UNIVERSITAT DE BARCELONA

Essays on Humancentred Innovation in Hospitality: Working Conditions, Multisensory Well Being, and Emotional Design

Álvaro E. Arrieta-Valle

PhD in Business

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Thesis tittle:

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Date:
March 2026

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"¿Fue tan difícil el camino? ¿Fue sólo difícil? ¿No fue también hermoso? ¿Hubiera usted conocido uno más hermoso y más fácil?"

Demian, Hermann Hesse

This thesis is dedicated to my best friend, Elena.

With all my love.

Acknowledgements

First and foremost, I want to express my deepest gratitude to my thesis supervisors, **Dr Montserrat Crespi Vallbona** and **Dr Oriol Anguera-Torrell**, for their unwavering support and immeasurable trust throughout this process. Thanks to them, I not only learned, but genuinely enjoyed the journey. I would also like to thank all the administrative staff at the UB Business School for their support with the academic procedures, and especially **Judit Farré**, from whom I only ever received clear answers and solutions to all my questions.

My gratitude also goes to **CETT Barcelona School of Tourism, Hospitality & Gastronomy** and its doctoral program for all the logistical support, and especially to all my colleagues who shared their insights, opinions, and were always willing to answer my questions and take part in countless brainstorming sessions. **Brina**, thank you for your dedication in reviewing every small error and for making my thesis a little less imperfect. My special thanks to **Jaisiel Madrid** for introducing me to the vast universe of Living Labs and giving me the strength to rethink my thesis at a crucial moment. Thanks to him, this work took the shape that best aligned with both my research motivations and my personal motivations.

On a personal note, I wish to thank my family, my siblings, and especially my parents, for allowing me to fly high from such a young age. Without their unconditional support, I would have never even considered undertaking this process. I am also grateful to the **Pimalapi Bordenave** family, *ma famille du Béarn*, for their trust and for making Saint Abit my personal refuge from the rest of the world. Thank you for believing in me so deeply. My gratitude also extends to **Jose, Toñi, Mire** and the entire **Roque family** for their patience with all the Sunday meals I missed while writing this thesis.

I cannot forget to thank my closest friends—**Arnold, Quembita, and Harnish**—for their dark humour and for reminding me that nothing in life is important enough to take it that seriously. To my favourite brotherhood of beautifully mismatched misfits, ***Los Espantajopos***, for welcoming me as one of their own and reminding me that when you don't quite fit in this mediocre world, it's because you're meant to transform it. To **Gustavo, Leo, Jezid, Nati, David** (a Catalan adopted by Barranquilla), **Karina**, and the whole crew of Caribbean souls who shared this journey with me in Barcelona, powered by conversations about García Márquez and Petrona Martínez,

cheap beer, and endless dancing in *El sótano de la sabrosura*. And to the great **Daus**, for giving me that piece of advice back in a café around 2017 that set this whole doctoral adventure in motion.

This thesis began as a simple administrative requirement, as something I thought I needed to keep building my academic future. However, it ended up becoming a profound journey of personal discovery: of my underlying motivations towards the hotel industry and of my true professional purpose. It allowed me to explore and bring together my three passions: Hospitality, sustainability, and open innovation, around what truly matters and what generates the most value: **the human focus**. May this thesis serve as an offering of gratitude to all the people I have worked with in hotels and restaurants, and above all, to all the **young students** I have had the pleasure of teaching over the past ten years.

Gracias totales.

Abstract

The hospitality industry is undergoing a profound transformation shaped by digitalization, shifting consumer expectations, and increasing attention to human well-being and social sustainability. While technological innovation has accelerated operational efficiency, it has also exposed gaps in how hospitality firms understand and design for the human experience. This thesis advances a Human-Centred Innovation framework for Hospitality by integrating three complementary perspectives: working conditions, multisensory well-being, and emotional design, through a mixed-methods, multi-scale research design. Across three empirical essays, the thesis investigates how human-centred decisions influence consumer behaviour, spatial experience, and emotional responses in real hospitality settings, contributing evidence-based insights for academia, industry, and policy.

The first essay examines the behavioural consequences of fair labour conditions in the context of Online Food Delivery. Despite extensive legal debate surrounding riders' employment status in Europe, little is known about how these regulatory changes affect consumers. Through a randomized online experiment with 264 participants, the study tests how informing users that riders are hired employees, complying with Spain's Rider Law, shapes satisfaction, perceived value, purchase intentions, and tipping behaviour. Results demonstrate that consumers report higher satisfaction, stronger value perceptions, and greater purchase intention when riders are formally employed, but no significant differences in tipping behaviour. This suggests that consumers reward platforms that adhere to socially sustainable labour practices, linking ethical compliance to positive market outcomes. The findings provide empirical support for policy efforts to regulate gig-economy labour and highlight the importance of transparent communication in strengthening platform competitiveness.

The second essay explores how multisensory and environmental factors influence the dining experience in a restaurant. Using a Living Lab methodology, the research conducts a two-phase diagnostic and intervention study at Summum Restaurant in Barcelona, integrating environmental measurements (light, acoustics, air quality), AI-based emotional and behavioural tracking, and subjective feedback from customers and staff. The study develops a parametric model linking environmental variables to

mental-emotional, behavioural, and physiological responses, serving as a design code for evidence-based interventions. Preliminary modifications to lighting, textiles, and interior atmosphere generated subtle positive emotional shifts, particularly toward calmness and satisfaction. The essay contributes a replicable framework for multisensory experience design and demonstrates how even modest spatial interventions can meaningfully shape perceptual and emotional outcomes.

The third essay investigates emotional experience in one of the most frequent and affectively significant hotel touchpoints: the breakfast buffet. Conducted at the Alimara Hotel using a Living Lab multistakeholder approach, the study integrates second-by-second emotional analytics via non-intrusive sensors, staff insights gathered through co-creation workshops, and evidence-based design interventions. Baseline emotional analysis revealed patterns of disappointment, disinterest, and dissatisfaction, especially in relation to buffet layout, visual occlusions at the entrance podium, and product quality (e.g., coffee, juices). After redesign (relocation of the buffet, improvements to lighting and circulation, product upgrades) data indicated increases in neutral and satisfied emotional states, enhanced staff workflow, and reduced friction points. The study extends servicescape theory to a high-autonomy, emotionally charged setting and demonstrates the feasibility of combining emotional analytics with collaborative spatial redesign.

Taken together, the three essays articulate a Human-Centred Innovation agenda in Hospitality. The thesis contributes theoretically by linking social sustainability with consumer behaviour, formalizing a multisensory pathway for spatial design, and demonstrating how emotional data can inform real-world service redesign. Methodologically, it advances the use of experiments, Living Labs, and neurocomputational tools in hospitality research. Practically, it offers evidence-based guidance for platforms, restaurants, and hotels seeking to align operational functionality with customer experiences that drive satisfaction, value creation, and well-being.

Keywords: Human-centred innovation; Social sustainability; Gig economy; Consumer behaviour; Value perception; Multisensory experience; Environmental well-being; Neuroarchitecture; Emotional analytics; Servicescape redesign; Living Labs; Hospitality innovation.

Títol: Assaigs sobre la Innovació Centrada en les Persones en l'Hoteleria: Condicions Laborals, Benestar Multisensorial i Disseny Emocional

Resum

La indústria de l'hospitalitat està immersa en una profunda transformació impulsada per la digitalització, els canvis en les expectatives dels consumidors i una atenció creixent al benestar humà i a la sostenibilitat social. Tot i que la innovació tecnològica ha accelerat l'eficiència operativa, també ha evidenciat mancances en la manera com les organitzacions del sector entenen i dissenyen les experiències humanes. Aquesta tesi avança un marc d'Innovació Centrada en les Persones aplicat a l'hospitalitat, integrant tres perspectives complementàries: condicions laborals, benestar multisensorial i disseny emocional, a través d'un disseny de recerca multi mètode i multi escala. Al llarg de tres assajos empírics, la tesi investiga com les decisions centrades en les persones influeixen en el comportament del consumidor, l'experiència espacial i les respostes emocionals en entorns reals d'hospitalitat, aportant evidència per al món acadèmic, la indústria i les polítiques públiques.

El primer assaig examina les conseqüències conductuals de les condicions laborals justes en el context del repartiment de menjar a domicili. Malgrat el debat jurídic existent a Europa sobre l'estatus laboral dels *riders*, se sap poc sobre com aquests canvis reguladors afecten els consumidors. Mitjançant un experiment aleatoritzat amb 264 participants, l'estudi analitza fins a quin punt informar els usuaris que els repartidors són contractats com a empleat (complint amb la Llei *Rider* espanyola) incideix en la satisfacció, la percepció de valor, les intencions de compra i el comportament de propina. Els resultats mostren que els consumidors reporten més satisfacció, una percepció de valor més gran i una major intenció de compra quan els repartidors estan formalment contractats, però sense diferències significatives en les propines. Això suggereix que els consumidors premien les plataformes que adopten pràctiques laborals socialment sostenibles, vinculant així l'ètica empresarial amb resultats positius de mercat. Les conclusions donen suport empíric als esforços reguladors sobre el treball a la *gig economy* i destaquen la importància d'una comunicació transparent per reforçar la competitivitat de les plataformes.

El segon assaig explora com els factors multisensorials i ambientals influeixen en l'experiència gastronòmica dins un restaurant. A través d'una metodologia de Living Lab, la recerca duu a terme un estudi diagnòstic i d'intervenció en dues fases al Restaurant Summum de Barcelona, integrant mesures ambientals (llum, acústica, qualitat de l'aire), seguiment emocional i conductual basat en IA, i feedback subjectiu de clients i personal. L'estudi desenvolupa un model paramètric que vincula variables ambientals amb respostes mentals, emocionals, conductuals i fisiològiques, i que actua com a codi de disseny per a intervencions fonamentades en evidència. Les modificacions preliminars d'il·luminació, tèxtils i atmosfera interior van generar canvis emocionals positius subtils, especialment cap a la calma i la satisfacció. L'assaig aporta un marc replicable de disseny d'experiències multisensorials i demostra com petites intervencions espacials poden incidir de manera significativa en les percepcions i respostes emocionals.

El tercer assaig investiga l'experiència emocional en un dels punts de contacte més freqüents i afectivament significatius d'un hotel: el bufet d'esmorzar. Realitzat a l'Hotel Alimara mitjançant un enfocament Living Lab multiactoral, l'estudi integra analítica emocional segon a segon a través de sensors no intrusius, coneixement aportat pel personal en tallers de cocreació i intervencions de disseny basades en evidència. L'anàlisi emocional inicial va revelar patrons de desil·lusió, desinterès i insatisfacció, especialment relacionats amb la disposició del bufet, les obstruccions visuals a l'entrada i la qualitat d'alguns productes (p. ex. cafè, sucs). Després del redisseny (relocació del bufet, millores en la llum i la circulació, i ajustos en l'oferta) les dades indiquen un augment d'estats emocionals neutres i satisfets, una millora del flux de treball del personal i una reducció dels punts de fricció. L'estudi amplia la teoria del *servicescape* en un entorn d'alta autonomia i càrrega emocional, i demostra la viabilitat de combinar analítica emocional amb redisseny espacial col·laboratiu.

