and Business Management of the University of Alcalá, who collaborated in the first tests of the prototype, whose interaction with the tool made it possible to identify improvements and confirm its usefulness in real learning contexts.

AUTHORS' NOTE

This manual has been conceived as a living resource.

The POSITIONING app will continue to evolve, incorporating new features, visualization enhancements, and additional modules to expand the scope of hands-on learning.

The authors invite teachers and students to send comments, suggestions and examples of use in the classroom, in order to continue strengthening this project and contribute to the development of a broader ecosystem of teaching applications in the area of marketing.

CONTENTS

1. Fundamentals of Positioning and Perceptual Maps	11
1.1. What is brand positioning?	11
1.2. What is a perceptual map?	12
1.3. What is it for? Real applications	12
1.4. Where are they applied? Real-world examples of industries.....	13
1.5. Simplified Examples of Perceptual Maps	14
1.6. How to interpret PCA vs. direct maps	17
1.6.1. How the marks are read	17
1.6.2. What is a direct map?	17
1.6.3. Key differences between the two types of maps	18
1.6.4. Which one to use in class?.....	18
2. Action Guide for Teachers	19
2.1. Learning objectives	19
2.2. The recommended agenda	19
2.3. Work dynamics (for groups or individual work)	20
2.4. Pedagogical recommendations.....	20
2.5. Evaluation criteria for positioning work	21
2.5.1. Synthetic rating rubric (overview).....	22
2.5.2. Detailed evaluation rubric (aligned with Activity 3.2).....	23
2.6. Application usage by subject type	23
2.6.1. Marketing Fundamentals	23
2.6.2. Marketing Strategies	24
2.6.3. Services Marketing	25
2.6.4. Commercial Distribution	26
2.6.5. Commercial Research / Marketing Research	26
2.6.6. International Marketing	27
2.7. Micro-exercises (5–10 min)	28
2.7.1. Microexercise 1 — Rapid Generation of a Perceptual Map.....	28
2.7.2. Microexercise 2 — Reading Distances and Perceptual Similarity ...	28
2.7.3. Microexercise 3 — Interpretation of attribute vectors	29
2.7.4. Microexercise 4 — Identification of redundant attributes.....	29

2.7.5. Microexercise 5 — Analysis of the IDEAL point	30
2.7.6. Micro-exercise 6 — Detection of quick opportunities	30
2.8. Frequent Student Mistakes	31
2.8.1. Selection of redundant or poorly differentiated attributes	31
2.8.2. Incorrect or inconsistent use of the assessment scale	31
2.8.3. Inadequate number of marks or attributes	32
2.8.4. Omission or poor definition of the IDEAL point	32
2.8.5. Literal interpretation of the axes	32
2.8.6. Confusing spatial proximity with causality	33
2.8.7. Ignoring the limitations of analysis	33
2.9. Accessibility considerations and students with specific needs	34
3. Student's Guide	35
3.1. Quick Guide: How to Use the App?	35
3.1.1. Preparing the data	35
3.1.2. Entering the Marks and Attributes	35
3.1.3. Loading the survey data	36
3.1.4. Generating the Perceptual Map (PCA)	38
3.1.5. Exploring the Map with Vectors and Distances	38
3.1.6. Interpreting the map	40
3.1.7. Exporting the result	40
3.2 Learner's main activity	41
3.2.1 Category and brand selection	42
3.2.2 Defining Assessment Attributes	43
3.2.3 Data collection and uploading	43
3.2.4 Perceptual Map Generation (PCA)	43
3.2.5 Analysis with interactive tools	44
3.2.6 Interpretation of the perceptual map	44
3.2.7 Repositioning proposal	44
3.2.8 Student conclusions	45
3.3. Illustrative cases	46
3.3.1. Illustrative example of correct maps	46
3.3.2. Illustrative example of an incorrect map	46

3.4. Comprehensive case studies.....	47
3.4.1. Case Study 1 — Hotels.....	47
3.4.2. Case Study 2 — Fashion.....	54
3.5. Activities, reflection questions and challenges for the student.....	61
3.5.1. Practical activities (basic–intermediate level)	62
3.5.2. Reflection Questions (Critical Thinking)	63
3.5.3. Advanced challenges (intermediate-advanced level)	64
4. Technical Annex.....	65
4.1. PCA Technical Fundamentals and Advanced Map Reading	65
4.1.1. What is a PCA map?	65
4.1.2. How coordinates are interpreted.....	65
4.1.3. How Attribute Arrows Are Read.....	65
4.1.4. How direct maps are interpreted.....	66
4.1.5. Practical example.....	66
4.1.6. Didactic introduction to the operation of PCA	66
4.1.6.1. What does the PCA do in simple terms?.....	66
4.1.6.2. Why are these methods useful in marketing class?.....	68
4.2. Algorithms used	68
4.3. Application Overview	69
4.3.1. Application attributes.....	69
4.3.2. The "Export JSON" button	70
4.3.3. The Benefits of JSON File.....	70
4.4. System metadata	70
4.4.1. General information.....	70
4.4.2. Input metadata	71
4.4.3. Output Metadata	71
4.5. Functional architecture of the application.....	71
4.5.1. Interface Module.....	72
4.5.2. Analytical module.....	72
4.5.3. Display Module	72
4.5.4. Management module	72
4.6 Limitations and assumptions of the model	73

4.6.1. Mathematical assumptions (Hair et al., 2019)	73
4.6.2. Limitations	73
4.7. Extended Technical Appendix	73
4.7.1. Formal derivation of the PCA.....	73
4.7.2. Data validation.....	74
4.7.3. Normality (approximate)	74
4.7.4. Sufficient variance	75
4.7.5. Correlation	75
4.7.6. Missing values	75
4.7.7. Checking Outliers	75
Conclusions.....	76
Bibliography	77

Introduction

The POSITIONING application is part of the Perceptual Mapping Lab academic project, developed at the University of Alcalá. The objective of the tool is to allow students and researchers to generate perceptual maps using multivariate methods, mainly PCA, to represent brands, attributes and consumer preferences and suggest changes that improve marketing strategies.

This document describes the technical fundamentals, the statistical methods used and the examples necessary for a complete understanding of the method, the use of the application and the teaching in the classes dedicated to this topic.

The POSICIONAMIENTO application is part of the UAH Marketing Lab academic project, which is a cycle of interactive marketing applications developed at the University of Alcalá. The objective of the tool is to allow students, teachers and researchers to generate perceptual maps using multivariate methods, mainly the PCA, to represent brands, attributes and consumer preferences.

This document describes the technical fundamentals, the statistical methods used and the examples necessary for a complete understanding.

In addition, this application constitutes the first module of a set of seventeen teaching applications that belong to the UAH Marketing Lab under development, designed to form an integrated ecosystem of practical learning in marketing. Each application will address a specific analytical competency, including segmentation, preference analysis, positioning, competitive dynamics, consumer behavior, and more in order to deliver a consistent, applied, and cross-cutting learning experience.

POSITIONING inaugurates this cycle as the conceptual and methodological basis on which the following tools will be built.

1. Fundamentals of Positioning and Perceptual Maps

1.1. What is brand positioning?

Positioning (Figure 1.1) is a phenomenon or the way consumers perceive a brand in their minds compared to its competitors (Barnes & Kitchen, 1995; Santesmases Mestre, 2012; Tahir et al., 2024). It does not refer only to what a company communicates, but also to the mental image that is really formed in the consumer (Aaker, 1996; Kotler & Keller, 2016; He et al., 2020).

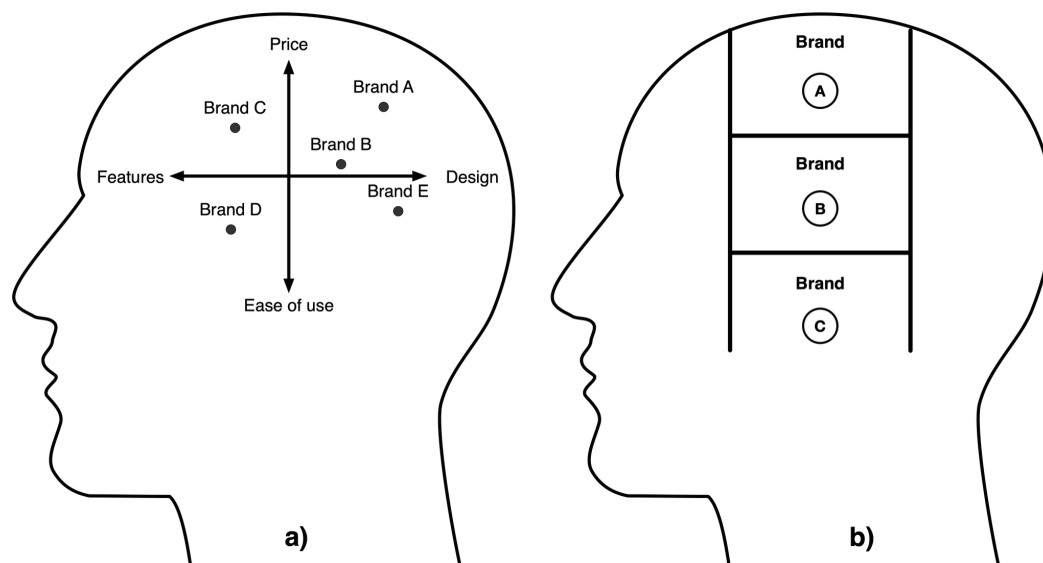


Figure 1.1.a). Perceptual map of brand positioning based on key attributes.
b). Perceptual map of brand positioning based on key attributes.

In strategic marketing, positioning involves answering three key questions from a brand's perspective (Kraujalienė & Kromalcas, 2022):

1. What is it? (brand identity)
2. What do you offer to the market or target consumers? (value proposition)
3. Why is it different from the other brands in our market? (competitive advantage)

The consumer's perception is built on the basis of their own experiences and expectations, as well as commercial communication and subjective comparisons with other brands (Santesmases Mestre, 2012; Keller, 2013).

