embryo-project | Ergonomics
**Poster 1/2**

# NeuroKansei Fusion

CiAUD

fct Fundação para a Ciência e a Tecnologia

## NeuroKansei Fusion: Integrating Biosignal Analysis, into Traditional Kansei to evaluate User Experience


### Principal Investigator / PI
João Pedro Sabina dos Santos Valente,
valente@ipcb.pt

### Integrated Researchers of CIAUD
Francisco Rebelo and Ernesto Filgueiras

### Collaborating Researchers of CIAUD

### External Researchers
Veronika Vladimirovna Kozlova



### Keywords
Facade Design, Predictive Modeling, Kansei, Eye Tracking, Psychophysiological Measures



### Partner Institutions
Instituto Politécnico de Castelo Branco

### Expected Future Partner Institutions
Faculdades de arquitetura


## OBJECTIVES

Kansei, utilizing subjective participant information (semantic differences), has been successfully applied in various studies assessing users' emotional and behavioral responses. Being subjective information, it can often contain participant assessment errors due to difficulties in evaluating the stimuli used.

There is a justified need to develop an approach that integrates, in addition to the subjective data from participants, objective information. This information is derived from eye tracking to accurately identify the elements of spaces that attract the participants' attention, and from biosensors (ECG, EDA), which provide information from the autonomic nervous system, to mitigate the problem.

## BIBLIOGRAPHIC REFERENCES


Nagamachi, M. (2002). Kansei engineering as a powerful consumer-oriented technology for product development. Applied ergonomics, 33(3), 289-294.

Guo, F., Liu, W. L., Cao, Y., Liu, F. T., & Li, M. L. (2016). Optimization design of a webpage based on Kansei engineering. Human Factors and Ergonomics in Manufacturing & Service Industries, 26(1), 110-126.

Valente, C., Laginha, J., & Raposo, D. (2017). Memorization of Brand marks in short-term. Convergências: Revista de Investigação e Ensino das Artes, 9(18), 1-8.

Eberhard, JP (2009). Aplicando a neurociência à arquitetura. Neuron , 62 (6), 753-756.

Valente, J., Godinho, L., Pintado, C., Baptista, C., Kozlova, V., Marques, L., ... & Plácido da Silva, H. (2021). Neuroorganoleptics: Organoleptic Testing Based on Psychophysiological Sensing. Foods, 10(9), 1974.


## ABSTRACT + IMAGES


Kansei, introduced by Mitsuo Nagamachi (2002), emerges as a powerful consumer-oriented technology for product development and has been successfully applied in a variety of studies evaluating users' emotional and behavioral reactions. However, as the information often used is subjective, it may often contain evaluation errors from participants, highlighting the need for a more objective approach.

In this regard, the use of technologies such as eye-tracking and biosignal analysis can play a crucial role. For example, studies like those of Guo et al. (2016) and Valente et al. (2017) demonstrate the effective use of eye-tracking in optimizing webpage design and memorization of brand marks in the short term, respectively. Eye-tracking allows for precise identification of the elements that attract participants' attention, helping to understand users' visual preferences and spatial orientation.

In addition, the application of biosensors, as evidenced in the study by Valente et al. (2021), provides information from the autonomic nervous system that can mitigate possible errors in the subjective evaluation of participants. The inclusion of these technologies can lead to the identification of biosignal predictors for consumer preference, increasing the accuracy of emotional analysis.

These innovative approaches, inspired by the referenced works, have the potential to enhance user experience, well-being, and the quality of design and architectural spaces. Furthermore, they could significantly contribute to the existing literature by introducing a new paradigm in emotional and behavioral assessment in design and ergonomics.

The  NeuroKansei Fusion project aims to develop an innovative methodology for predictive modeling of semantic concepts in design, integrating neuroscience, biosignal analysis, and machine learning techniques. The goal is to deepen the understanding of human interactions with design and improve the accuracy of design evaluation, with a focus on creating emotionally satisfying spaces. The specific objectives of this project are as follows:

1) Apply Kansei Design to identify the most relevant aesthetic and emotional aspects in design and architecture projects;

2) Utilize advanced techniques in biosignal analysis and neuroscience to understand the cognitive, emotional, and perceptual processes involved in user interactions with design and ergonomics;

3) Investigate the correlation between biosignal data and users' emotional responses to identify emotional and social predictors;

4) Integrate Kansei Design methodology, biosignal data, and machine learning to enhance the accuracy of evaluating emotional design impact, aiming to anticipate and align users' emotional responses with the intentional design concept.


embryo-project | Ergonomics

**Poster 2/2**

# NeuroKansei Fusion

CiAUD

Fundação para a Ciência e a Tecnologia

## SCIENTIFIC RELEVANCE FOR THE DISCIPLINE

This research proposes an innovative fusion of Kansei Engineering, eye-tracking, biosignal analysis, and machine learning techniques to significantly enrich the field of ergonomics, particularly with respect to cognitive and affective aspects. The focus is to elucidate the emotional and behavioral dimensions of human interactions within constructed environments.