En conjunt, els tres assajos articulen una agenda d'Innovació Centrada en les Persones en l'hospitalitat. La tesi contribueix teòricament en vincular la sostenibilitat social amb el comportament del consumidor, formalitzar un recorregut multisensorial per al disseny espacial i demostrar com les dades emocionals poden informar el redisseny de serveis en contextos reals. Metodològicament, impulsa l'ús d'experiments, Living Labs i eines neurocomputacionals en la recerca en hospitalitat. Des d'un punt de vista

pràctic, ofereix orientacions basades en evidència per a plataformes, restaurants i hotels que busquen alinear la funcionalitat operativa amb experiències que promouen satisfacció, creació de valor i benestar.

Paraules clau: Innovació centrada en les persones; Sostenibilitat social; Economia col·laborativa; Comportament del consumidor; Percepció de valor; Experiència multisensorial; Benestar ambiental; Neuroarquitectura; Analítica emocional; Redisseny del servicescape; Living Labs; Innovació en hospitalitat.

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Acronyms

AI	Artificial Intelligence
dB	Decibels
ENoLL	European Network of Living Labs
ESG	Environmental, Social, and Governance
FDA	Food Delivery Apps
GEN AI	Generative Artificial Intelligence
LL	Living Labs
Lux	Luminous flux per unit area
OFD	Online Food Delivery
VOC	Volatile organic compounds
WoS	Web of Science

CHAPTER 1

INTRODUCTION

1. INTRODUCTION

1.1. Background

The hospitality industry is undergoing a profound transformation that first started with the disruption and democratization of many technological advancements as well as, several changes in customer's behaviour that started long before COVID-19 pandemic (Ezzaouia & Bulchand-Gidumal, 2020; Hernandez et al., 2026). Yet it was not after 2020 that hoteliers realised that their business models and their value creation was not spotted in their business-as-usual features. While technological progress has amplified operational efficiency and scale, it has also brought to the front human-centred questions: How do labour conditions on digital platforms shape market outcomes? How can spatial and multisensory design evidence, rather than intuition, guide experience improvements? And to what extent can emotional analytics inform the redesign of servicescapes in real contexts such as hotels and restaurants? Addressing these questions requires a cross-disciplinary lens that integrates labour studies, consumer behaviour, environmental studies, emotional design, and neurotechnologies applied in the hospitality industry.

This thesis adopts Human-centricity as the key paradigm (Perelman, 2007). Instead of treating technology as an end in itself, the work emphasizes human value creation across three levels of analysis: (i) social sustainability (Crespi-Vallbona et al., 2023; Dell'Era et al., 2019; Rodríguez-Piñero Royo, 2023); (ii) evidence-based spatial design in restaurants (He, 2025); and (iii) emotion-driven redesign of hotel servicescapes through Living Lab methodologies (Cigir, 2018; Fortiş & Petcu, 2022; Koens et al., 2024). Each level is investigated through an independent essay, yet all are articulated around an integrative proposition: putting people (workers, guests, and staff) at the centre of innovation improves experiential quality and can generate favourable behavioural and economic outcomes.

Despite abundant discourse on experience and innovation, hospitality research, as well as Living Lab solutions often remain siloed (Leminen & Westerlund, 2025a): Labour issues are analysed separately from consumer behaviour; spatial design is guided by best practice more than by in-situ evidence; and emotions, a central issue to hospitality widely studied by Louzao Belmonte (2024), are measured ex post or via self-reports rather than

captured in real time in natural settings. As a result, organisations risk optimising local functions (e.g., operations or aesthetics) without aligning them with human outcomes that matter: fairness, well-being, and emotional response.

Concretely, three lines of inquiry motivate this thesis: (i) Labour conditions and consumer response in platform services; (ii) Evidence-based restaurant design grounded in real-world, data-driven diagnostics; and (iii) Emotion-aware redesign of hotel servicescapes in a breakfast context using a Living Lab approach. Each of these dimensions is examined in one of the three empirical articles that form the core of this work.

The **first article** addresses labour fairness as a fundamental component of human-centred innovation. It responds to a specific research gap: the lack of experimental evidence linking riders' working conditions in online food delivery platforms to consumer attitudes and behaviours. The Rider Law, approved in Spain in 2021, established that delivery riders must be legally recognized as employees of digital delivery platforms rather than freelancers. While the Rider Law in Spain has generated extensive legal debate about employment classification, little was known about how such regulation affects online food delivery consumers. Therefore, the first research question formulated was *RQ1: To what extent do fair labour conditions in online food delivery influence consumer satisfaction, perceived value, purchase intentions, and tipping behaviour?*

To fill this gap, the study employs a randomized online experiment with 264 participants in which information about riders' contractual status is manipulated. This method allows for causal identification of the effects on satisfaction, perceived value, purchase intention, and tipping behaviour. The results indicate that informing users that a rider is a hired employee increases satisfaction, value perception, and purchase intention, while tipping remains unaffected. These findings show that fair labour conditions can translate into market advantages, supporting the central argument of the thesis: human-centred decisions can generate favourable consumer responses and should be considered part of innovation strategies.

The **second article** focuses on multisensory well-being by analysing how environmental factors and emotional states influence the dining experience in a functioning restaurant. The second research question formulated was

RQ2: How can real-world multisensory analysis, combining environmental measures and computational neuroscience, inform evidence-based spatial interventions that enhance user experience in restaurants?

To do so, it uses a Living Lab methodology, which is appropriate for studying complex phenomena in real-life settings. The study is conducted in two phases: (i) diagnosis and (ii) implementation at a real restaurant in Barcelona. Through a combination of environmental measurements (light, acoustics, air quality), computational neuroscience tools, and subjective feedback from customers and staff, the research develops a parametric model linking spatial variables with emotional, cognitive, behavioural, and physiological responses. Preliminary interventions centred on lighting, textiles, and interior atmosphere produce subtle positive emotional effects, especially related to calmness and satisfaction. The contribution of this article lies in demonstrating how an evidence-based and human-centred approach to spatial design can improve user experience. The study shows that even small design modifications, when guided by data, influence emotional responses and provide a foundation for deeper spatial interventions in line with a human-centred innovation perspective.

The **third article** examines emotional design in one of the most frequent and affectively significant touchpoints in hotels: the breakfast buffet. Within the broader framework of Human-Centred Innovation, this space is particularly relevant due to its emotional weight, autonomy of use, and influence on the overall guest experience. In this essay, the research question formulated was *RQ3: Can emotion-driven redesigns of hotel servicescapes measurably improve guest affective states and staff workflow in a breakfast buffet context?*

Using a multi-stakeholder Living Lab approach at the Alimara Hotel, the study integrates second-by-second emotional analytics collected through non-intrusive neurosensors, staff insights obtained in co-creation workshops, and evidence-based design interventions. Baseline emotional analysis reveals patterns of disappointment, disinterest, and dissatisfaction linked to buffet layout, visual obstructions, and product quality. After the redesign, which includes relocating the buffet, improving lighting and circulation, and upgrading selected products, data show increases in neutral and satisfied emotional states as well as enhanced staff workflow and reduced friction points. This article demonstrates the feasibility of applying emotional

analytics in real hospitality settings and highlights the value of integrating such data with co-creation to guide service redesign.

1.2. Summary of Essay Contributions

Essay 1 — *Freelance or Hired? Consumer Preferences for Online Food Delivery Riders' Conditions.* This article was submitted to the **European Journal of Tourism Research (SJR, Q2)** on 23 May 2025, and the authors are currently awaiting the final decision.

Contribution: It establishes a causal relationship between fair labour and consumer attitudes (satisfaction, value perception, purchase intention), with no significant change in tipping, suggesting expectations of structural fairness. The study provides evidence that transparent communication regarding riders' employment status can serve as an effective managerial tool. Platforms that disclose information about fair working conditions are more likely to benefit from stronger customer evaluations and potentially enhanced loyalty. This positions labour transparency as a strategic asset rather than a cost, reinforcing the idea that social sustainability can be leveraged as a competitive advantage. Furthermore, the study confirms that tipping behaviour is not significantly influenced by the riders' contractual conditions. This distinction is important because it indicates that improving working conditions, as well as communicating these improvements, has a greater impact on customer responses than relying on individual tipping norms. For managers, this suggests that investing in fair employment structures is more effective than encouraging tipping to enhance the customer's sense of fairness or satisfaction.

Finally, the essay contributes to ongoing regulatory discussions by showing that government interventions have behavioural effects that extend beyond the labour dimension. While regulatory frameworks aim to improve the working conditions of riders, this study demonstrates that such interventions also shape how customers evaluate and interact with delivery platforms. By linking regulatory decisions to observable shifts in consumer behaviour, the study provides a clearer understanding of the wider societal impact of labour regulations in the gig economy.

Essay 2 — *Multisensory and Environmental Well-being in Gastronomic Spaces: A Computational Neuroscience Case Study.* This article was submitted to the **International Journal of Food Design (SJR, Q1)** in

November 2024. The authors received minor-revision comments in September 2025, followed by final recommendations for inclusion in the upcoming issue in January 2026. The manuscript remains under review, and the authors are currently awaiting the final decision and publication.

Contribution: It determines a diagnostic-to-intervention loop in a functioning restaurant through a Living Lab approach: measure, model (parametric code), intervene (lighting/textiles), evaluate, outlining structural proposals (layout, materials, biophilia). It provides evidence on how spatial stimuli influence emotional, cognitive, and behavioural responses in restaurant environments. Also, the essay advances methodological practices by integrating AI-driven emotional analysis into the design process. Rather than relying solely on subjective evaluations, the approach incorporates real-time measurements of emotional and behavioural responses, creating a clearer and more objective understanding of how spatial configurations affect users.

Lastly, the study emphasizes the role of creativity and sensory design in shaping meaningful dining environments. By analysing elements such as noise levels, lighting quality, tactile materials, and spatial organisation, the research shows that multisensory strategies can enhance satisfaction and contribute to commercial success. The findings illustrate how sensory-focused interventions create immersive atmospheres that respond to diners' expectations and emotional needs, reinforcing the relevance of design as a competitive asset within the restaurant sector.

Essay 3 — *Redesigning the Hotel Breakfast Servicescape through Emotional Analytics: A Living Lab Case Study*. This article was submitted to the **Journal of Innovation Management (SJR, Q3)** in February 2026. The manuscript is currently under review, and the authors are awaiting the journal's response.

Contribution: A key contribution of the study is the demonstration of the feasibility and value of using non-intrusive emotional tracking in real hospitality environments. By complementing traditional satisfaction measures with second-by-second emotional data, the research offers a more granular understanding of how guests respond to design features and operational conditions. The exploratory regression analysis highlights both the potential and the current limitations of modelling real-time affective

states, pointing to the need for methodological refinement and replication in future studies.

The project also underscores the importance of multistakeholder co-creation. The integration of staff knowledge into the design process was essential for interpreting emotional insights, identifying operational constraints, and validating design decisions. Staff contributions led to practical and effective interventions that improved both guest experience and workflow efficiency. This reinforces the idea that successful design solutions emerge when experiential, operational, and managerial perspectives are aligned.