The graphical representations in Figure 1.1. illustrate how positioning works in the consumer's mind: on the one hand, as a perceptual space in which brands occupy relative positions (a); and on the other, as a hierarchical "ladder" of remembrance that

influences preference and final choice (b). Both schemes show that positioning is not what the firm says, but what is actually "installed" in the consumer's mind and internal comparisons (Ries & Trout, 1981; 2001).

1.2. What is a perceptual map?

A perceptual map is , as a general rule, a two-dimensional visual representation (Gupta et al., 2021). It shows the analytics (Figure 1.1.a.):

- how consumers perceive brands,
- which attributes they consider most important to them,
- which brands are similar and which are different,
- where ideal preferences lie, and where opportunities for improvement are to be found

In practice, a perceptual map allows complex information to be synthesized in a simple visualization (Diwan, 2004).

1.3. What is it for? Real applications

Perceptual maps are used in companies, consultancies, and marketing departments (Blankson & Kalafatis; 2007; Malhotra, 2019) for:

- Identify market opportunities:
 - gaps in the market not filled by any brand,
 - poorly served segments,
 - untapped attributes.
- Compare competing brands
 - see similarities,
 - identify overlapping positions,
 - Analyze perceptual strengths and weaknesses.
- Guide marketing decisions

- repositioning,
 - new product development,
 - commercial communication,
 - differentiation strategy.
- Analyze key attributes for each category
 - Typical examples:
 - price-quality (low-cost vs. premium categories),
 - innovation–tradition,
 - taste–naturalness,
 - design-technology, etc.

1.4. Where are they applied? Real-world examples of industries

Food and beverage sector (juices, soft drinks, coffees)

Common attributes: naturalness, sugar, taste, price, brand.

Example: Don Simón vs. Granini vs. Doing.

Automotive

Attributes: safety, power, design, price, innovation.

Example: Tesla (innovation) vs. Toyota (reliability) vs. BMW (speed).

Smartphones

Attributes: camera, battery, design, ecosystem, price.

Example: iPhone vs. Samsung vs. Xiaomi.

Airlines

Attributes: punctuality, service, price, comfort.

Example: Ryanair (price) vs. Ryanair Iberia (service) vs. Emirates (luxury).

Retail & Fashion

Attributes: style, quality, sustainability, price.

Example: Zara vs. H&M vs. Patagonia.

1.5. Simplified Examples of Perceptual Maps

Axes:

- PC1 → Naturalness
- PC2 → Flavor Density

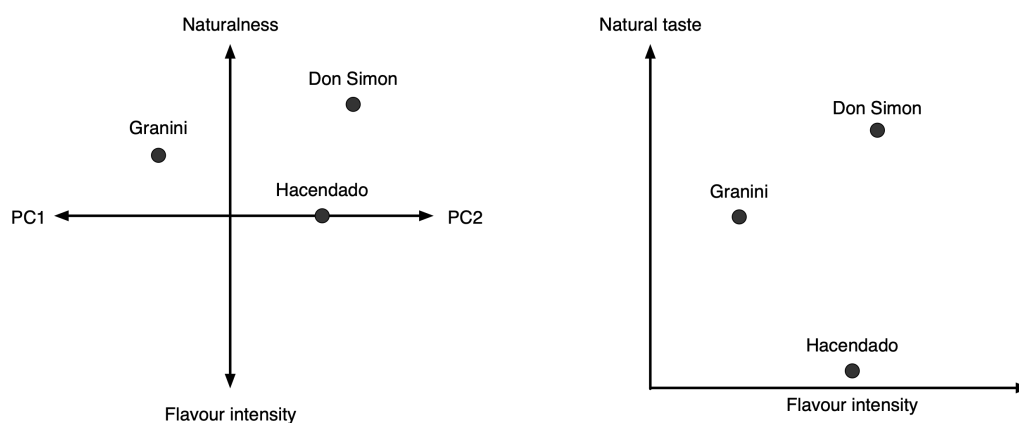


Figure 1.2. Perception map of packaged juices

Typical positioning:

- Granini → intense, less natural flavor.
- Don Simón → medium-high naturalness.
- Landowner → price-naturalness balance.

Example 2 — Smartphone Sector (Figure 1.3)

Axes:

- PC1 → Technical Performance
- PC2 → Price

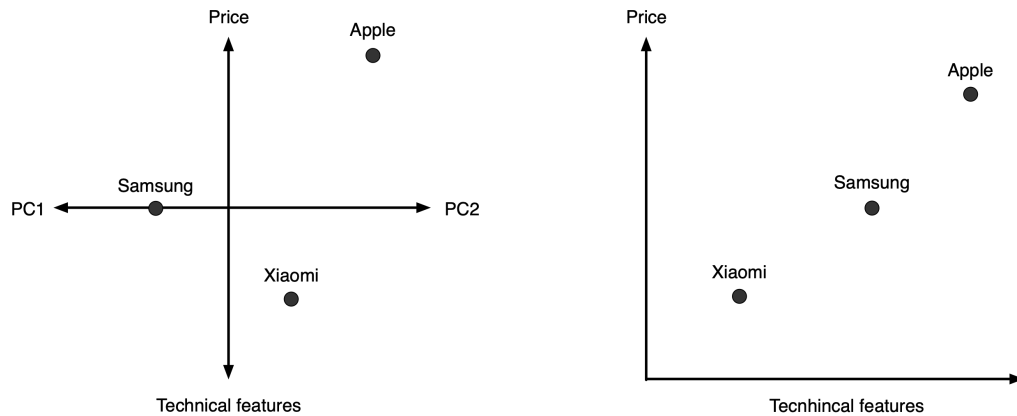


Figure 1.3. Perception map of smartphones

Typical positioning:

- Apple → high performance, high price.
- Xiaomi → good performance, low price.
- Samsung → in between.

Example 3. Automotive sector (Figure 1.4)

Axes:

- PC1 → Technical Performance
- PC2 → Innovation

Typical positioning:

- Tesla → very high innovation, high performance.
- BMW → high performance, medium innovation.

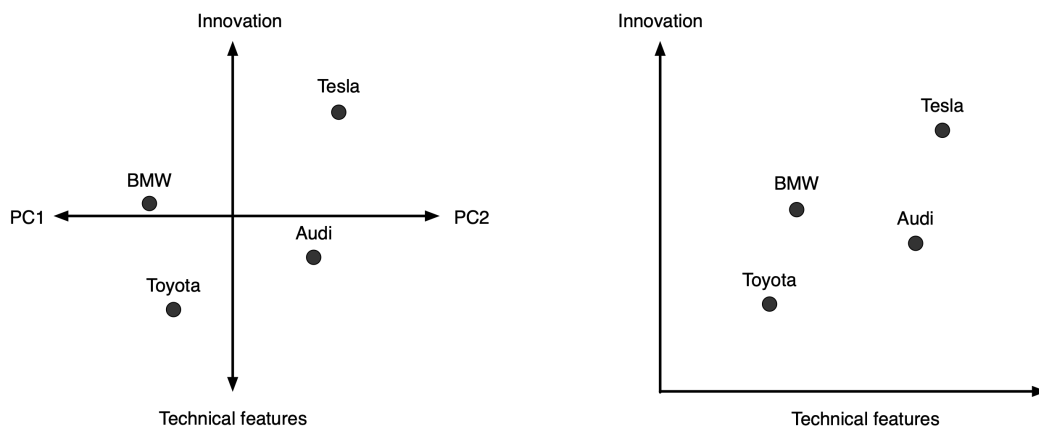


Figure 1.4. Perception map of automotive brands

- Audi → very high performance, medium innovation.
- Toyota → reliability, moderate innovation, balanced performance.

Example 4. Airlines sector (Figure 1.5)

Axes:

PC1 → Quality of Service

PC2 → Price

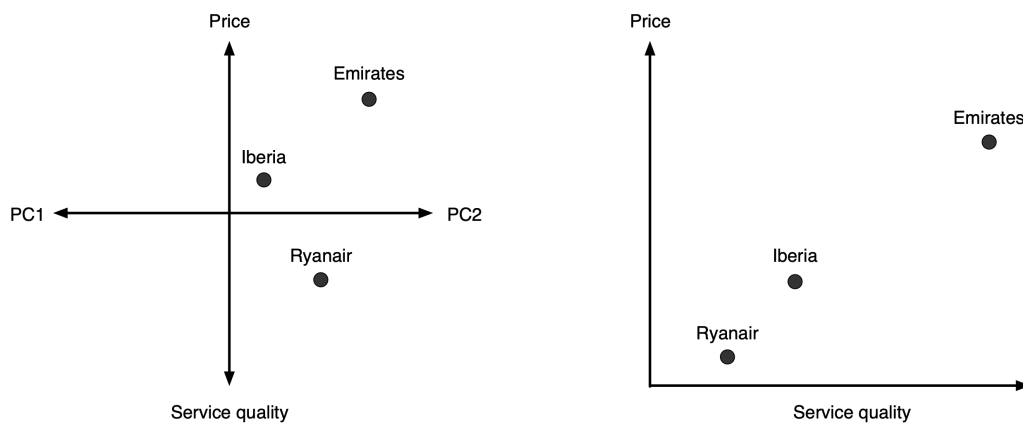


Figure 1.5. Perception map of airlines

Typical positioning:

- Emirates → high quality service, high price.

- Iberia → medium-high quality, medium price.
- Ryanair → low price, limited quality of service.

1.6. How to interpret PCA vs. direct maps

There are two main ways to represent marks and attributes in positioning analysis: PCA-based maps and direct maps. Although visually they may seem similar, their internal logic, reading, and interpretation are completely different (Hair et al., 2019; Torres Júnior et al., 2024). This section clearly explains how to understand each and in which situations they are used.

1.6.1. How the marks are read

- A mark located near an arrow has a high value in that attribute.
- Brands close to each other are perceived as similar.
- Distant marks represent different perceptions.

1.6.2. What is a direct map?

A direct map uses specific, user-defined attributes as axes.

For example:

- X-axis → naturalness
- Y-axis → Flavor density

This type of graph is deterministic, not mathematical.