By harnessing the insights generated from this study, it will be feasible to design architectural spaces that resonate more closely with the expectations and emotional responses of the users. This in turn will enhance the user experience, fostering a greater sense of satisfaction and improved well-being among occupants.

The scientific contribution of this study to ergonomics is substantial. It strives to foster a deeper, more holistic understanding of the intricate relationship between humans and their environmental contexts. This endeavor is executed through a comprehensive approach that amalgamates both subjective perceptions and objective data. The ultimate goal is to promote a user-centric ethos in ergonomics, encapsulating a more holistic perspective.

## EXPECTED ECONOMIC AND SOCIAL IMPACT

The study may stimulate the formation of new businesses that adopt the proposed methodology, thereby driving market innovation.

The proposed approach holds the potential to generate marketable models, creating a new revenue stream and stimulating economic growth.

By improving the user experience, an increase in consumer satisfaction is expected, which could translate into greater customer loyalty and profitability for businesses.

The study may contribute to the enhancement of quality of life, promoting well-being by creating more pleasant and emotionally rewarding spaces.

## RESEARCH PLAN AND TASKS

Research Questions:

1) How can we integrate participant's subjective data (semantic scales) with objective information obtained from biosensors?

2) How can eye-tracking data complement and enhance Kansei's subjective evaluations?

3) How can data collected through biosensors help mitigate possible errors in the subjective assessments made by the participants?

4) Is it possible to identify consistent biosignal predictors for consumer preference, thereby increasing the accuracy of emotional analysis?

Step 1: Identification of Semantic Concepts

Review of literature on façade characteristics to identify key semantic concepts;

Consultations with architecture experts to gain additional insights;

Development of a list of semantic concepts for application in predictive modeling.

Step 2: Creation of Stimuli and Data Collection

Selection or creation of real and/or simulated images that incorporate the identified semantic concepts;

Design and development of questionnaires for data collection;

Application of questionnaires to participants, and collection and storage of data.

Step 3: Development of Predictive Modeling

Implementation of the Type I Quantification Analysis algorithm;

Input of collected data into the model;

Execution of the model and evaluation of the accuracy of predictions.

Step 4: Integration of Neuroscience Studies

Implementation of an eye-tracking approach to capture participants' visual interactions with the design;

Analysis of eye-tracking data to identify main focus areas;

Correlation of eye-tracking data with the semantic analysis of the design.

Step 5: Biosignals Collection and Analysis

Collection of biosignals, including electrocardiogram and skin conductance response;

Analysis of biosignals to extract relevant features;

Identification of potential predictors of design semantics from the biosignals.

Step 6: Integration of Kansei Methodology and Machine Learning

Development of a method for the integration of the Kansei methodology, psychophysiological data, and machine learning;

Implementation of the method to find the best predictors for abstract concepts;

Tuning and refining the predictive model based on the results.

Step 7: Model Evaluation

Testing of the predictive model on an independent validation set;

Review and analysis of the results to assess the accuracy and reliability of the model;

Adjustments and improvements to the model based on the evaluation results.

## EXPECTED SCIENTIFIC RESULTS

This study has the potential to generate several important scientific publications in various fields. Some possible publications include:

A detailed literature review could be conducted to compare the results of this study with previous research, identifying emerging trends and gaps that still need to be filled.

These can detail the results of the study, focusing on aspects such as the developed methodology, advances in predictive modeling, interpretation of biosignal data, and the interaction between humans and architectural design.

Based on the results obtained, detailed case studies could be developed demonstrating the practical application of the findings in the design of real architectural spaces.

## BUDGET: € 7.160,00

This project involves various sensor equipment and an eye-tracker. However, the ergoUX laboratory is already equipped with all the necessary equipment except for the eye-tracking device and the software for analysis and stimulus presentation.

The estimated price for the tobbi eye-tracker and software is 7.160€