By applying an iterative Living Lab methodology, the study shows how hotels can systematically evaluate and redesign servicescapes through a structured combination of emotional analytics, observation, and collaborative decision-making. The approach resulted in a redesigned breakfast environment that reduced sources of negative emotion, improved accessibility, and generated more positive guest reactions. At the same time, staff reported enhanced efficiency and smoother operations, highlighting the dual impact of design interventions on both customer experience and employee well-being.

1.3. Theoretical, Methodological, and Practical Implications

From a theoretical perspective, this thesis offers three core contributions. First, it links social sustainability in labour markets with consumer behaviour by experimentally analysing how customers respond to information about riders' contractual status in online food delivery. This provides a new angle for interpreting the debates surrounding Spain's Rider Law and the potential social frictions that may emerge in other countries without clear regulatory frameworks for digital platforms. Second, the thesis formalises a multisensory-to-emotion pathway for evidence-based design in restaurant environments, proposing an alternative way of approaching spatial redesign in gastronomic settings. Third, it introduces an emotion-driven redesign approach at the hotel servicescape level, integrating emotional analytics into decision-making and thereby contributing to a broader human-centred framework for hospitality innovation. In doing so, the thesis offers a distinct perspective compared to traditional approaches in the literature, which typically focus either on interior design considerations or on operational efficiency and service excellence.

The methodological contributions are equally significant. The thesis validates field-based mixed methods across three distinct dimensions: an online experiment to analyse customer perspectives; and two Living Lab studies that combine environmental sensing, AI-enabled emotional analytics, user surveys, and co-creation formats. This triangulation of neurotechnologies, subjective feedback, and participatory methods demonstrates the value of integrating multiple forms of data within open-innovation ecosystems. As a result, the thesis advances both the thematic scope and the methodological tools available for studying innovation in hospitality.

In practical terms, the findings provide actionable guidance for online food delivery platforms and regulators. The results highlight that transparent disclosure and compliance with fair employment conditions can generate positive market responses, reinforcing the value of socially sustainable labour decisions. For hoteliers and designers, the thesis offers a procedural blueprint for implementing evidence-based spatial interventions that align guest emotional experience with staff efficiency and broader ESG objectives. This contributes to a more integrated understanding of how physical design, operational performance, and affective value can be aligned in hospitality settings.

Finally, the remainder of the thesis follows a traditional three-essay format preceded by this general introduction and followed by a general conclusion: Chapter 2 tests causal impacts of rider employment disclosure; Chapter 3 develops evidence-based spatial design in a restaurant via a parametric model; Chapter 4 applies emotion-aware redesign to a hotel breakfast servicescape with pre/post evaluation; Chapter 5 synthesises findings, implications, limitations, and avenues for future work.

CHAPTER 2

FREELANCE OR HIRED? CONSUMER PREFERENCES FOR ONLINE FOOD DELIVERY RIDERS' CONDITIONS[1][2]

[1] This chapter was presented in the following congresses:

- **Congreso Latinoamericano de Investigación en Hotelería y Restauración**. 8th of November 2023, *ONLINE*
- **THE INC 2024** – Conference Programme "Technology Enabled Competitiveness and Experiences in Tourism, Hospitality and Events". 5th -7th June 2024, Hotelschool the Hague, *Amsterdam, Netherlands*

[2] This article was submitted to the **European Journal of Tourism Research (SJR, Q2)** on 23 May 2025, and the authors are currently awaiting the final decision.

ABSTRACT

Online food delivery (OFD) platforms have transformed the restaurant industry. However, the employment status of delivery drivers working for these platforms continues to be a controversial issue. In 2021, Spain required these platforms to directly hire delivery drivers as platform employees, which represented a significant change in labour regulations. Previous research has examined this change from a legal perspective, but its impact on consumer behaviour remains to be explored. Accordingly, this study proposes to analyse how the employment status of OFD platforms' delivery drivers (freelance or contract) affects consumer satisfaction, value perception, purchase intention, and tipping behaviour. To this end, an online experiment with 264 participants has been conducted, and the results show that consumers are more satisfied, perceive higher value, and show higher purchase intention when delivery drivers are hired employees. In contrast, no significant differences were found in tipping behaviour, suggesting that consumers prioritize fair working conditions over individual generosity. These findings highlight the economic and social benefits of fair labour practices for OFD platforms, offering insights for policymakers and industry players in the changing collaborative economy.

Keywords: consumer behaviour; delivery riders; fair labour practices; gig economy; online food delivery platforms; social sustainability

1. Introduction

Food delivery apps have become very important players in the restaurant industry across the world. In 2025, the online food delivery (OFD) business is expected to reach 1.4 trillion US dollars worldwide (Statista, 2024). The most important OFD markets by number of users are China, followed by Europe and North America. These three geographic blocks represent 87% of the food delivery users worldwide, and the number of worldwide users is expected to grow by 30% in the following five (Statista, 2025). The expansion of OFD platforms has changed the rules of the game for the restaurant industry, and it has forced restaurateurs to reassess their business model (Alvarez-Palau et al., 2022). Nevertheless, the contractual status of delivery riders—often providing freelancers with their services to OFD platforms—has been associated with a debate about social justice and sustainability.

In August 2020, the Spanish Supreme Court stipulated that riders were lawfully bound to the delivery apps as workers. That is, riders should not be considered freelancers providing their services to OFD platforms but workers of the platforms. This allowed for the creation of what is known as the *Rider Law* in Spain in 2021. This law represents a significant challenge, not only to the online delivery industry but also to the European legal framework, since this has been the first time that a Supreme Court has ruled on this matter, and companies must abide by it. Furthermore, in 2023, the Spanish government advocated for the regulation of contractual measures for the gig economy, defined by short-term, flexible, task-based arrangements facilitated by digital platforms, for workers throughout the European Union (EU). However, achieving an EU-wide consensus was not initially possible because some countries, like France and Germany, opposed the proposed legislation (O´Carroll, 2024) In any case, in 2024, the European Commission passed a new directive that classifies gig workers as direct employees. As a direct consequence of this new regulation, approximately 40 million platform workers in Europe will have access to fairer labour conditions.

Despite Spain's leadership in advancing workers' rights within the EU, compliance with the Rider Law among OFD platforms remains inconsistent. Since the law took effect in 2021, there have been varied interpretations of the regulations governing riders' contractual status (Nieto, 2021). For

instance, some intermediary transport firms have emerged, allegedly acting as clusters for riders. However, evidence suggests that delivery apps still maintain direct control over riders, a key factor in the Supreme Court's ruling in favour of classifying riders as employees. This ambiguity generates social and legal challenges, exacerbated by limited oversight and enforcement by government regulatory bodies (Fernández & Moares, 2024; Gutiérrez, 2022).

Previous studies have praised the Rider Law for promoting equal rights for workers and establishing a clear presumption of employment (Báez Laguna, 2021; Imaz & Gil de Gómez, 2022; Nieto, 2021). However, critics argue that the ruling missed a crucial opportunity to address broader regulatory challenges. According to Ginès i Fabrellas (2021), the law was insufficient, as it failed to fully address the complexities of algorithmic management—a core issue in platform labour. Additionally, the regulation was limited to the online food delivery sector and did not consider other sectors such as on-demand work platforms or virtual delivery supermarkets. While the effects of the Rider Law have been widely studied from a legal perspective (Ginès i Fabrellas, 2021; Imaz & Gil de Gómez, 2022; Sanz de Miguel et al., 2023; Todolí Signes, 2021), its effects on consumer behaviour remain unexplored. This gap is critical, as consumer attitudes and preferences are key to platform success and market dynamics.

Accordingly, this study proposes to investigate how rider employment status—freelance versus hired—on OFD platforms impacts consumer satisfaction, value perception, purchase intentions, and tipping behaviour. Using an online experiment with 264 participants, the study examined whether informing consumers about a platform's compliance with the Rider Law influences their perceptions and behaviours. The results show that consumers are more satisfied, perceive higher value, and have higher purchase intentions when drivers are employees directly hired by the platforms. Interestingly, no differences in tipping behaviour are detected depending on whether they are hired or not. Therefore, consumers seem to prioritize fair working conditions over individual acts of generosity.

This research makes several contributions. It establishes a causal relationship between labour regulations and consumer attitudes. Specifically, it highlights that fair labour conditions for OFD platform workers can lead to economic benefits for those platforms, as consumers view these improved working

conditions positively. As a result, this study connects fair labour conditions with consumer behaviour and thus links ethical practices to market outcomes.

The rest of this paper is structured as follows. Section 2 reviews the literature on OFD platforms, labour regulations, and consumer behaviour, and introduces the research hypotheses. Section 3 outlines the experimental design and methodology. Section 4 presents the results, and Section 5 discusses the implications for theory, practice, and policy, as well as the conclusions with recommendations for future research.

2. Related Literature and hypothesis development

The literature review encompasses three strands of related and interrelated authors, theories, and studies that help to better understand the importance of working conditions within gig economy-related business models and the consumer's impact.

2.1. OFD in the context of the Gig Economy

The gig economy was irrupted by its capacity to digitally connect gig workers, consumers, and other stakeholders via online platforms, and takes a fee often from the consumer and the seller. Its difference resides in the ability to sell a by-hours or by-task workforce, which may consist of one or several individuals, to one customer or many companies (Koutsimpogiorgos et al., 2020). OFD companies emerged as a natural response to the growing need to approach restaurants in this new gig economy system. Even though the concept of food delivery is not new (Ahuja et al., 2021), the platform-to-consumer model has changed the market rules by enhancing its performance with highly complex algorithms (Jabbour Al Maalouf et al., 2025).

Online platforms are mostly based on the idea of time freedom and work flexibility, but Griesbach et al. (2019) explained that these platforms, through their algorithms, often regulate the time and activities of couriers, limiting their time freedom. In fact, some studies place the negative sides of algorithm management in online platforms since the ultimate concern has been optimization and the creation of new value transactions. However, these developments have shown some externalities, such as the overcollection of privacy (Etter et al., 2019), opacity of data use, privacy breach, price

discrimination for both customers and couriers and match invalidity (Zhu et al., 2024).

2.2. Riders' conditions

One of the landmark efforts of the gig economy was that gig jobs could become not only a side hustle job (Veluchamy et al., 2021), but a real transformative contractual form where many individuals could offer their time and workforce through an app and therefore get paid for the number of tasks done (Cao, 2022). In the context of OFD, the most optimistic perspective was mostly promoted by OFD platforms that widespread the innovative and highly optimizable way to expand economic opportunities by leveraging a new management model far from Fayol´s traditional management system (Cropanzano & Lehman, 2023). The gig economy, therefore, claimed to offer easy admittance to flexible work environments that were previously not accessible to excluded workers. However, many scholars point out that food couriers are the ultimate example of the generalised precarious employment in the contemporary job market (Imaz & Gil de Gómez, 2022; Kaine & Josserand, 2019; Nieto, 2021; Sanz de Miguel et al., 2023; Vandevenne & Vanroelen, 2024).