1.6.3. Key differences between the two types of maps

Appearance	PCA Map	Direct map
Type of axes	Components (PC1, PC2)	Real attributes
Nature	Mathematics, reduced	Literal, user-defined
Correlations	They are observed at angles	They are not represented
Complexity	Further interpretation	Immediate reading
Recommended Use	Real statistical analysis	Didactic example or simple visualization

1.6.4. Which one to use in class?

Both are useful but with different objectives:

PCA for:

- real analysis of surveys,
- advanced interpretation,
- Introduction to multivariate methods.

Direct maps for:

- Explain the concept of positioning,
- quick exercises in class,
- activities without statistical calculations.

Before presenting the mathematical details, it is important to intuitively understand what the algorithms used by the POSITIONING application do (Figure 2.1) and why they are useful in marketing.

2. Action Guide for Teachers

This guide provides a clear structure for teachers to integrate the POSITIONING app into their class sessions effectively, combining theory, practice, and strategic discussion.

The current app link is (16/12/2025) –

<https://uah-marketing-lab-posicionamiento.netlify.app/>

2.1. Learning objectives

At the end of the activity, students will be able to:

- Understand the concept of perceptual positioning and its relevance in marketing.
- Perform a basic PCA analysis applied to brands and attributes.
- Interpret perceptual maps.
- Analyze attribute vectors and distances to the IDEAL point.
- Formulate strategic recommendations based on visual evidence and data.
- Develop critical thinking about which attributes are relevant, redundant or missing.
- Compare the real market perceptions with the axes derived from the PCA.

2.2. The recommended agenda

- Theoretical explanation: 20–30 min
- Survey preparation or completion (if applicable): 10 min
- Data Upload and PCA Generation: 15–20 min
- Group work and interpretation: 20–30 min
- Sharing and discussion: 15 min
- In total the activity lasts 75–90 minutes

Note: The session can be adapted to shorter formats (45–60 min) by eliminating the survey part and working with a mass of the data already prepared.

2.3. Work dynamics (for groups or individual work)

1. Each group selects 3–5 brands within a category.
2. Students define 6–8 relevant attributes in Spanish and English.
3. They enter the data into the application.
4. They generate the PCA map and analyze the dispersion of the marks.
5. They turn attribute vectors on and off to clarify patterns and analysis results.
6. They analyze the distances to the IDEAL point and the relationship between attributes.
7. They draw strategic conclusions (repositioning, segmentation, product or communication improvements).
8. Prepare a short presentation or visual summary.

2.4. Pedagogical recommendations

Promote debate by comparing the axes of the PCA with actual market perceptions.

Encourage critical questions:

- What attributes are missing?
- Which ones are redundant?
- What happens if we remove an extreme brand or IDEAL brand?

Reinforce visual interpretation:

- Length and direction of vectors.
- Clusters of the brands analyzed.
- Opportunities that are located in empty areas of the map.

Use the map to connect with the right marketing decisions:

- price, channels, communication, consumers, repositioning.

Suggest that students generate their own masses of data to increase the realism of the exercise. It is recommended to pilot test the PCA analysis with a small group of students to assess their understanding of the perceptual map, the ease of use of the app, and the cognitive load of the exercise. The results will allow the activity to be adjusted before its general implementation in the course.

2.5. Evaluation criteria for positioning work

The evaluation of the positioning work carried out with the POSITIONING application is based on a combination of analytical, interpretive and strategic criteria, aligned with the learning objectives of the subject and with the **main student activity** described in Section 3.2.

These criteria allow us to assess not only the final result (perceptual map), but also the coherence of the process followed by the student and the quality of the interpretation carried out.

Evaluation criteria

The works will be evaluated taking into account, among others, the following aspects:

Selection of the category and brands, considering their relevance and competitive coherence.

Definition of the attributes, assessing their conceptual clarity, their relevance to the category and the absence of redundancies.

Data quality and consistency, including consistent use of the assessment scale and the absence of errors in data loading.

Correct generation of the perceptual map, as well as the proper use of the application's display options.

Map interpretation: analysis of the relative position of marks, perceptual distances, attribute vectors, and proximity to the IDEAL point.

Strategic analysis capacity, reflected in the identification of opportunities, competitive weaknesses and possible lines of repositioning.

Clarity and coherence of the conclusions, including a critical reflection on the limitations of the analysis carried out.

Rating Scale

These criteria can be applied by means of a standard assessment scale (e.g. Excellent / Outstanding / Pass / Poor) or by numerical weighting, depending on the regulations and assessment practices of each subject.

For more detailed and transparent assessment, especially in applied learning contexts, these general criteria are complemented by an analytical rubric aligned with each phase of the Learner's Core Activity (see Section 2.5.2).

Methodological note for teachers

The criteria defined here are designed to be flexible and adaptable to different teaching formats (individual or group work, bachelor's or master's degrees). Teachers can adjust the relative weightings of each criterion according to the specific objectives of the subject.

2.5.1. Synthetic rating rubric (overview)

This rubric provides an overall assessment of the work. For a more detailed assessment aligned with each phase of the activity, please refer to the analytical rubric in Section 2.5.2.

Criteria	Excellent (10)	Notable (8)	Approved (6)	Insufficient
<i>Attribute selection</i>	Relevant, non-redundant attributes	Somewhat redundant, but minimal	Acceptable attributes	Irrelevant or duplicate attributes
<i>Axis identification</i>	Based on PCA loads correctly	Reasonably correct	Intuited, but not demonstrated	Incorrect
<i>Map Interpretation</i>	Clear, strategic, very coherent	Partially correct	Superficial	Erroneous
<i>Analysis (vectors, distances, IDEAL)</i>	Precise, with solid conclusions	Suitable	Basic	Incorrect or absent
<i>Strategic recommendations</i>	Feasible and well-founded	Suitable	Simple	Unsubstantiated

2.5.2. Detailed evaluation rubric (aligned with Activity 3.2)

The following detailed rubric complements the general criteria and facilitates a transparent assessment aligned with each phase of the student's main activity.

Evaluation criteria	Description	Excellent	Suitable	Basic	Insufficient	Weighting
Category and brand selection	Adequacy and consistency of the category and selected brands	Highly relevant category and clearly justified marks	Appropriate category with sufficient justification	Limited or unclear justification	Poorly defined category or markings	10%
Defining Attributes	Relevance, clarity, and non-redundancy of attributes	Highly relevant, clear and redundancy-free attributes	Suitable attributes with slight overlaps	Unclear or partially redundant attributes	Irrelevant or redundant attributes	15%
Data quality and consistency	Consistent use of scale and absence of errors	Consistent and well-structured data	Small inconsistencies without critical impact	Various inconsistencies in the data	Incorrect or inconsistent data	15%
Perceptual map generation	Correct execution and visualization of the map	Correctly generated and well-configured map	Correct map with minimal adjustments	Map generated with minor errors	Incorrect or uninterpretable map	10%
Using Interactive Tools	Exploring Vectors, Distances, and Options	Systematic and relevant use of tools	Proper but limited use	Superficial use of tools	Not used properly	10%
Map Interpretation	Analysis and understanding of positioning	Clear, in-depth and well-argued interpretation	Correct interpretation with some nuances	Descriptive and limited interpretation	Misinterpretation or confusion	20%
Repositioning proposal	Coherence and strategic justification	Coherent, realistic and well-founded proposal	Adequate but poorly developed proposal	Weak or unjustified proposal	Incoherent or non-existent proposal	15%

2.6. Application usage by subject type

The POSITIONING — Perceptual Mapping Lab application is a flexible tool that can be integrated into different subjects in the marketing area, adapting the level of complexity, the type of data and the expected results to the student's profile and the teaching objectives of each course. Specific guidelines for use are described below according to the type of subject.

2.6.1. Marketing Fundamentals

Teaching objective

Introduce the concept of brand positioning and familiarize the student with the basic reading of perceptual maps.

Recommended level

Degree — first years or elective course during the 3rd or 4th year.

Methodological approach

- Guided use of the application.
- Simple or simulated data.
- Emphasis on visual interpretation, not statistical method.

Recommendations for use

- Work with 3–4 marks and 4–5 clear attributes.
- Use examples close to the student (such as juices, smartphones, and airlines).
- Enter the IDEAL point as an intuitive reference of the preference.
- Avoid technical explanations of the PCA; focus on distances and relative positions.

Expected results

- Basic understanding of positioning.
- Ability to explain why brands are perceived as similar or different.

*2.6.2. Marketing Strategies***Teaching objective**

Analyze the competitive structure of the market and formulate strategic decisions based on the perceptual map.

Recommended level

Advanced Degree, 3rd or 4th Year / Master's Degree.

Methodological approach

- Group work.
- Strategic interpretation of the map.
- Discussion of possible repositioning.

Recommendations for use

- Use 5–6 marks and 6–8 attributes.

- Analyze competitive clusters and empty areas on the map.
- Compare the actual position of the brand with the IDEAL point.
- Request justified repositioning proposals.

Expected results

- Identification of strategic opportunities.
- Ability to translate a visualization into marketing decisions.

2.6.3. Services Marketing

Teaching objective

Understand the multidimensional nature of service perception and its impact on consumer choice.

Recommended level

Bachelor's Degree, 2nd, 3rd, 4th year / Master's degree.

Methodological approach

- Analysis of intangible attributes.
- Discussion of perceived quality and experience.

Recommendations for use

- Working with sectors such as hotels, airlines, education or banking.
- Prioritize attributes such as service, trust, experience, and reputation.
- Compare expectations (IDEAL) with actual perceptions.
- Analyze the difficulty of differentiating oneself in service markets.

Expected results

- Understanding perceptual complexity in services.
- Improved interpretation of intangible attributes.

2.6.4. Commercial Distribution

Teaching objective

Analyze the positioning of commercial formats and distribution brands.

Recommended level

Grade, 3rd or 4th year.

Methodological approach

- Comparison of formats and value propositions.
- Point of sale perception analysis.