Todolí-Signes (2021b) indicated that regulations in this regard tend to clarify the employment status since the technological options are merely a means to perform an economic activity. Subsequently, this raises the question of whether couriers should be considered as employees. Despite the vast interest in the gig economy (Koutsimpogiorgos et al., 2020), there are still few regulations from governments, and this places the OFD platforms in a grey area (Ginès i Fabrellas, 2018) that leaves informal workers in a desperate struggle for livelihood, as suggested by Chan (2021). Moreover, food delivery riders have poor institutional representation, and therefore, they lack the bargaining power to enforce protective rights (Vandaele, 2018), such as unemployment and healthcare (Vandevenne & Vanroelen, 2024).

Jing et al. (2023) argue that when the relationship between a gig worker (income dependence) and the OFD platform is asymmetrical, the platform is more likely to exploit the courier, leading to more risk injuries. The health and safety risks associated with the riders in the context of the gig economy have been widely explored (Christie & Ward, 2019; Peticca-Harris et al.,

2020). The need for intervention regarding the safety and behaviour of riders is a growing area of concern (Salmon et al., 2023). In fact, discrepancies arise when talking about sustainability since OFD companies tend to promote the use of motorcycles due to their rapidity instead of less polluting options. Regarding bicycle food delivery riders, Oviedo-Trespalacios et al. (2022) point out the potentially dangerous riding behaviour compared to private bicycle riders. (Krier et al., 2022) explain how delivery riders use public service e-bikes to carry out their duties in the case of Paris. Finally, Christie & Ward (2023) explain how riders are more incentivised to ride in dangerous conditions if needed rather than not meeting the company standards. This further reinforces the need for more comprehensive policy interventions.

As a consequence of the potential concerns, such as risks and job precariousness bound to this job segment (Ravenelle, 2023), there is an emerging collective solidarity among riders (Tassinari & Maccarrone, 2019) that ends up in associative groups that try to unionize and create a counterbalance to the algorithmic management system (Sanz de Miguel et al., 2023). Relevant examples of rider mobilisation across the world include, amongst many others, the union movement in Italy (Tassinari & Maccarrone, 2017), the Manchester mobilisation (Popan, 2021), and the food delivery labour´s union movement in Japan (Uchiyama et al., 2022). However, one could argue that the most relevant case is the Spanish trade union´s strategies on litigation and social dialogue that resulted into the first food delivery riders' legislation in Europe (Arasanz Díaz & Sanz de Miguel, 2023).

2.3. Consumer experience in OFD

Before COVID-19, there were several attempts by some authors to point out the relevance of consumer behaviours and attitudes, but it was right after the pandemic that this concept became incrementally substantial to the scientific community. (Rivera, 2019) has stated the need for a better understanding of the consumers´ motivations, driving factors, and interests in the context of OFD. Attitude and purchase intention are elements mostly influenced by the customer experience for e-commerce (Weisberg et al., 2011). Yeo et al. (2017) claimed that the previous statement was also proved to be right in the context of OFD, and that hedonic motivation is also an important factor. Along the same line, consumers' attitudes towards OFD improve when there is the notion of timesaving previously introduced by Jabbour Al Maalouf et

al. (2025). Moreover, consumers´ habits play a role in shaping customers' intentions towards the use of OFD (Gunden et al., 2020a). In the context of COVID-19, it has been showed that food quality plays an important role in customer satisfaction and, therefore, in customer loyalty (Dsouza & Sharma, 2021).

According to Pillai et al. (2022), convenience, trust, order accuracy, and variety of choices shape the attitude of consumers in the OFDS environment. When consumers tend to positively perceive the convenience of the apps, they get a positive attitude towards the OFD (Pigatto et al., 2017). In accordance with this, discounts and promotion codes in platforms can enhance positive desire and expand customer loyalty (Tsai et al., 2023). Moreover, there is a growing research interest in fairness and social welfare, which includes customers' experience.

2.4. Hypotheses development

Nonetheless, the impact of policy regulations regarding workers' welfare on customers' attitudes and willingness to pay has been limitedly explored. This study´s main objective is to start addressing the existing research gap between OFD's ethical aspects, particularly riders' working conditions, and customers' perceptions. To this end, this paper draws on Elkington's (2013) triple bottom line theory claiming that companies that incorporate economic, social and environmental frameworks to their operations may have a more positive impact regarding their value creation and customer perception. Thus, based on the above-discussed literature and the triple bottom line theory, the following three hypotheses about firms' compliance with the Rider Law, which requires them to hire riders as employees, have been set:

H1: Displaying information on food delivery apps (FDAs) that the platform complies with the Rider's Law positively influences customer satisfaction.

H2: Displaying information on FDAs that the platform complies with the Rider's Law positively influences customers' perceived value of the service.

H3: Displaying information on FDAs that the platform complies with the Rider's Law positively influences customers' purchase intentions.

Furthermore, building on Adams (1963) equity theory that revolves around the idea that exchanges should be fair, we note that if consumers perceive that workers are better paid by the OFD platform, consumers may be less compelled to give higher tips to complement their salaries. Hence, the following hypothesis has also been proposed:

H4: Displaying information on FDAs that the platform complies with the Rider's Law positively influences customers' tipping behaviour.

3. METHODOLOGY

3.1. Experimental setting

A randomized experiment was conducted to assess customers´ purchasing behaviour in relation to rider's working conditions with a specific focus on their contractual situation. This method has been chosen because it is ideal for proving cause-and-effect relationships (Viglia & Dolnicar, 2020), such as the one this research aims to establish regarding how riders' contractual working status can influence consumers' attitudes towards online food delivery. The majority of the experiment's participants were recruited from a University Campus in Barcelona, including both students and staff. The decision to focus on students was informed by the fact that Generation Z and millennials represent the largest adopters of prepared meals and OFD services (Ahuja et al., 2021). Additionally, some Barcelona residents were recruited to participate, as other generations also engage with OFD platforms, although to a lesser extent. In other words, a convenience sample comprising students and staff from a university campus in Barcelona, as well as a smaller number of city residents, joined the experiment. Participants were randomly divided into a control group and a treated group. Both groups were asked to imagine a scenario in which they were using an OFD platform to order dinner. They were instructed as follows: *"Assume it is a weekend, and you are in the mood for dinner, but you do not feel like cooking. You decide to place an order from your mobile phone for a Barbecue pizza along with two drinks through a food delivery app"*. This menu was selected because it represents the most frequently ordered combination in Barcelona, according to the Gastrómetro Report by Just Eat (2021).

Then, individuals were shown a picture resembling an order summary on a real OFD and were asked to take a few seconds to revise it. At the top of the

picture, there was a list with the ordered items (the pizza and the two beverages), then a section in which they were shown the possibility of tipping the rider, and, finally, they had an economic recap of their order following the same principles of regular OFD companies to make it appear more realistic and restricting participants´ set-ups. The pictures shown to the control and the treated groups were essentially the same for both groups, except that in the treated group order, there was an extra text box -coloured yellow so that participants saw it- just before the tipping section stating that *"the rider that will deliver you the food is hired and paid according to the Spanish regulations. By using our services, you are contributing to a fairer working environment"*. Therefore, this approach would be very beneficial in the current marketing environment, as high moral standards can improve customers´ perception of fairness (Takala & Uusitalo, 1996). However, this is yet to be proven in the OFD context. The control group picture had no text box about working conditions or ethical standards. The food orders in both groups costed 22 euros for one pizza and two beverages. Moreover, there was a transport fee of 3,49 euros and a company's fee of 0,30 euros, which gave a total amount of 25,79 euros which could be considered a standard delivery cost for two people.

Accordingly, this experiment setup allows to test if the sentiment of fairness regarding riders working conditions influenced the consumer's purchasing perceptions and behaviour. Indeed, to measure such perceptions and tipping behaviour, after seeing these images, participants were asked about their satisfaction, value perception, buying intentions and tipping behaviour. They were asked the following questions Q1-Q4:

- Q1: "Please indicate the degree of satisfaction generated by the payment and transport fee conditions that this order shows."
- Q2: "Please indicate how much you agree with the value of the order and its delivery."
- Q3: "Please indicate how willing or inclined you would be to finalise this purchase"
- Q4: "Please indicate if you would be willing to leave a tip for the delivery person for this order."

For the degree of satisfaction (*Q1*), participants could choose a number between one and five, where one was used to mean "very unsatisfied" and

five was used to mean "very satisfied". Likewise, when they were asked how much they agreed with the value (*Q2*), they could choose between one and five, where one was "strongly disagree" and five meant "strongly agree". Similarly, buying intentions (*Q3*) were measured from one to five, where one meant "Not willing at all", and five meant "very much willing". The answers to these first three questions were recorded in three numerical variables respectively labelled as satisfaction, value and purchase, and that constitute variables of interest for this paper. Finally, when participants were asked if they were willing to leave a tip to the delivery person (*Q4*), they could choose between three answers: "Yes, I would leave a tip", "I would not leave a tip" and "Does not know / does not answer". If the previous answer was "Yes, I would leave a tip", they were asked to say which tip they would leave as a multiple of 50 cents. The answers to this last question were also recorded in a numerical variable labelled as tipping and constitute a variable of interest.

After participants had answered those questions, they saw a new screen on which they had to answer some further questions. The first of them asked participants if they recalled that the order summary explained the legal working status of the rider, and it was used as the manipulation check. Next, they were asked to indicate the frequency with which they use online food delivery apps, from "never" to "more than twice per week". Then, participants were asked about their age, gender, and education. A total of 264 people participated in the experiment in different sessions between February and April 2023. Participants carried out the experiment on individual mobile devices in each experimental session to make it more realistic.

3.2. Statistical analysis

To assess whether there exist statistically significant differences between the control and treated group regarding the four main variables of interest — satisfaction, value, purchase, and tipping—a t-test has been estimated for each of them. The null hypothesis for each of these tests claims that the population means for the considered numerical variable are the same in the control and treated groups. Alternatively, the alternative hypothesis states that they are different. For each variable of interest, if the null hypothesis can be rejected, it should be interpreted as displaying information claiming that the rider is hired by the OFD platform and paid according to the current Spanish regulations has an impact on the variable.

As a robustness check, the following equation has been estimated by ordinary least squares per each of the outcome variables:

$$output_i = \alpha + \beta treated_i + X'\gamma + \epsilon_i \quad (1)$$

where i stands for a participant i; $output_i$ equals to one of the four output variables of interest (satisfaction, value, purchase, and tipping); $treated_i$ is a dummy variable equal to one if an individual was in the treatment group and zero otherwise; X is a matrix of socio-demographic variables (a dummy indicating if an individual has female gender, a dummy variable indicating if an individual's highest attained education is master or more, the age of the individual, and a dummy variable indicating if an individual tends to order food on OFD apps once a month or more); and ϵ_i is the error term. The coefficient of interest is β. If the estimated β is positive and statistically significant, it indicates that informing that the platform abides by the new law positively impacts the outcome variable.

4. RESULTS

4.1. Profile of participants

A total of 264 individuals participated in the experiment. Table 1 reports the basic socio-demographics of the sample. There were more female (60.4%) than male (39.6%) participants. Regarding the highest level of education attained, 45.3% had earned a master's or PhD degree, whereas 45.3% are currently studying for an undergraduate degree. The average age is 30, with a standard deviation of 10 years. In turn, 55.1% of participants order food at least once a month via a delivery app, suggesting that this experiment's sample represents frequent online food delivery consumers.