Recommendations for use

- Use well-known retail brands or distributors.
- Recommended attributes: price, assortment, convenience, perceived quality, in-store experience.
- Interpret competitive overlaps between formats.

Expected results

- Ability to analyze differentiation in retail.
- Understanding of private label positioning.

2.6.5. Commercial Research / Marketing Research

Teaching objective

Apply real-world multivariate techniques to survey data and understand their analytical implications.

Recommended level

Advanced Degree, 3rd or 4th Year / Master's Degree.

Methodological approach

- Use of real or student-collected data.
- Link between the questionnaire design and the map results.

Recommendations for use

- Design short surveys (6–8 attributes, consistent scales).

- Analyze how attribute selection affects PCA.
- Discuss the limitations of the method and statistical assumptions.
- Connect the map to data quality.

Expected results

- Applied understanding of the PCA.
- Critical ability to evaluate analytical results.

2.6.6. International Marketing

Teaching objective

Compare brand perceptions across markets or cultural segments.

Recommended level

Bachelor's degree, 2nd, 3rd, 4th / Master's degree.

Methodological approach

- Comparative analysis.
- Intercultural discussion.

Recommendations for use

- Use datasets differentiated by country or segment.
- Compare perceptual maps between contexts.
- Analyze changes in the IDEAL point according to the market.
- Discuss the implications for standardization or adaptation of the strategy.

Expected results

- Understanding positioning in international contexts.
- Ability to interpret perceptual differences between markets.

The versatility of the POSITIONING application allows it to be integrated into different subjects and training levels, adjusting the complexity of the exercise and the expected results. This flexibility facilitates its transversal adoption in the marketing area and reinforces its usefulness as a tool for teaching innovation.

2.7. Micro-exercises (5–10 min)

Microexercises are short, highly focused activities designed to be done over a 5-10 minute interval. Its objective is to reinforce key concepts of perceptual positioning, familiarize the student with the POSITIONING app and promote active learning without the need to develop a complete case.

These micro-exercises are especially useful in short sessions, flipped classroom dynamics, moments of transition within the class or as reinforcement activities prior to a main practice.

2.7.1. Microexercise 1 — Rapid Generation of a Perceptual Map

Objective

Familiarize the student with the basic flow of the application and the generation of the map.

Instructions

- Enter 3 marks and 4 attributes.
- Upload simulated or teacher-provided data.
- Generate the perceptual map (PCA).

Key question

Which brands are closest to each other and why?

Estimated time

5 minutes.

2.7.2. Microexercise 2 — Reading Distances and Perceptual Similarity

Objective

Understand the meaning of the distances between marks on the map.

Instructions

- Use an already generated map.
- Identify the two closest brands.
- Identify the brand furthest from the rest.

Key question

What does proximity or remoteness between brands indicate in terms of consumer perception?

Estimated time

5 minutes.

*2.7.3. Microexercise 3 — Interpretation of attribute vectors***Objective**

Learn to read the direction and meaning of attribute vectors.

Instructions

- Activate only 2 or 3 attribute vectors.
- Observe where they point and what marks align with them.

Key question

Which attribute seems to most clearly differentiate the brands analyzed?

Estimated time

5–7 minutes.

*2.7.4. Microexercise 4 — Identification of redundant attributes***Objective**

Detect highly correlated attributes and reflect on their impact on analysis.

Instructions

- Observe two vectors that are very close to each other.
- Analyze their orientation and proximity.

Key question

Would it be reasonable to eliminate one of these attributes? What effect would it have on the map?

Estimated time

5–7 minutes.

*2.7.5. Microexercise 5 — Analysis of the IDEAL point***Objective**

Interpret the relationship between the brands and the IDEAL point.

Instructions

- Activate the display of distances to the IDEAL point.
- Identify the closest and farthest mark.

Key question

Which brand best fits the consumer's ideal preference and why?

Estimated time

5 minutes.

*2.7.6. Micro-exercise 6 — Detection of quick opportunities***Objective**

Introduce strategic reasoning from the perceptual map.

Instructions

- Observe areas of the map with a low concentration of marks.
- Relate those areas to combinations of attributes.

Key question

Could there be a market opportunity in that area of the map?

Estimated time

7–10 minutes.

These micro-exercises allow perceptual analysis to be introduced progressively, reducing the student's cognitive load and facilitating a natural transition to more

complex activities. Its systematic use favors active participation, visual understanding of positioning, and the gradual development of analytical thinking in marketing.

2.8. Frequent Student Mistakes

In general, during the use of the POSITIONING application, students tend to make a series of typical and recurring errors that are not always related to the technical handling of the tool, but to the conceptual understanding of positioning and perceptual maps. Identifying these errors and learning how to visually spot them on the map is an essential part of the learning process.

The most common errors are described below, along with guidance for their detection and interpretation.

2.8.1. Selection of redundant or poorly differentiated attributes

Description of the error

The learner defines attributes that are very similar to each other (e.g., *quality* and *good quality*, or *innovation* and *technology*), which introduces redundancy into the analysis.

How it's detected on the map

- Vectors of almost overlapping attributes.
- Very similar addresses between various attributes.

Pedagogical consequence

The map loses interpretative clarity and does not provide additional relevant information.

2.8.2. Incorrect or inconsistent use of the assessment scale

Description of the error

The student uses the assessment scale inconsistently, for example, by interpreting the values of the scale (1–5) differently between attributes or by not clearly defining what each end represents.

How it's detected on the map

- Extreme positions that are not very coherent between brands.
- Brand distributions that are difficult to interpret visually.

Pedagogical consequence

The results reflect problems of measurement and interpretation of the scale, rather than real differences in the perception of the brands.

*2.8.3. Inadequate number of marks or attributes***Description of the error**

Students enter too many marks or attributes, or not enough of them, to generate an interpretable map.

How it's detected on the map

- Excessively saturated or visually confusing map.
- Map too simple, without a clear differentiation between the brands.

Pedagogical consequence

It is difficult to read the map and draw strategic conclusions.

*2.8.4. Omission or poor definition of the IDEAL point***Description of the error**

Students do not include the IDEAL point or define it without prior reflection on consumer preference.

How it's detected on the map

- Absence of a clear reference of preference.
- Difficulty assessing the proximity of brands to the optimal option.

Pedagogical consequence

The analysis loses its strategic dimension and is limited to a descriptive comparison between brands.

*2.8.5. Literal interpretation of the axes***Description of the error**

The student tries to assign a direct and fixed meaning to the axes of the map without considering that they represent combinations of attributes.

How it's detected on the map

- Simplistic explanations such as "X-axis = price" without justification.
- Ignoring the joint contribution of attributes.

Pedagogical consequence

The interpretative richness of the map is reduced and the analysis is oversimplified.

2.8.6. Confusing spatial proximity with causality

Description of the error

It is assumed that the closeness between brands implies a causal relationship or a deliberate strategy.

How it's detected on the map

Unsubstantiated claims about brands' strategic decisions.

Pedagogical consequence

Perceptual patterns are confused with unproven causal explanations.

2.8.7. Ignoring the limitations of analysis

Description of the error

The student interprets the map as an accurate and definitive representation of the market, without considering the limitations of the data or the method.

How it's detected on the map

- Excessively categorical conclusions.
- Lack of critical reflection on the origin of the data.

Pedagogical consequence

The opportunity to develop critical and analytical thinking is lost.

The analysis of frequent errors helps students understand that a perceptual map is not only a visual result but also a reflection of previous methodological decisions. From a

teaching perspective, these errors constitute learning opportunities that facilitate critical discussion, progressive improvement of analysis, and a deeper understanding of brand positioning.

2.9. Accessibility considerations and students with specific needs

The UAH Marketing Lab – Cycle of interactive marketing applications project is developed following the principles of universal accessibility and design for all. The aim is for students with functional diversity, specific learning difficulties or curricular adaptation needs to be able to participate fully in practical activities.

Integrated accessibility measures:

- digital interface compatible with screen readers;
- clear and redundant iconography (text + symbol);
- accessible language and descriptions parallel to the graphics;
- absence of critical information coded solely by color;
- minimal animations and visual movements;
- Structure of the manual is based on clear and progressive steps.

For students who require additional adaptations, this material can be integrated into UAH procedures related to:

- extension of time,
- personalised support,
- alternative formats (accessible PDF, simplified text),
- accompaniment of teachers in the interpretation of data.

The aim is to ensure that all students, regardless of their profile, can benefit from this resource and demonstrate their competences in perceptual analysis and decision-making.

3. Student's Guide

(Step by step for inexperienced users)

3.1. Quick Guide: How to Use the App?

3.1.1. Preparing the data

Before you open the app, gather:

- Brands to compare (3 – 6): A brand should be the IDEAL brand that has been used as the best.
- Attributes that consumers will evaluate (6 – 8).
- Survey with scores (Likert scale or semantic differential scale).

➡ Examples of attributes: Price, Quality, Design, Naturalness, Taste, Innovation.

This step is key to ensuring that subsequent work in the application is smooth and that the resulting perceptual map is interpretable.

3.1.2. Entering the Marks and Attributes

On the home screen (Figure 3.1):

- Write down brand names.
- Enter the list of attributes.
- You are supposed to enter the names of the attributes in two indications, in English and Spanish, simultaneously (e.g., ES: Price → EN: Price; ES: Sabor → EN: Flavour; EN: Naturalness → EN: Naturalness). Otherwise, the application will not add the attribute to the list used for analysis.
- Check that the spelling and order are correct (they will appear on the map).

➡ Tip: Use clear, non-redundant attributes.

It is possible to assign another brand, among those included, as a reference brand. The IDEAL mark may be unnecessary in this case.

Quick checklist before moving forward:

- All brands belong to the same category.

- Attributes do not overlap conceptually.
- Each attribute has its denomination in ES and EN.
- The spelling and order are correct (they will appear on the map).

Figure 3.1. Designer screen for entering brand names and product attributes

On this screen the student should be able to:

- introduce between 3 and 6 comparable brands within the same category;
- define between 6 and 8 relevant and non-redundant attributes;
- correctly enter each attribute in Spanish and English, as required by the application;
- decide whether it is necessary to include an IDEAL mark or an alternative reference mark.