Table 1. Descriptive statistics

	Observations	Percentage (%)
Gender		
Male	104	39.39
Female	160	60.61
Highest educational level attained		
High school	25	9.47
Undergraduate	119	45.08

Master's degree or more	120	45.45
Frequency in which ordering delivery food		
Once a month or more		
Less than once a month	146	55.30
	118	44.70
Knowledge regarding the *Rider Law* enactment		
Yes, did have heard about		
No, has not heard of it	141	53.41
Doesn´t know / Doesn´t answer	116	43.94
	7	2.65

	Mean (St. Dev.)	Range
Age	29.83 (9.97)	18-68

Table 2 showcases the results of the conducted t-tests. The first two columns report the means for each output variable, respectively, for the control and treated groups. In turn, columns (3) and (4) show the estimated t and the p-value, while the last column shows the level of statistical significance. The first variable studied was how satisfied respondents were with the order shown on the screen. The group "Control" had a mean satisfaction of 3.07, whereas the treated group had a mean of 3.56. The T-test result indicates that there is a statistically significant difference (P= 0.0004<0.01) between the two groups, and therefore, customers are more satisfied when they are told that the OFD provides working conditions that abide to the current legislation and that are fairer.

Table 2. T-test results

	(1) Control	(2) Treated	(3) t	(4) p-value	(5) Stat. Sig.
Satisfaction	3.070	3.563	-3.611	0.000	***
Value	2.861	3.163	-2.214	0.028	**
Purchase	2.992	3.356	-2.396	0.017	**
Tipping	1.357	1.314	0.391	0.697	

Statistical significance: $^{*}p < .1$, $^{**}p < .05$, $^{***}p < .01$

The next variable sought to assess how participants agreed with the value of the order. The T-test revealed that responses are statistically significant different (P= 0.0277<0.05) between the two groups. In fact, the mean for the group control is lower (M= 2.86) than the mean of the treated group (M= 3.16). This suggests that individuals agree more with the value of the order when they know that riders´ working conditions are respected. Consequently, for the purchase variable, which means that respondents needed to assess how inclined they were to go ahead with the purchase order, the results were quite consistent with the previous two variables. For the group control, the mean was quite lower (M= 2.99) than the treatment group (M=3.35). These results showed that there is a significant difference (P= 0.0173<0.05) in the purchase intentions of the consumers, which positively impacts the results of this study.

Regarding the tipping question, of the 264 participants, only 140 answered positively to the question, and, accordingly, subsequently provided the tipping amount in multiples of 0.50 cents. The last row of Table 2 shows that there are no statistically significant differences when comparing the means of tipping between the control and the treated groups (P= 0.69>0.10). This last result suggests that making consumers aware of better working conditions for riders does not impact their tipping behaviour. It is important to note that 80% of the participants in the treatment group reported that the displayed order summary specified the legal working status of the rider. In comparison, only 30% of the participants in the control group ascertained that. This question, which was used as a manipulation check, validates the methodology used.

Finally, Table 3 shows that the robustness check of estimating Equation (1) per each of the outcome variables confirms the T-tests of Table 2. In average, individuals are more satisfied, assign a higher value and display higher purchasing intentions when they are told that the OFD provides working conditions that abide to the current legislation and that are fairer. Yet there are no statistically significant differences regarding the tipping variable.

Table 3. Robustness check

	(1) satisfaction	(2) value	(3) purchase	(4) tipping
treated	0.476***	0.277**	0.339**	-0.057

	(0.136)	(0.137)	(0.153)	(0.112)
female	-0.025	0.132	0.177	0.017
	(0.144)	(0.146)	(0.166)	(0.115)
master	0.191	0.095	0.061	0.089
	(0.156)	(0.149)	(0.170)	(0.128)
age	0.015*	0.014*	0.014*	0.007
	(0.008)	(0.007)	(0.009)	(0.006)
frequent	0.066	0.203	0.045	-0.007
	(0.167)	(0.164)	(0.186)	(0.173)
Constant	2.529***	2.279***	2.434***	1.097***
	(0.258)	(0.229)	(0.269)	(0.194)
Observations	264	264	264	140
R^2	0.083	0.050	0.043	0.026

Robust standard errors in parentheses: * $p < .1$, ** $p < .05$, *** $p < .01$

5. DISCUSSION

The results of this study highlight that the working conditions of delivery drivers on OFD platforms impact consumer perceptions and behaviour. The results reveal that customers showcase higher satisfaction levels when they receive information highlighting improvements in delivery drivers' working conditions. This extends existing research on the drivers of customers satisfaction in OFD, which has traditionally focused on factors such as convenience, food quality and regular use (Dsouza & Sharma, 2021; Gunden et al., 2020b; Meena & Kumar, 2022). These results align with and expand upon the works of Zanetta et al. (2021) regarding collective solidarity indicating that is not merely a situational response but a continuing driver of consumers intentions.

The study also reveals that customers perceive greater value when they are informed about the riders' working conditions. These findings build on the work of Sanz de Miguel et al. (2023) who have explored the relationship between ethical practices and consumer perceptions. By establishing a link between riders' working conditions and value perception, these results also contribute to a more nuanced understanding of social welfare within the OFD ecosystem expanding the findings of Shroff et al. (2023). Furthermore, the positive impact on purchase intentions highlights the economic benefits of ethical labour practices also expanding the works of Crespi-Vallbona et al. (2023) and Louzao & Crespi-Vallbona (2022) in which emotional

engagement and fair labour practices increase customers' satisfaction, thus offering a new perspective on the interplay between regulatory measures and consumer behaviour.

From a policy point of view, the findings of this study challenge the traditional focus on economic efficiency in regulating OFD. For instance, while Ji et al. (2024), explained how lower wages can increase platforms' profits but may affect labour welfare and supply levels, our results suggest that fair working conditions can improve customer perceptions and boost the platform's long-term success. Likewise, when governments are more concerned about restaurants' profitability, they implement a "commission cap policy" that performs better than "wage floor regulation", and thus, it seeks to more efficiently improve the entire OFD ecosystem. The results of this study provide empirical support for policies prioritizing both social sustainability and economic efficiency. Moreover, the need for more comprehensive policy intervention is a growing concern unanimously expressed by several authors. Yet, their inquiries were limited either to the safety and health risks (Christie & Ward, 2023; Peticca-Harris et al., 2020; Quy Nguyen-Phuoc et al., 2023; Salmon et al., 2023) or the social precariousness resulting from the current Gig economy model (Álvarez Cuesta, 2018; Imaz & Gil de Gómez, 2022; Ravenelle, 2019, 2023; Todolí Signes, 2021). These results explain the positive outcome and customer impact of a proper managerial communication strategy derived from the implementation of groundbreaking government regulations in the context of OFD. Government regulations have an impact on the overall OFD ecosystem, but this study now provides a clear focus on the customers´ behaviour because of a societal response to the regulatory changes.

Concerning the tipping behaviour, these results align with Duhaime & Woessner (2019), since the social norm of tipping has also evolved in the context of the gig economy. However, this study cast new insights into tipping behaviour for it is not as relevant as the contractual conditions. Therefore, it is more efficient to make sure that firms abide to this new law guaranteeing better working conditions by properly disclosing information regarding the riders´ contractual conditions rather than promoting tipping as a strategy to make customer feel better with the transaction.

6. CONCLUSIONS AND FUTURE LINES OF RESEARCH

The growing tendency of consuming meals through delivery apps is a global reality, and OFD platforms continue to expand their operations worldwide. However, this rapid market expansion raises significant fairness concerns which can be examined from the triple bottom line framework, since the main themes are revenue distribution (Ji et al., 2024), social working rights (Ravenelle, 2023) and environmental impact (Li et al., 2020). Considering this situation, policymakers are striving to regulate this relatively recent economic activity. While the innovative nature of OFD platforms is unquestionable, they are not exempt from externalities, such as social distress, which require further understanding to develop positive solutions for the entire OFD ecosystem.

The objective of this research was to experimentally test whether the riders' working contractual conditions influence customer behaviour in the context of OFD platforms. To do so, an experiment was carried out to assess the impact of such conditions on customer satisfaction, value perception, purchase intentions and tipping behaviour among regular OFD users in Barcelona. The results indicate that customers are more likely to feel satisfied, perceive greater value, and exhibit higher purchase intentions when they are informed that their purchase is aligns with regulatory measures ensuring better working conditions for riders. Yet the results also show that this information about riders' working conditions do not impact customers tipping behaviour.

Consequently, these results entail important managerial implications for both OFD platforms and for policymakers. First, it places social sustainability as a significant element in consumers´ purchasing behaviours. This means delivery platforms that transparently disclose contractual information that improves riders' working conditions may benefit from higher customer satisfaction and value perception. In fact, since the purchase intention is higher, they may use different marketing strategies to upsell and to provide a better-quality service perception from customers. Opting for abiding by the legal current measures represents a competitive advantage for these platforms as it results ultimately in increased customer loyalty and thereby obtaining a positive economic payoff.

Second, the results suggest that legislating for more regulatory contractual situations can lead to a more positive customer perception regarding OFD platforms. Therefore, policymakers need to further seek more efficient ways to regulate these new forms of labour in the gig economy. Spain has set a precedent internationally regarding the legislation of labour force in the gig economy. However, since the majority of the OFD platforms operate internationally, it is crucial that more international institutions implement regulatory measures.

7. LIMITATIONS

Finally, this study is not exempt from limitations. First, the experiment was conducted within Barcelona's context to evaluate the Rider Law's effects. In this sense, customer choices may differ in other cities with less regulatory awareness. It is recommended that future research expand the geographic coverage of this study to a national level. Second, this study has focused on young individuals to obtain the results. In this regard, future studies could broaden the sample to include individuals from different socio-economic backgrounds. Third, this investigation was conducted at a time when, although the law required OFD platforms to hire riders as formal employees, most apps did not comply with it. Accordingly, we leave the analysis of OFD platforms' performance and customers' attitudes towards them as future work once full compliance with the law is achieved.

CHAPTER 3

MULTISENSORY AND ENVIRONMENTAL WELL-BEING IN GASTRONOMIC SPACES: A COMPUTATIONAL NEUROSCIENCE CASE STUDY.[3][4]

[3] This chapter was presented in the following congresses:

- (Best Paper Award nomination) **EFOOD24**: Designing for phygital Food Systems Congress. *Barcelona, Spain*
- **EUROCHRIE 2025:** Hospitality & Tourism Innovation: Exploring Inspiration Across Industry Lines. *The Hague, The Netherlands*
- **OLLD 25:** Open Living Lab Days. *La Velha, Andorra*

[4] This article was submitted to the **International Journal of Food Design (SJR, Q1)** in November 2024. The authors received minor-revision comments in September 2025, followed by final recommendations for inclusion in the upcoming issue in January 2026. The manuscript remains under review, and the authors are currently awaiting the final decision and publication.

ABSTRACT

Holistic gastronomic experiences include culinary, spatial, and multisensory aspects. However, restaurant space design often relies on theoretical principles, without necessarily considering real-world environments. Drawing on the Living Lab methodology, this paper aims to investigate the spatial experience linked to stimuli of a restaurant to develop evidence-based design interventions that enhance user experience. Neuroscience AI-driven technology was employed in a real restaurant to observe and measure customers' emotional responses. In (1) Diagnosis Phase, participants displayed neutral emotions when exposed to the existing restaurant layout, potentially due to high luminosity and the textile quality. Therefore, interventions were implemented focusing on the artificial lighting system, and the use of more natural textiles for table settings. During (2) Implementation Phase, participants who experienced the post-intervention environment exhibited slight emotional shifts from neutrality towards positivity. These results entail theoretical and managerial implications for hospitality operators and design professionals. The study offers detailed insights into how minor spatial modifications can stimulate distinctive changes in human responses, while more substantial structural interventions may significantly enhance the overall dining experience. This highlights the potential of AI technologies in evaluating and optimising user experiences within gastronomic spaces.

Keywords: Computational neuroscience; Gastronomic spaces; Multisensory experience; Neuroarchitecture

1. INTRODUCTION

In the field of architecture, artificial intelligence (AI) has previously been employed as a tool to support ideation in engineering design (Camburn et al., 2020). However, it was not until the widespread use of Generative AI (Gen AI) that it has emerged as a pivotal instrument for conceptualization and automated design. These algorithms can generate numerous iterations of a project, optimizing aspects such as material usage, energy efficiency, and spatial aesthetics (Chengyuan Li et al., 2025). In recent years, Gen AI tools have been extensively used in architectural design and image generation, offering architects the ability to visualize their creations rapidly and effectively (Tan & Luhrs, 2024).

From a business perspective, GenAI has also been increasingly adopted to optimise internal processes and enhance customer-facing operations in the hospitality sector. Restaurants and hotels, for example, have integrated GenAI tools to streamline reservation management, automate communication through chatbots, and provide more personalised customer information. These applications demonstrate the potential of AI to support operational efficiency and customer service improvements. However, despite these advances, the hospitality industry has only begun to scratch the surface of the broader possibilities that GenAI can offer. Its potential to transform decision-making processes, redesign workflows, and enable new service methodologies remains largely unexplored. As organisations in the sector continue to adopt digital tools, the integration of AI and GenAI into business models, operational systems, and innovation processes is likely to become increasingly relevant for achieving competitive advantage and enhancing both employee and customer experiences

Aboushall (2024) demonstrates a clear relationship between Gen AI and interior design processes where machines can produce design outputs with high accuracy, resulting in time optimization. Gen AI systems also support preliminary design exploration, home design and multiangle analysis (Chen & Wang, 2020; Wang et al., 2024). Moreover, they offer new aesthetic possibilities that help analyse how people interact with spaces, identifying patterns that enable designers to enhance functional adaptability, visual satisfaction, efficiency and space utilization (He, 2025). For instance, AI can simulate how different furniture layouts or lighting variations affect visual,

thermal, and acoustic comfort, allowing the creation of more pleasant and functional environments.

In the gastronomic context, the importance of improving interior spaces goes far beyond aesthetics or functionality; it is closely tied to the creation of unique multisensory experiences. In the restaurant industry, architecture and interior design play a crucial role in shaping how customers perceive and enjoy food, as the physical environment can influence the customer's purchasing decisions (Ayalp et al., 2017). Generative AI can be used to design immersive restaurant environments that optimise sensory perception, helping to craft experiences that deeply resonate with diners' emotions. For example, AI can model the impact of various environmental factors such as lighting, sound, or even plate design on taste perception, enabling the creation of spaces that enhance emotional responses and user enjoyment (Rottigni & Spence, 2024).

The phygital concept, defined as the integration of physical and digital elements, is widely used by practitioners to describe how companies engage customers through both physical and digital touchpoints enhancing the customer experience by leveraging multiple smart technologies (Mele et al., 2023). This approach has introduced new forms of potentially disruptive business models particularly in the tourism (Ballina et al., 2019) and retail (Banik, 2021) sectors. However, there remains a clear gap regarding how the phygital concept can be actively applied within the field of Food Design. This study addresses this gap by adopting a phygital approach that blends physical design interventions with real-time, AI-driven digital feedback in a gastronomic context to enhance the emotional customer experience.

People interact with the built environment mainly through their sensory systems, which receive and process information to enable interpretation. This interaction influences both the efficiency and quality of spatial experiences. In gastronomic contexts, this is particularly relevant due to the increasing interest in delivering tasting experiences that evoke emotional responses such as shock, nostalgia, or even tears (Rottigni & Spence, 2024; Spence & Youssef, 2022). Emotions are therefore fundamental components directly linked to multisensory analysis in fine-dining experiences. However, previous studies have mainly adopted two methodological approaches: (i) semantic network analysis and machine learning algorithms to analyse web

content after the experience has occurred (Oh & Kim, 2021), and (ii) artificial laboratory-based experiments that attempt to replicate real-world environment (Schifferstein et al., 2013; Spence, 2022). In both cases, researchers agree that all senses contribute to the perception of taste and flavour in food and drink.

Using the *El Bulli* restaurant as a paradigm of innovation in gastronomy (Capdevila et al., 2015), it becomes evident how Michelin-starred chefs have extended their influence beyond the kitchen and culinary offerings, incorporating elements such as ambient soundscapes and conceptual spatial design to create immersive experiences. However, the innovative aspects of spatial design are no longer confined to the exclusive domain of fine dining, as many restaurant businesses seek to strengthen brand positioning and expand market share, particularly in the aftermath of the COVID-19 crisis. As stated by Horng et al. (2013), innovation in the restaurant industry through spatial design has become increasingly important in recent years, offering a strategic opportunity to attract new market segments.

Another important concept is the Living Lab methodology, which has emerged as a key tool for addressing interior design in gastronomic contexts through innovative approaches. Living Labs are environments where products, services, and processes are developed and tested under real-life conditions, involving users as active participants in the innovation process (Schuurman et al., 2025) This methodology enables continuous experimentation and direct feedback loops between designers, users, and other stakeholders involved in the project (Dekker et al., 2020). In the context of restaurants, Kanstrup et al. (2010) used the Living Lab methodology to explore mobile support for everyday life with diabetes, demonstrating how this method provides a platform for testing technologies in real settings. Moreover, other studies have focused in studying the emergence of culinary innovation ecosystems with the help of living lab embedded in the innovation process (Galarraga & Martinez de Albeniz, 2025).

While AI enables the rapid and optimized exploration of multiple design options, the Living Lab approach offers a practical framework for continuous real-world experimentation, allowing spaces to dynamically adapt to users' needs and emotions. However, there is currently no evidence of how Living Lab can provide interior designers and restaurant operators with a platform

to test and refine design solutions based on actual user behaviour, thereby reducing the risk of implementing concepts that may fail in commercial settings. In a post-pandemic world, where restaurants strive to differentiate themselves through unique experiences, these tools might become essential for creating environments that are not only aesthetically pleasing but also enrich the emotional and sensory experience of diners.

Finally, while Zhang & Andersen (2025) have extensively reviewed various metrics for human responses to biophilic environments and interior design elements, there is still no evidence of the use of computational neuroscience, enhanced by Gen AI, to analyse emotional responses in restaurants. The purpose of this study is to address this research gap by conducting an experimental analysis in a real restaurant setting and developing evidence-based design interventions through the Living Lab methodology. Beyond filling this gap, the study also holds relevant managerial implications. Understanding how guests and staff emotionally respond to spatial conditions provides restaurant managers and hospitality operators with actionable insights to optimise the dining environment, improve service workflows, and enhance customer satisfaction. By integrating emotional analytics into decision-making, businesses can more effectively align their design strategies with guest expectations, support staff well-being, and strengthen their overall value proposition in an increasingly competitive market.

The remainder of the paper is structured as follows: Section 2 outlines the methodological design; Section 3 presents the results; and Sections 4 and 5 discuss the theoretical and managerial implications, followed by the conclusions.

2. METHODOLOGY

A mixed-method approach was employed, combining three distinct sources of information. First, subjective data were collected via surveys, administered through Google Forms, from space users, including both customers and staff members. Second, objective data were gathered from the built environment, using physical-environmental assessment tools such as the Testo 400 with various sensors and AQ500 (see Figure 1.a and Table 1. Types of studies). Third, emotional and behavioural responses of individuals—customers and staff—were captured using artificial intelligence and computational neuroscience systems provided by GOLI Technology (see

Table 1. Types of studies). These systems enabled neurological and physiological evaluation through two modes: an individual mode, which required informed consent, and an aggregated mode, which did not (see Figure 1.b). The research was conducted in two phases over a six-month period, integrating physical interventions with digital monitoring and feedback to establish a continuous phygital interaction throughout the process.

2.1. Design and participants

The study was carried out in two main phases: (1) Diagnosis and (2) Implementation, conducted between October 2023 and April 2024. The main objective of the first phase was to assess the restaurant´s current conditions related to the multisensory gastronomic experience identifying key design challenges. The second phase focused on implementing initial design proposals and evaluating the impact of spatial changes based on scientific evidence. Feedback from both customers and staff provided new insights, which informed future, more structural interventions.

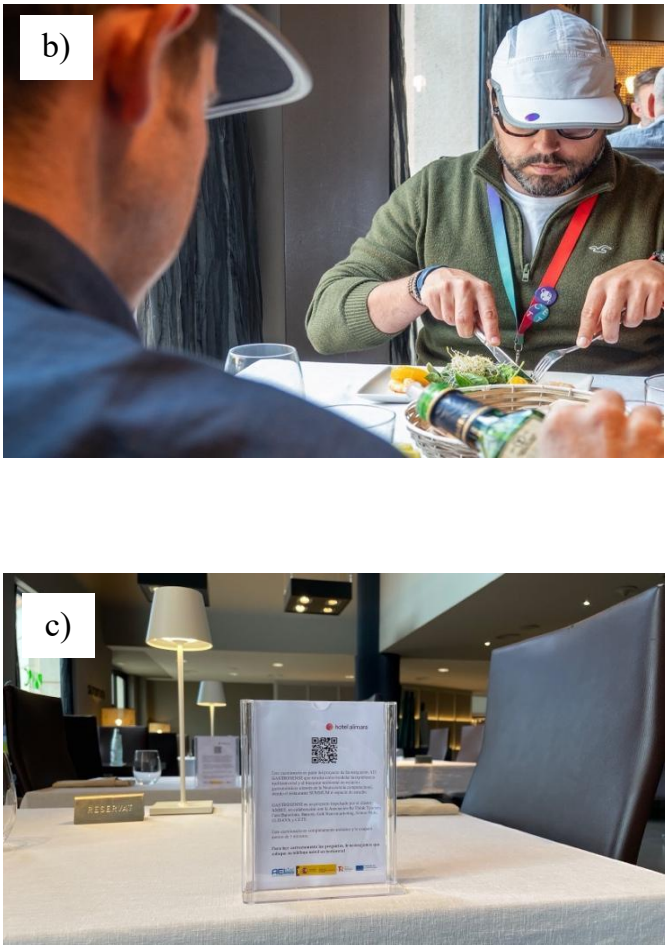

Figure 1. Test measurement tools: a) Testo tools b) Golineuro Cap, c) QR to the survey, placed on each table.