Common error on this screen:

Defining attributes that are very similar to each other, which generates redundant vectors and makes it difficult to interpret the map later.

3.1.3. Loading the survey data

You can (Figure 3.2):

- Manually enter scores, or

- Import an exported JSON file from surveys from previous sessions in this app or from Google/Typeform (if available).
- Make sure that:
- Each brand has scores for all attributes.
- There are no empty values.

POSICIONAMIENTO
Perceptual Mapping Lab

Language: English Export JSON Import JSON

Performance (1-5)

Don Simon

Attribute	Score
Taste	5
Convenient packaging	2
Naturalness (%)	4
No pulp/residue	1
Color	3
Price	5
Smell	3
Overall, how much would you prefer this brand? (1-5)	4

Haciendo

Attribute	Score
Taste	2
Convenient packaging	4
Naturalness (%)	2
No pulp/residue	4
Color	2
Price	4

QR

<https://poetic-arithmetic-a9c8ad.netlify.app/#/survey>

Figure 3.2. Survey screen

On this screen, the student should be able to:

- Verify that all brands have scores for all attributes;
- verify the consistent use of the evaluation scale;
- detect and correct empty or inconsistent values.

Micro-task (2 minutes):

Select a flag and manually verify that it has values in all attributes before continuing.

3.1.4. Generating the Perceptual Map (PCA)

Click the "Send Reply" button at the bottom of the screen.

The application then:

- automatically calculates PC1 and PC2,
- draw the map,
- shows attribute arrows,
- Position brands based on perceptions.

➡ This map shows how consumers view the market.

Expected result:

A two-dimensional perceptual map that represents the perceptual structure of the market according to the inputted evaluations.

Pedagogical note:

The student does not control the statistical calculation, but is responsible for correctly interpreting the result generated.

3.1.5. Exploring the Map with Vectors and Distances

The application allows the perceptual map (Figure 3.3) to be analyzed interactively by:

- Show or hide attribute vectors

On the right side of the map there is a list of attributes with boxes:

- When you select a checkbox → the attribute vector is displayed on the map.
- When you deactivate it → the vector disappears to avoid visual saturation.

➡ This allows you to focus only on the attributes that are relevant to the analysis.

- View distances between marks and the IDEAL mark or other assigned reference mark

When hovering over any mark:

- their distances to the IDEAL mark are shown,
- and distances to the selected attributes.

➡ The smaller the distance, the greater the affinity between the brand and the attribute (or IDEAL point).

- Analyze the direction of vectors

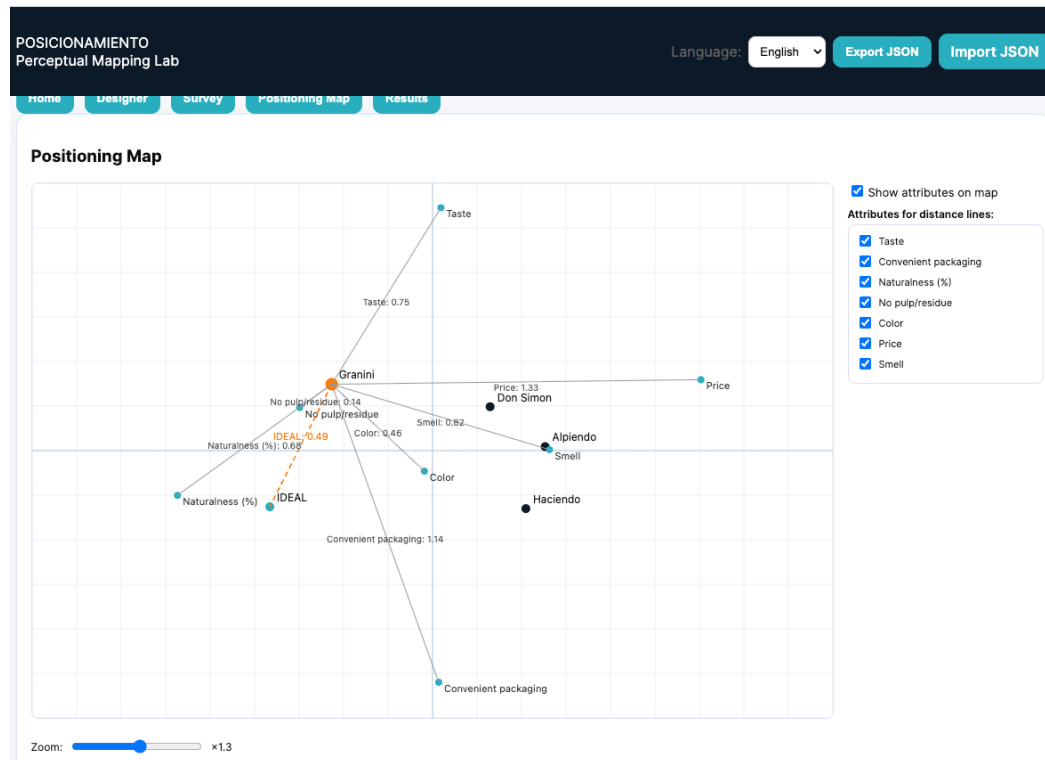


Figure 3.3. Positioning map with vectors visualizing distances between the selected and IDEAL brands, as well as distances from the chosen brands to the

On this screen, the student should be able to:

- activate and deactivate vectors to reduce visual saturation;
- analyze distances between marks and with respect to the IDEAL point;
- identify correlated or opposite attributes.

The vectors show:

- where each attribute increases,
- which brands are most aligned with that attribute,
- and which attributes are correlated (proximal vectors) or opposite (vectors in opposite directions).
- Use map zoom

The Zoom control (up to $\times 2.0$) allows:

- zoom in or out of the map,
- study groups of brands in greater detail,
- improve vector vision when they are in close proximity.

➡ Very useful for class presentations and accuracy analysis.

- Basic interpretation of this step
 - You mark near a vector → high perceived value in that attribute.
 - Marks away from the vector → low perceived value.
 - Brands close to IDEAL → greater adaptation to the preference.
 - Marks close to each other → greater perceptual similarity.

3.1.6. Interpreting the map

Be guided by:

- The position of the marks (close = similar).
- The direction of the attributes (arrows).
- The distance from the preferred vector (if applicable).

➡ The map is used to detect opportunities, repositioning and clusters.

This step connects directly to the student's Core Activity (Section 3.2), where these interpretations will need to be formalized and justified.

3.1.7. Exporting the result

You can export (Figure 3.4):

- Map in PDF (high quality).
- Full JSON analysis (for R/Python).
- Screenshots of results.

➡ Useful for reports, presentations, and academic papers.

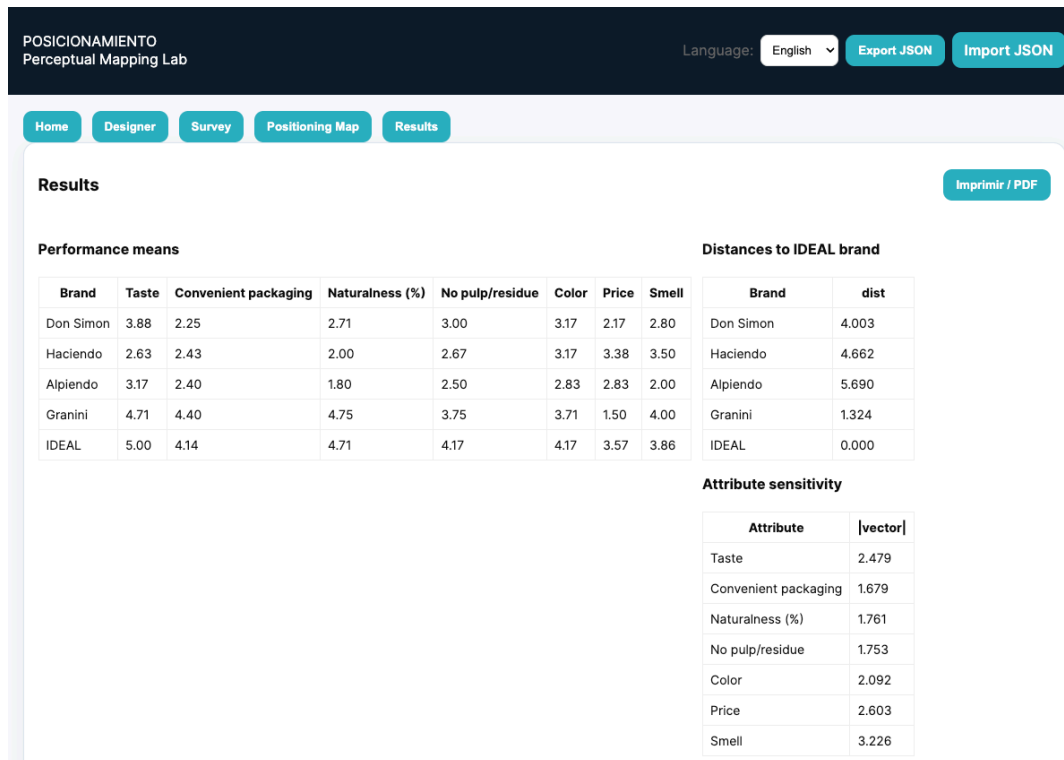


Figure 3.4. Results screen exhibiting the numerical outcomes of the positioning analysis

Visual summary (quick checklist)

Step	Action	Result
1	Prepare data	List of Brands and Attributes
2	Enter into the app	Basic configuration ready
3	Upload Scores	Complete evaluation matrix
4	Run PCA	Perceptual Map
5	Analyze the map	Strategic Insight
6	Export	PDF/JSON/image

3.2 Learner's main activity

Applied perceptual positioning work

This activity constitutes the **practical assessable core** of the module and aims to apply the concepts of positioning and perceptual maps in an integrated way through the use of the POSITIONING application.

The activity can be carried out **individually or in groups**, as planned by the teacher, and culminates in the preparation of a **perceptual analysis report and a strategic proposal**.

Learning objectives of the activity

Upon completion of this activity, the student will be able to:

- Appropriately select relevant brands and attributes in a market category;
- construct and interpret a PCA-based perceptual map;
- analyze the relative position of the brands and the IDEAL point;
- formulate conclusions and proposals for well-founded repositioning.

Description of the activity and deliverable

Expected deliverable

A short report (individual or group) that includes:

- the generated perceptual map;
- map interpretation;
- the main strategic conclusions;
- a reasoned proposal for repositioning.

The format of the report (document, presentation or report integrated into the teaching platform) will be defined by the teacher.

3.2.1 Category and brand selection

Student Task

Select a product or service category of interest (e.g., juices, smartphones, airlines, coffees, detergents) and identify **4-5 competing brands**.

Guiding evaluation criteria

- Adequacy and coherence of the selected category.
- Reasoned justification for the choice of trademarks.

3.2.2 Defining Assessment Attributes

Student Task

Identify between **6 and 8 attributes** relevant to the purchase decision in the selected category.

For each attribute, the student must:

- briefly explain its meaning in the context of the category;
- check that there is no redundancy with other attributes;
- Enter the attribute name correctly in Spanish and English.

Guiding evaluation criteria

- Relevance and clarity of attributes.
- Absence of redundancies.
- Conceptual coherence of the set of attributes.

3.2.3 Data collection and uploading

Student Task

Collect real or simulated brand evaluation data using the standard application scale (1–5) and load it correctly into the tool.

Guiding evaluation criteria

- Internal data consistency.
- Consistent use of the evaluation scale.
- Absence of missing or inconsistent values.

3.2.4 Perceptual Map Generation (PCA)

Student Task

Use the application to generate the perceptual map and visualize the relative position of the marks and attributes.

Guiding evaluation criteria

- Correct map generation.

- Proper use of display options.

3.2.5 Analysis with interactive tools

Student Task

Analyze the map using the interactive features of the app:

- attribute vectors;
- distances between marks;
- distance to the IDEAL point;
- Attribute activation and deactivation.

Guiding evaluation criteria

- Ability to explore the map systematically.
- Relevant use of interactive tools.

3.2.6 Interpretation of the perceptual map

Student Task

Interpret the map by answering, among others, the following questions:

- What perceptual dimensions emerge from the analysis?
- Which brands are perceived as most similar?
- What attributes explain the main differences?
- Which brand is closest to the IDEAL point?

Guiding evaluation criteria

- Clarity and coherence in interpretation.
- Proper use of visual map information.
- Avoid simplistic interpretations or unjustified causes.

3.2.7 Repositioning proposal

Student Task

Select a brand and propose a repositioning strategy based on the analysis carried out.

Guiding evaluation criteria

- Coherence between the map and the strategic proposal.
- Clear justification of the attributes to be reinforced or communicated.
- Realism of the proposal.

3.2.8 Student conclusions

Student Task

Draw final conclusions that summarize:

- the main findings of the analysis;
- the strategic implications;
- the limitations of the exercise and the method.

Guiding evaluation criteria

- Ability to synthesize.
- Critical reflection on the analysis carried out.

This activity integrates theory, data analysis and strategic interpretation, which allows the student to develop analytical and decision-making skills in marketing. It also provides a solid basis for the assessment of applied learning and critical discussion in the classroom.

3.3. Illustrative cases



Figure 3.5. Good example map

3.3.1. Illustrative example of correct maps

Good (correct) example (Figure 3.5)

- Well-defined attributes (4–5).
- Sufficient variance between brands.
- Clear differences between attributes.

3.3.2. Illustrative example of an incorrect map

Bad example (incorrect) (Figure 3.6)

- Redundant attributes.
- Identical scores between brands.
- Lack of correlation.



Figure 3.6. Map of bad example

3.4. Comprehensive case studies

3.4.1. Case Study 1 — Hotels

Case objective

Apply perceptual positioning analysis to the hospitality industry to understand how consumers perceive hotels across multiple attributes and how these perceptions can inform strategic decisions.

Context of the case

The hotel sector is particularly suitable for perceptual positioning analysis, as choosing a hotel involves the simultaneous evaluation of tangible and intangible attributes, such as price, quality of service, or overall experience.

In this case, several hotel brands that compete within the same market segment are analyzed.

Exercise Settings

Brands analyzed

Example of hotel brands:

- UrbanStay
- Royal Garden
- budgetInn
- VistaMar
- BusinessHub
- IDEAL

(Brands can be adapted according to the teaching context or the market analyzed.)

Assessment attributes

Example:

- Price
- Quality of service
- Room comfort
- Location
- Global experience

➡ **Didactic note:** the attributes must be clear, non-redundant and relevant to the hotel client's decision.

Dataset used (attribute array × marks)

Attribute	UrbanStay	Royal Garden	budgetInn	VistaMar	BusinessHub	IDEAL
Price	3	5	1	4	4	4
Location	5	4	3	3	5	5
Comfort	4	5	2	5	4	5
Service	4	5	2	4	5	5
Design	4	5	1	5	3	5
Reputation	4	5	2	5	4	5
Preference	4	4	2	4	5	5

Table 3.1. Hotel perception data

(The figures are simulated, but consistent for PCA analysis.)

Perceptual Map

The perceptual map generated by PCA shows a clear two-dimensional structure:

- **Dimension 1** is mainly associated with the **experience and quality of the service**.
- **Dimension 2** reflects an opposition between **price** and **comfort/location**.

The map shows two main groupings of hotels, as well as a clear differentiation between the brands.

On the actual map of the software the markings (Figure 3.7) are arranged as follows:

- **budgetInn.**
 - Located at the bottom right.
 - Despite being cheap (actual data), PCA puts it on the right because its scores are consistent with a low-quality pattern, which forms a cluster in PC1 with a positive or negative charge depending on the structure.

- Its low position in PC2 reflects minor service, minor design, and minor reputation.



Figure 3.7. PCA Map of the Hotels Case

- **Royal Garden**
 - Located in the upper central quadrant.
 - It doesn't appear as separate as expected because Price, Service, and Reputation don't generate enough variance against other attributes.
 - It represents a high-quality hotel, but its proximity to UrbanStay and BusinessHub indicates direct competition in overall perception, though without excelling in differentiating attributes.
- **UrbanStay**
 - In the lower right quadrant.
 - It's close to BusinessHub.
 - The PCA reveals that UrbanStay is perceived as modern, well-located and balanced, but not as premium as VistaMar.

- The proximity to the IDEAL indicates a strong competitiveness in global value.
- **BusinessHub**
 - Very close to UrbanStay, slightly further down.
 - Aligns with Service and partially with Reputation.
 - According to the actual position on the map, the hotel is the closest to the IDEAL, which confirms the preference (5/5).
 - PCA identifies it as the most efficient and balanced option on the market.
- **VistaMar**
 - Located at the top right, aligned with the Comfort vector and partially with the Price vector.
 - It represents a hotel with a solid design and high quality.
 - PCA clearly separates it from the UrbanStay/BusinessHub cluster, indicating a more aspirational positioning.
- **IDEAL**
 - At the bottom left of the central cluster.
 - On the actual map it tends to shift slightly to the left due to the distribution of the data in PCA.
 - Its proximity to UrbanStay and BusinessHub confirms that these two hotels best meet the pattern of preference.

Vector Interpretation

The vectors in the graphic show:

- Price → above (high influence on PC2)
- Location → bottom-right
- Left-top → comfort

- Right-Moderate → Service
- Bottom-left → design
- Reputation → center-right

Key takeaways:

- VistaMar aligns with Comfort and Price.
- BusinessHub and UrbanStay align with Service and Reputation.
- BudgetInn is far from all the positive attributes.
- Royal Garden appears moderately close to Reputation and Design, but without clear leadership.

Analysis of the IDEAL point

The IDEAL point is located:

- near UrbanStay
- very close to BusinessHub
- Nearest to Royal Garden
- away from BudgetInn
- moderately distant from VistaMar

Therefore:

- The best positioned with respect to the IDEAL is BusinessHub, closely followed by UrbanStay. VistaMar and Royal Garden are at the same distance. BudgetInn is the worst aligned with ideal preferences.

Strategic opportunities identified

1. "High quality without extreme price" segment (clear gap)

Between UrbanStay/BusinessHub and VistaMar there is a space where:

- high quality,
- average price,
- Good location,
- Strong service.

No hotel occupies it completely.

2. Extreme competitive pressure in the core cluster

Royal Garden, BusinessHub, and UrbanStay are all competing closely. They need to be differentiated by a specific attribute.

3. BudgetInn as an urgent repositioning case

It is isolated, far from favorable vectors.

There are opportunities if you improve:

- Reputation
- Service
- Basic comfort

— all with moderate investments.

Repositioning proposal (example: Royal Garden)

Royal Garden appears:

- Stuck in the middle zone
- no leadership in any attribute
- no clear advantage over VistaMar or BusinessHub

Suggested repositioning:

- Perceived Value Reinforcement
 - Premium Packages
 - Personalized experience
- Communicational repositioning
 - Emphasis on reputation, history, or exclusivity
- Price Review
 - small adjustment to avoid cannibalization with VistaMar

Conclusions of the case

- The actual map shows a bimodal market:
 - value cluster (UrbanStay, BusinessHub)
 - aspirational cluster (VistaMar and Royal Garden)
- BusinessHub is the best-positioned brand against IDEAL.
- BudgetInn requires repositioning or retargeting.
- PCA analysis provides a clear and actionable reading of the competitive structure.
- The case demonstrates how to interpret a real perceptual map generated from data and how to translate it into strategic decisions in the hospitality sector.

3.4.2. Case Study 2 — Fashion

Case objective

To illustrate, through an applied example, how a perceptual map allows the competitive positioning of fashion brands to be analysed based on attributes related to style, price, quality and brand experience, and how these perceptions can be translated into strategic implications for brand management.