The study was conducted at Summum Restaurant, located in Barcelona (Spain). The restaurant offers a modern Mediterranean gastronomy rooted in Catalan cuisine, with a seasonal menu. The site comprises 196 m² on a single floor at the main entrance of Hotel Alimara, including a garden terrace. The research was conducted in the interior dining area.

Participants volunteered without receiving any compensation, to avoid bias in the appreciation of the experience. Volunteers were selected to represent typical user profiles of the restaurant. CETT Barcelona School of Tourism, Hospitality & Gastronomy Tourism coordinated the recruitment and

scheduling of participants. Additionally, information boards with QR codes were placed on restaurant tables to facilitate participation (see Figure 1c).

In the individual mode (with informed consent), seven (7) staff members and four (4) customers participated in the (1) Diagnosis phase, and nine (9) staff members and eighteen (18) customers took part in the (2) Implementation phase, helping researchers evaluate both, the gastronomic and working experiences. In the aggregated mode, twenty-two (22) customers responded to the (1) Diagnosis survey and thirty-three (33) to the (2) Implementation survey.

In total, across both phases, participation included 16 staff members, 22 customers in individual mode (with informed consent), and 55 customers in aggregated mode (without informed consent).

2.2. Measurements and tools

Two analyses were conducted, one in each phase: (1) Diagnosis and (2) Implementation. The Diagnosis analysis focused on assessing the initial situation, while the Implementation analysis aimed to evaluate the benefits of the intervention. Both analyses incorporated the following data collection methods:

- Aggregated neuroscientific measurements of customers' and staff member's emotional and behavioural responses to the gastronomic experience, conducted over one month in each phase using GOLI Neuro Artificial Vision Technology (Golineuro CAM´s and Proprietary software). Notably, this technology operated anonymously, without user recognition.

- Anonymous customer surveys capturing subjective perceptions and emotional responses to the restaurant experience. These surveys were available for nine days during each phase.

- Individual neuroscientific measurements of volunteer customers and staff during one midday and one evening service in the Diagnosis phase, and two midday and one evening service in the Implementation phase. Emotional and behavioural responses were evaluated using Golineuro CAMs, the Golineuro Cap, and the Golineuro Bracelet. In

these tests, user recognition was required, and informed consent was mandatory.

- Post-service surveys completed by volunteers (customers and staff) to assess their subjective perceptions and emotional states during the restaurant experience.

- Environmental measurements taken during services involving volunteers. Gauging was performed at six distinct points within the Summum restaurant, corresponding to six identified ambient zones. Parameters measured included light intensity, temperature, relative humidity, CO_2 levels, airspeed, noise, formaldehyde (CH_2O), and volatile organic compounds (VOCs). These data were collected using the Testo 400 with various sensors (Lux probe, IAQ probe 0632 1543, and hot wire probe), Testo 815, and AQ500 (GSE sensor and AQ-VOC sensor).

Table 4 summarizes the research methods applied in both phases and the measurement tools used

Table 4. Method data target of study scope period parameters details tool

Method	Data	Target of study	Scope	Period	Parameters	Details	Tool
Neuro scientific	Objective	Customers & staff	Aggregated	One (1) month for each analysis	Emotional & behavioural responses	Space & products use attraction, number of total uses, blockage detection, circulation & attention patterns. Predominant emotion & first impression Socialization: emotion changes in people's interaction.	GOLI technology: Golineuro CAMs & proprietary AI Sw
		Customers & staff	Individual through informed consent	One/two (1-2) midday service & one (1) evening service			GOLI technology: Golineuro CAMs & proprietary AI Sw + Golineuro Cap & Golineuro Brac
Survey	Subjective	Customers	Aggregated Anonymous	Nine (9) days	Subjective perception & emotional response	Perception and feelings about certain parameters of space (natural light, artificial light, luminosity, textiles, etc.)	Google forms
		Customers & staff	Individual through informed consent	One/two (1-2) midday service & one (1) evening service			
Spatial measurements	Objective	Space	Six restaurants points	One/two (1-2) midday service & one (1) evening service	Light intensity	Lux	Testo 400 + Lux probe (digital)
					Temperature	ºC	Testo 400 + IAQ probe 0632 1543
					Relative humidity	%	
					CO2	ppm	
					Air velocity	m/s	Testo 400 + Hot wire probe (digital)
					Noise	dB(A)	Testo 815 - Sound Level Meter
					CH20	ppm	AQ 500 + GSE (CH20) Sensor
					VOCs	ppm	AQ 500 + AQ-VOC Sensor

2.3. Procedure

Before detailing the procedure, it is important to note that all project partners were involved through a collaborative Living Lab methodology. Additionally, the study was reviewed and approved by a subcommittee of the CETT Barcelona School of Tourism, Hospitality and Gastronomy's research ethics committee

The procedures for phases (1) Diagnosis and (2) Implementation differed slightly (see Figure 2). As illustrated in the workflow, the Diagnosis phase began with three activities: a Preliminary Study, a Desired Experience Mapping Session, and the diagnostic analysis.

The Preliminary Study involved exploring the day-to-day operations of the Summum restaurant through meetings with administrative managers. A *Desired Experience Mapping* session was designed to gather insights from the staff regarding spatial challenges affecting their work, customer-reported issues, and suggestions for improvement.

The restaurant's core experience, which served as the basis for developing the parametric model, was defined during the (1) Diagnosis, using findings from these three activities and complementary desk research. Together, these sources enabled researchers to link the core experience with both environmental parameters and human response metrics to be evaluated in relation to experiential stimuli.

Given the involvement of lighting and textile companies as project partners, the study focused specifically on lighting and textile parameters, leading to the development of design codes, guidelines derived from the parametric model to inform spatial interventions.

Through the diagnostic analysis, researchers identified key design challenges, which were addressed in the intervention proposals developed by the design studio partner. The (2) Implementation phase involved executing these proposals at the Summum restaurant, focusing on lighting and textile interventions and their subsequent evaluation.

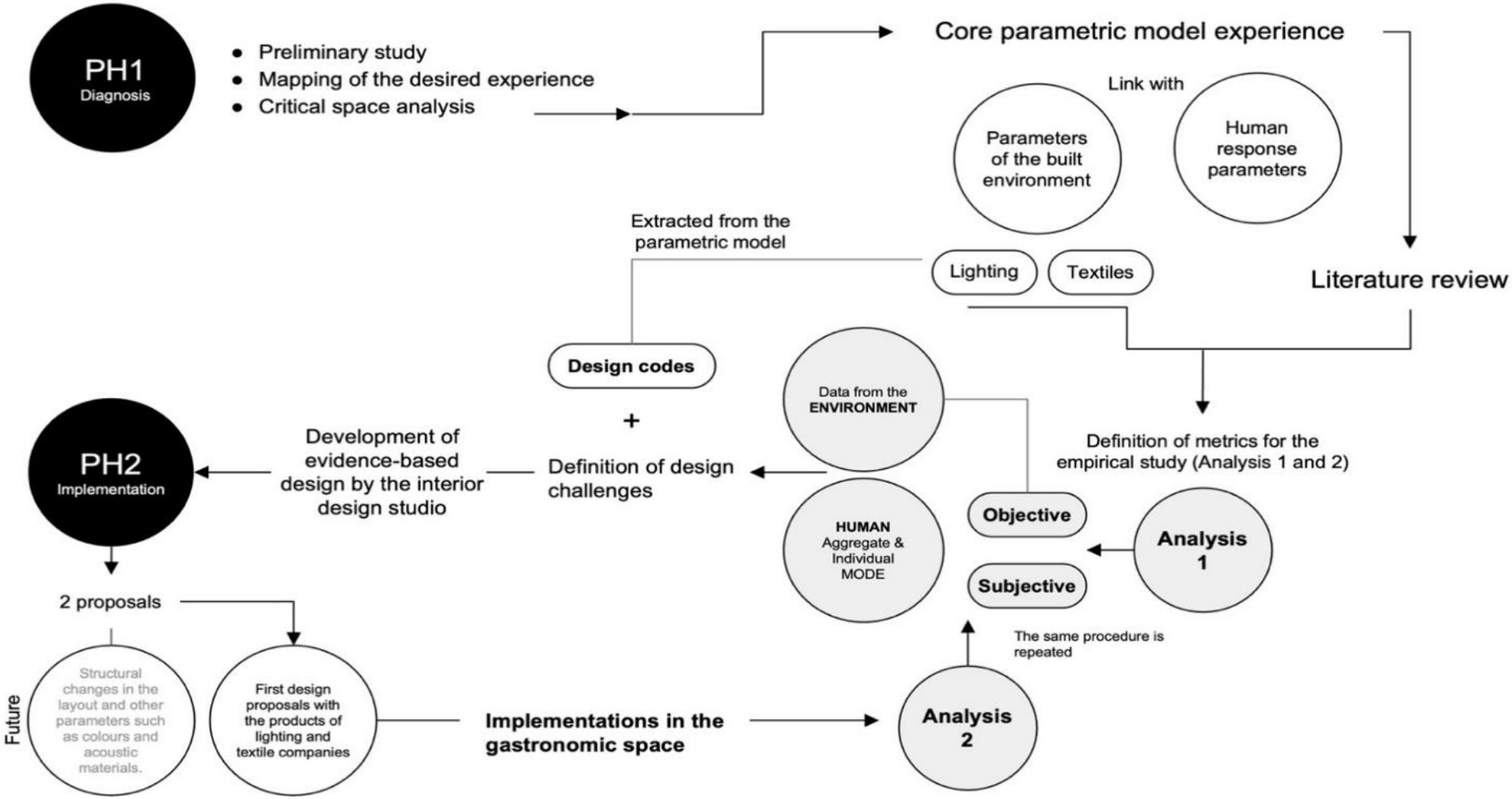

Figure 2. Workflow of the procedure used in this case study.

3. RESULTS

Based on the aim of this study, which was to explore the spatial experience linked to restaurant stimuli, the following results emerged. First, a parametric model was developed, grounded in design challenges and hypotheses. Second, preliminary design interventions were proposed and evaluated. Finally, recommendations for future structural changes were formulated.