Context of the case

The fashion sector is characterised by a high level of symbolic differentiation, a strong influence of brand image and a high consumer sensitivity to both functional and emotional attributes. In this context, perceptual positioning analysis is especially useful for visualizing similarities and differences between brands and for identifying competitive spaces based on how they are perceived by consumers.

Brands included

The case includes five brands inspired by real market archetypes:

- Luxoria — premium, exclusive design, high price, aspirational approach.
- UrbanFit — urban, youthful, modern, mid-priced.
- EcoWear — sustainable, ethical, organic materials, simple design.
- FastTrend — fast fashion, very accessible, high turnover, seasonal style.
- ClassicLine — classic style, high durability, medium-high price.

Assessed attributes

Six key attributes were selected:

- Perceived quality
- Design / Style
- Durability
- Price
- Sustainability
- Reputation / Brand Image
- General Preference (1–5)

The scale used is from 1 to 5.

Dataset used (attribute array × marks)

Attribute	Luxoria	UrbanFit	EcoWear	FastTrend	ClassicLine	IDEAL
Quality	5	3	4	2	5	5
Design / Style	5	5	3	4	3	5
Durability	4	3	4	2	5	5
Price	5	3	3	1	4	3
Sustainability	3	2	5	1	3	5
Reputation	5	3	4	2	4	5
Preference (1-5)	4	4	5	3	4	5

Table 3.2. Perception data of fashion brands**Perceptual Map (PCA)**

(Strictly based on the actual map generated by the software)

The PCA of software reveals a multidimensional structure in which the axes do not represent traditional concepts such as "quality" or "price," but rather latent combinations of several simultaneous attributes (Figure 3.8).

- **FastTrend**
 - Located in the upper right quadrant.
 - This indicates alignment with the Price vector and a lower relationship with quality or sustainability attributes.
 - The PCA stresses that the brand, although accessible, is perceived more by price and moderate style than by qualitative attributes.
- **UrbanFit**
 - Located in the lower right area, near the Reputation and Design vectors.
 - It represents a youthful, modern and competitive style in the image, but with less emphasis on sustainability or durability.
 - Its distance from the IDEAL indicates a positive, although not optimal, perception.

- **ClassicLine**
 - Located in the top-central part, very close to EcoWear.
 - Its position reflects an emphasis on durability, reputation and a stable perception of quality.
 - Despite its more conservative design, it is positioned as a solid brand, with good overall quality.



Figure 3.8. PCA Fashion Brands Case Map

EcoWear

- In the upper central right area, clearly aligned with the Sustainability vector.
- Its proximity to ClassicLine, but with a stronger focus on sustainability, is evidence of a differentiated position as an ethical brand.
- It is the closest brand to the IDEAL along with ClassicLine.
- **Luxoria**
 - Located in the lower left quadrant.

- Despite its high nominal quality in the table, the actual PCA suggests that Luxoria is perceived to be less aligned with the attributes that explain most of the variance (sustainability, price, style).
- Its distance from the IDEAL reflects an aspirational positioning but not preferred by the current market pattern.
- **IDEAL**
 - It is located in the center-left area of the map.
 - Its proximity to ClassicLine and EcoWear indicates that consumers are looking for a combination of:
 - Good quality
 - Sustainability
 - Durability
 - Positive reputation
 - Moderate price

Vector Interpretation

The map shows the following vectors:

- Price → top-right

FastTrend and partly EcoWear are geared towards it.

- Bottom-right → design

It aligns strongly with UrbanFit.

- Bottom-left → durability

It partially aligns Luxoria and ClassicLine.

- Top-left → quality

Place ClassicLine and EcoWear in a favorable zone.

- Sustainability → top-center left

EcoWear is clearly associated with this attribute.

- Reputation → center right

UrbanFit and ClassicLine are located relatively close.

Key takeaways:

EcoWear dominates the sustainability vector.

- ClassicLine combines attributes of quality and durability.
- UrbanFit depends on image and design rather than functional attributes.
- FastTrend is clearly separated in price and lower quality.
- Luxoria is isolated and not very aligned with the dominant attributes.

Analysis of the IDEAL point

The IDEAL is located:

- very close to ClassicLine
- near EcoWear
- within average distance of UrbanFit
- Further away from FastTrend
- clearly distant from Luxoria

Therefore:

The brands best positioned against the IDEAL are ClassicLine and EcoWear, both aligned with sustainability, quality and durability.

UrbanFit occupies an intermediate position, while FastTrend and Luxoria move away from the ideal pattern.

Strategic opportunities identified

1. "Sustainable + modern design" segment (large market gap)

No brand combines:

- High sustainability
- Strong design
- Average price

A hybrid of UrbanFit and EcoWear would be highly competitive.

2. Luxoria needs to redefine its value proposition

Luxoria is isolated:

- not sustainable
- Not the most preferred
- does not master the design in the actual PCA

It could reorient itself towards premium sustainability.

3. FastTrend increases the risk of negative perception

It is far from the most valued attributes today. It must improve durability or reputation so as not to be relegated.

Repositioning proposal (example of FastTrend)

Problem:

- FastTrend is excessively price-dependent.
- In the PCA, it appears disconnected from key attributes such as quality, sustainability or durability.
- Suggested repositioning:
- Incremental quality improvements
 - Longer-lasting fabrics
 - Better Manufacturing Controls

- Accessible sustainability onboarding
 - Recycled materials
 - Basic certifications
- Narrative repositioning
 - "affordable but ethical fashion"
 - small capsules with collaborative design

This would move FastTrend to a more central and competitive area.

Conclusions of the case

- The map shows a structure with two dominant poles: sustainability/durability (EcoWear, ClassicLine) and price/fast design (FastTrend, UrbanFit).
- ClassicLine and EcoWear are the brands most aligned with the IDEAL.
- Luxoria is out of alignment with current perceptual trends.
- The PCA reveals clear gaps for new sustainable fashion proposals with a modern design.
- The case illustrates how to interpret a real perceptual map and how to translate it into strategic decisions for the fashion sector.

3.5. Activities, reflection questions and challenges for the student

This section offers a set of activities designed to encourage active learning, critical reflection and student autonomy. All of them can be done using the POSITIONING application and the data included in the examples, or using datasets created by the students themselves.

These exercises can be used as supplementary questions to the main task or considered independent activities. Independent exercises are provided to practice and reinforce the concepts worked on in the main activity (Section 8).

3.5.1. Practical activities (basic–intermediate level)

Activity 1 — Identification of main axes

Look at the perceptual map generated by the app and answer:

- What attributes seem to primarily define the horizontal axis (PC1)?
- What about the vertical axis (PC2)?
- What graphic evidence leads you to this interpretation?

Activity 2 — Comparison between brands

Select two marks that appear close to each other on the map.

- Explain why they are close to each other based on attribute scores.
- In what attributes are they similar?
- In which attributes do they differ slightly?

Activity 3 — Selective Vector Activation

Activate only three relevant attributes in the side panel.

- Describe how your interpretation of the map changes.
- What attributes generate a greater separation between brands?
- Does any mark significantly change its reading by hiding the other vectors?

Activity 4 — Analysis of the IDEAL point

Hover over several marks and analyze their distances to the IDEAL point.

- Which brand is closest to the sweet spot?
- What is the second best option?
- What does this mean in terms of product positioning?

Activity 5 — Detecting Redundant Attributes

Choose two attributes whose vectors are very close to each other.

- What does this indicate about their correlation?
- Would it be reasonable to remove one from the analysis? Why?
- What effect would it have on the PCA?

3.5.2. Reflection Questions (Critical Thinking)

Reflection 1 — What attribute is missing?

Imagine you're the marketing director.

- What is an important attribute that has not been included?
- How could the map change if we added it?

Reflection 2 — Consumer segments

Based on the position of the brands, answer:

- Which consumer segment would each brand prefer?
- What perceptions need to be modified to reach another segment?

Reflection 3 — Strategic Interpretation

- Which brand is best positioned?
- Which brand is in the worst competitive situation?
- What factors influence this assessment?

Reflection 4 — Empty spaces on the map

Are there areas of the map where no markings appear?

Could they represent an opportunity to launch a new product?

3.5.3. *Advanced challenges (intermediate-advanced level)*

Challenge 1 — Remove an Extreme Mark

Remove the mark from the dataset that is furthest from the center of the map.

- How do PC1 and PC2 change?
- What about vector orientation?
- How does it affect the grouping of the other brands?

Challenge 2 — Add a highly correlated attribute

Introduces a new attribute that is very similar to an existing one (e.g., "Sweetness" and "Flavor").

Run the PCA again.

- Do you see deformation on the map?
- What about explained variance?
- What does this recommend about using redundant attributes?

Challenge 3 — Strategic repositioning

Choose a brand and imagine that you want to reposition it.

- Indicates where you should move on the map.
- What attributes should be improved or communicated?
- What marketing actions would make it possible to achieve this movement?

Challenge 4 — Create your own dataset

Create a short survey with 5–6 real or dummy marks and 6–8 attributes.

- Gather 10–20 responses.
- Upload them to the app.

- Generate your own perceptual map.
- Analyze perceptions, dominant attributes, and repositioning recommendations.

4. Technical Annex

4.1. PCA Technical Fundamentals and Advanced Map Reading

4.1.1. What is a PCA map?

A PCA map is a representation derived mathematically from the data (Diwan, 2004).

The aim of the PCA is to:

- reduce many attributes to only two axes (PC1 and PC2),
- maximizing explained variance,
- and showing the relationships between brands and attributes in a simplified space.

4.1.2. How coordinates are interpreted

- PC1 and PC2 are not attributes but linear combinations of several attributes (Green & Srinivasan, 1990).
- Their orientation and meaning depend on the data and can be rotated, reversed, or combined with factors.
- To interpret the map correctly, the vectors of the attributes (arrows) must be observed.

4.1.3. How Attribute Arrows Are Read

- The direction of the vector indicates which side of the map that attribute increases.
- Length reflects how much variance it explains.
- The angle between vectors indicates correlation:
 - proximate vectors → correlated attributes,
 - opposite vectors → opposite attributes,

- perpendicular vectors → independent attributes.

4.1.4. How direct maps are interpreted

- If a mark appears farther to the right, → is more natural.
- If it appears higher → its flavor is more intense.
- There are no hidden components or statistical transformations.
- It is a literal representation, useful for basic explanations and simple exercises.

Although the app does not generate maps directly from attributes, they are included here to help students understand how PCA maps relate to simpler attribute-based visualizations.

4.1.5. Practical example

PCA Map (as in the app):

- PC1 mainly combines naturalness and taste.
- PC2 collects minor variations (e.g., aromatic notes).
- Interpretation requires examining attribute vectors.

Direct map:

- X = Naturalness
- Y = Flavor density
- Each mark is placed directly where it belongs according to the assigned values.

4.1.6. Didactic introduction to the operation of PCA

4.1.6.1. What does the PCA do in simple terms?

Principal Component Analysis (PCA) serves to reduce many attributes to only two dimensions, allowing complex information to be visualized on a simple map (Wind, 1982; Hair et al., 2019).

- Key idea

PCA identifies the two axes (PC1 and PC2) that best summarize how consumers perceive brands based on the attributes evaluated.

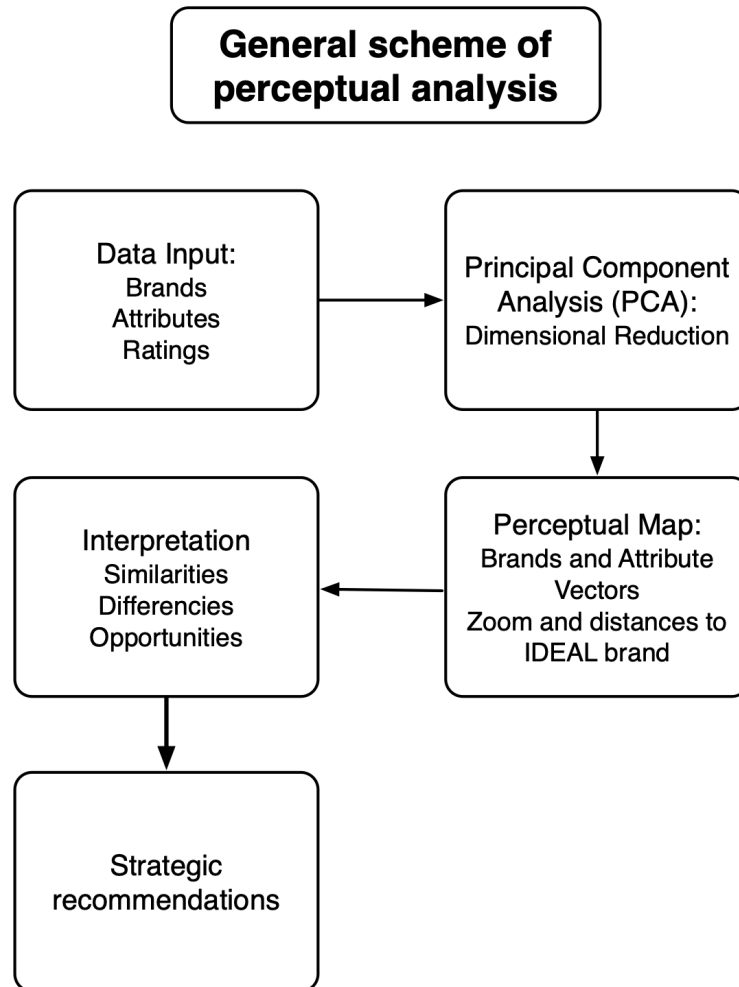


Figure 4.1. The process of perceptual analysis

- Why is PCA necessary?

Because:

- Attributes are often correlated (e.g., intense flavor and sweetness).
- Representing 6–8 attributes in a 2D graph would be impossible.
- PCA transforms these attributes into two major "directions" of perception, which we can interpret from the arrows in the attributes.

- How to Read Results Without Math
 - PC1 is the axis that explains most of the differences between brands.
 - PC2 explains the second most important part.
 - The attribute arrows show what each axis means.
 - The marks are placed where they fit best based on their actual scores.

PCA doesn't invent anything: it simply organizes the information to make it visible.

4.1.6.2. Why are these methods useful in marketing class?

- Because they allow:
 - visualize real perceptions and preferences,
 - understand how markets are structured,
 - make data-driven decisions (repositioning, segmentation, branding),
 - Learn multivariate techniques intuitively.
- No need to understand formulas to interpret the map

The technical version below is useful for those who want to go deeper, but for most students it is enough to understand:

"PCA draws the map to understand the positioning of brands in the market."

4.2. Algorithms used

Principal component analysis (PCA) is applied. PCA is used to reduce dimensionality.

Let the data matrix be:

$$X_{n \times p} = \{x_{ij}\}$$

After centering the variables:

$$\tilde{X} = X - \bar{X}$$

The variance of an attribute:

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^N (x_i - \mu)^2$$

The PCA gets:

$$X = TP^T$$

where:

- T : component scores
- P : loadings
- $P^T P = I$

The first two components are used to build the map.

4.3. Application Overview

4.3.1. Application attributes

- Enter product/brand attributes.
- Upload survey data (preferences, assessments, and ratings).
- Automatically calculate GWP.
- Visualize the perceptual map.
- Export results and figures.

The structure is designed for use in university teaching and market research projects.

4.3.2. The "Export JSON" button

The application includes an "Export JSON" button, which allows you to download the entire data structure used by the application in JSON format.

This file contains:

- the attribute matrix,
- Calculation metadata,
- PCA scores,
- loadings,
- preferred vectors,
- Selected configuration parameters.

4.3.3. The Benefits of JSON File

This format is especially useful for:

- replay the analysis in R, Python, or MATLAB,
- integrate it into other academic systems,
- save complex configurations.

4.4. System metadata

The metadata describes the information structure automatically generated by the POSITIONING application:

4.4.1. General information

- Project Name: POSITIONING – PCA Lab

- Software Version: 1.5 (26/11/2025)
- Institution: University of Alcalá
- Supported languages: ES / EN
- The source code of the POSITIONING application is not part of this manual. For technical requests, collaboration or access to the repository, interested teachers can contact the authors.

4.4.2. Input metadata

- Number of brands
- Number of attributes
- Type of scale (Likert, semantic differential, ranking, preference)
- Unique Observation Identifiers

4.4.3. Output Metadata

- Variance explained by components
- Load matrix P
- Score matrix T
- Coordinates of marks in $PC1 - PC2$
- Vectors of preference (if applicable)
- Regression parameters
- Generated graphics (maps, biplots, attribute arrows)

4.5. Functional architecture of the application

The application follows a modular architecture, consisting of:

4.5.1. Interface Module

- Data Entry Panel
- Settings panel
- Language Selector
- Graphics Panel

4.5.2. Analytical module

- Data normalization
- Calculation of covariance matrices
- PCA (eigen decomposition algorithm)
- Error Handling

4.5.3. Display Module

- Biplots
- Attribute projection
- Vector projection of preference
- PNG/CSV Export

4.5.4. Management module

- Version Control
- Metadata logging
- Export of results
-

4.6 Limitations and assumptions of the model

4.6.1. Mathematical assumptions (Hair et al., 2019)

- Linearity between variables.
- (Approximate) normality of variables.
- Continuous and metric relationship between attributes.
- Sufficient variance between brands.
- No extreme multicollinearity.

4.6.2. Limitations

- PCA does not detect nonlinear relationships.
- If the attributes are highly correlated, the axes can be difficult to interpret.
- The map loses information if components 3 and 4 have significant variance.
- Inconsistent scales produce distorted maps.

4.7. Extended Technical Appendix

Here I present the complete derivations, mathematical steps, and validations.

4.7.1. Formal derivation of the PCA

Let the matrix X (centered):

$$\tilde{X} = X - \bar{X}$$

The covariance matrix is:

$$S = \frac{1}{N-1} \tilde{X}^T \tilde{X}$$

We look for the eigenvalues:

$$Sp_i = \lambda_i p_i$$

where:

- λ_i : Variance explained by component
- p_i : Own vector (loading)

The scores:

$$t_i = \tilde{X} p_i$$

The approximate reconstruction:

$$\tilde{X} \approx t_1 p_1^T + t_2 p_2^T$$

4.7.2. Data validation

4.7.3. Normality (approximate)

Recommended Test:

- Shapiro-Wilk
- Q-Q plot
- Skewness/Kurtosis

4.7.4. Sufficient variance

We require:

$$\sigma^2 > 0.30$$

by attribute.

4.7.5. Correlation

PCA works best if:

$$|r_{ij}| > 0.30$$

4.7.6. Missing values

Recommended Method:

- Average Imputation
- Listwise deletion if little data is missing

4.7.7. Checking Outliers

Methods:

- Mahalanobis Distance
- Z-score

Conclusions

This manual provides a complete technical and conceptual basis for understanding the fundamentals of perceptual analysis and rigorously applying the PCA method through the POSITIONING – Perceptual Mapping Lab application. Through accessible explanations, illustrative examples, comprehensive case studies, and additional exercises, the paper allows students to gain a solid understanding of how to interpret perceptual maps, identify market patterns, and assess the competitive structure of a set of brands.

In addition to the technical component, the manual incorporates methodological guidelines, user guides, evaluation criteria and pedagogical recommendations that facilitate its direct implementation in the classroom. This allows both students and teachers to have a coherent, applicable resource aligned with the best teaching practices in marketing analysis. The inclusion of practical cases based on simulated data, together with the detailed explanation of axes, vectors and distances to the IDEAL point, contributes to the development of essential analytical competencies for strategic decision-making in real business environments.

Finally, the document is conceived as the first piece of a broader set of teaching materials aimed at modernizing marketing teaching through lightweight, interactive tools focused on applied learning. Its modular structure and practical approach allow this manual to be expanded in the future with new applications, new cases and advanced materials, and thus serve as a methodological reference for subjects in the marketing area at different training levels.

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