3.1. Parametric model and design challenges

Among the main outcomes, the parametric model (See figure 3) stands out as an innovative tool that bridges scientific knowledge and spatial design. It connects the core of the gastronomic experience with both environmental parameters and human responses. The model is structured around the design challenges and hypotheses, the preliminary intervention proposals and their evaluation, and the recommendations for future structural changes. At the centre of the model are the most relevant aspects of the human experience organised into three dimensions of human response:

- Mental-emotional responses: perception, individual emotion, social emotion, cognition
- Behavioural responses:
    - Individual: Affordances, Reaction, Productivity
    - Social: Interaction
- Physiological responses: satisfaction and well-being

Two types of profiles, customers and staff members, were identified and represented in salmon colour. Human parameters are shown in grey, while environmental parameters are depicted in yellow. Human parameters allow for both objective and subjective evaluation of the core experience are classified as: (i) use of space, (ii) patterns of attention, (iii) resources, services, and activities, (iv) emotion, predominant sensation, (v) staff experience, (vi) block detection. In the meantime, environmental parameters are categorized as (i) visual, (ii) acoustic (iii) haptic (iv) olfactory and (v) gustatory

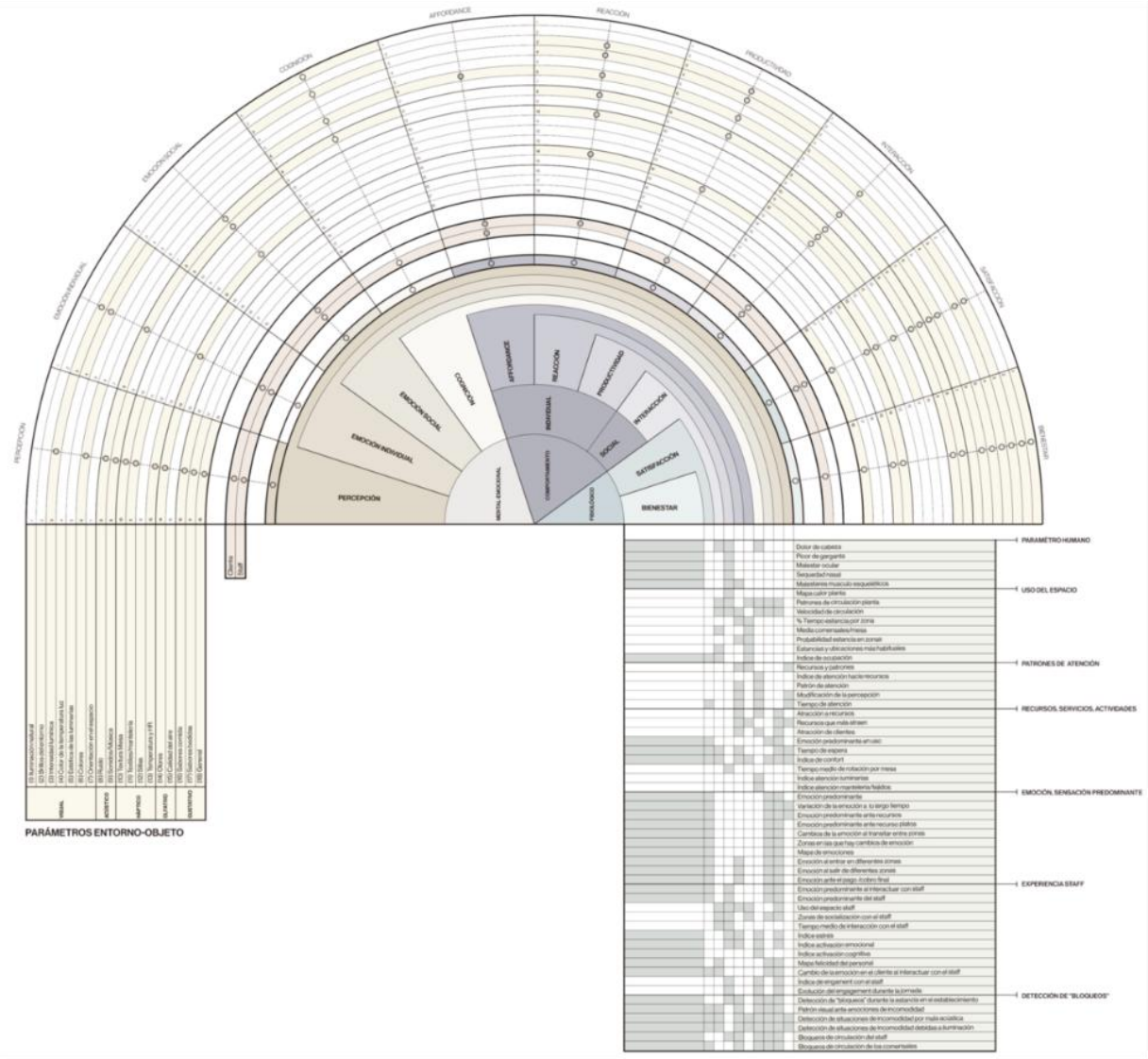

Figure 3. Parametric model

All connections within the parametric model are based on scientific evidence gathered through desk research. Both the Desired Experience Mapping and the Diagnosis analysis informed the desk research, the development of the parametric model, and the identification of design challenges.

User profiles, clients, and staff members, were defined, and their desired experiences were analysed across different service types: midday and dinner, weekday and weekend. For weekday midday customers, desired emotional and cognitive responses included calm, security, reliability, satisfaction, trust, and agility. For weekday dinner customers, expectation, surprise, calm, and happiness were predominant. Weekend customers expressed similar emotional needs.

Staff responses regarding their desired experience focused on efficiency, interest, attention, concentration, kindness, productivity, interest, security, empathy, and happiness.

The critical space analysis (see Figure 4) identified spatial risk factors that could hinder the desired experience. These findings were later confirmed and expanded through the first phase of analysis. Key issues included:

- Underused and poorly lit areas
- Tables with insufficient lighting
- Limited visual control for staff.
- Glare problems near windows
- High noise levels from the coffee machine.
- Noise caused by chairs scraping the floor.
- Lack of decorative elements.
- Excessive use of dark colours.

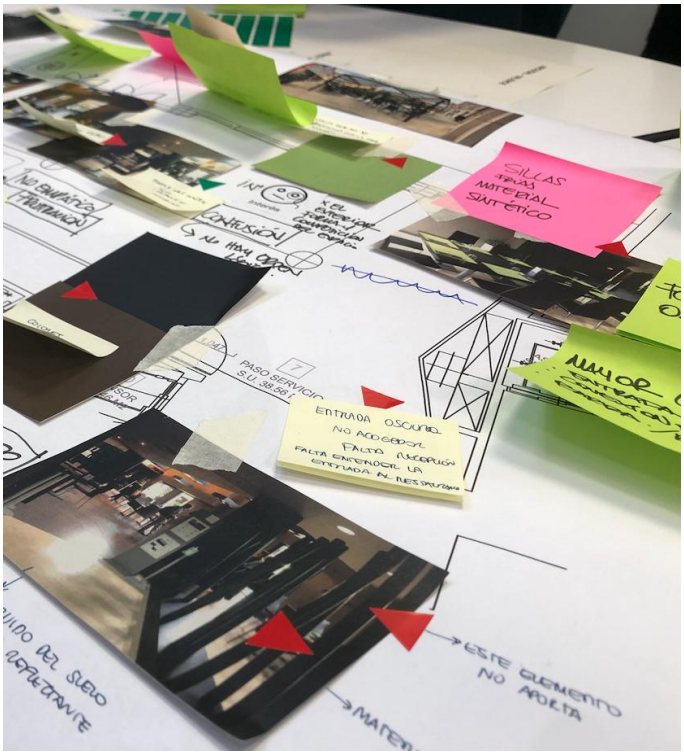

Figure 4. Critical space analysis

In both individual and aggregated analyses, a notable finding was the predominance of neutral emotional responses during the diagnosis phase, both subjectively and objectively. Noise, along with elevated light intensity and glare, emerged as the most critical environmental parameters affecting the gastronomic experience.

Although the highest recorded light intensity was 641 lux, which is above recommended levels, the main issue was the uncontrolled brightness from outside, generating a very high contrast with the interior. Noise levels ranged from 62.4 dB(A) to 69.4 dB(A), both of which can negatively impact well-being and contribute to the neutral emotional responses detected by both technology and participant self-reports.

With respect to human reactions to these environmental stimuli:

- In aggregate self-reports, brightness elicited neutral reactions, while natural light and light intensity were associated with positive emotions.

- In individual self-reports, brightness again triggered neutral responses, with natural light perceived positively.

- Staff reported more negative emotions in response to noise and light intensity whereas customers associated light intensity with calmness.

These unfavourable results informed the design challenges addressed by the interior design studio, guided by the parametric model (see Figure 3). Six key design challenges were identified: (i) Eliminate noise pollution between the hotel and restaurant entrances, (ii) promote a sense of calm for diners, (iii) enhance memory states for staff members, (iv) reorient customer views toward the exterior space, (v) regulate natural lighting, (vi) provide greater identity to the underutilized back area.

3.2. First design proposal interventions and evaluation of their impacts

Once the design challenges were identified and analysed, several improvements were applied in phase (2) Implementation. The spatial interventions primarily focused on the artificial lighting system, which combined technical and decorative lighting to create distinct atmospheres. Elements were also introduced to regulate natural light entry (see Figure 5). Table linen made from more natural textiles was incorporated, and staff members were provided with aprons aligned with the restaurant's updated colour palette.

Figure 5. Left: pre-intervention. Right: post-intervention configuration

Following these preliminary interventions, changes were observed in the emotional states of both staff and customers. Increase attention and pleasure were associated with the textiles and the lighting ambiance, particularly due to the installation of luminaires at each table, which enhanced the overall dining experience.

Regarding environmental data, light intensity increased at the most critical evaluation point, while variation across different points was reduced—potentially improving brightness uniformity. Noise levels decreased slightly. However, self-reported emotional responses remained like those recorded in the initial analysis. Customer responses were more frequently located in the "calm" and "happiness" quadrants compared to the first phase. In contrast, staff emotions tended to remain neutral, with a slight inclination toward the "sadness" and "anger" quadrants.

3.3. Proposal for more structural and future changes

Based on the results obtained and the design challenges identified during the first phase, final design strategies were defined for future interventions in the space (See figure 6). These proposals include two main categories of intervention: changes to the layout and modifications to coverings and furniture. The **changes to layout** included: (i) Bar-type table at the entrance:

Intended to improve staff control and help orient customers upon arrival. It also serves as a waiting area or a quick-service café zone, becoming both a visual and operational reference within the restaurant. (ii) Coffee area with high tables and dividing screens: Adds flexibility to the space, offering alternative seating arrangements and enabling the purchase of different products, such as appetizers. (iii) New intimate dining area: Allows for differentiated atmospheres, giving customers greater freedom in choosing where to sit. (iv) Backlit wall in the rear area: Designed to draw attention from entering customers and improve light quality in a zone previously below the recommended 78 lux threshold.

Regarding the **coverings and furniture**, modifications included: (i) Application of ecological paint in warm white tones on walls and columns: Aims to increase light and warmth in the space, addressing the perceived darkness reported by users. (ii) Lacquered doors in matching warm white: Ensures visual consistency and contributes to the overall brightness. (iii) Microcement flooring in greige “Shadow White”: Selected for improved maintenance and alignment with the new warmer colour palette, addressing previous issues with cleaning efficiency. (iv) Replacement of tables with natural wood finishes: Introduces biophilic elements that enhance the haptic and olfactory experience, contributing to a richer multisensory environment. (v) Incorporation of vegetation: Plays a key role in shaping the atmosphere, complementing the use of natural materials. (vi) General and decorative lighting updates: Designed to create varied atmospheres and introduce new colour dynamics throughout the space.

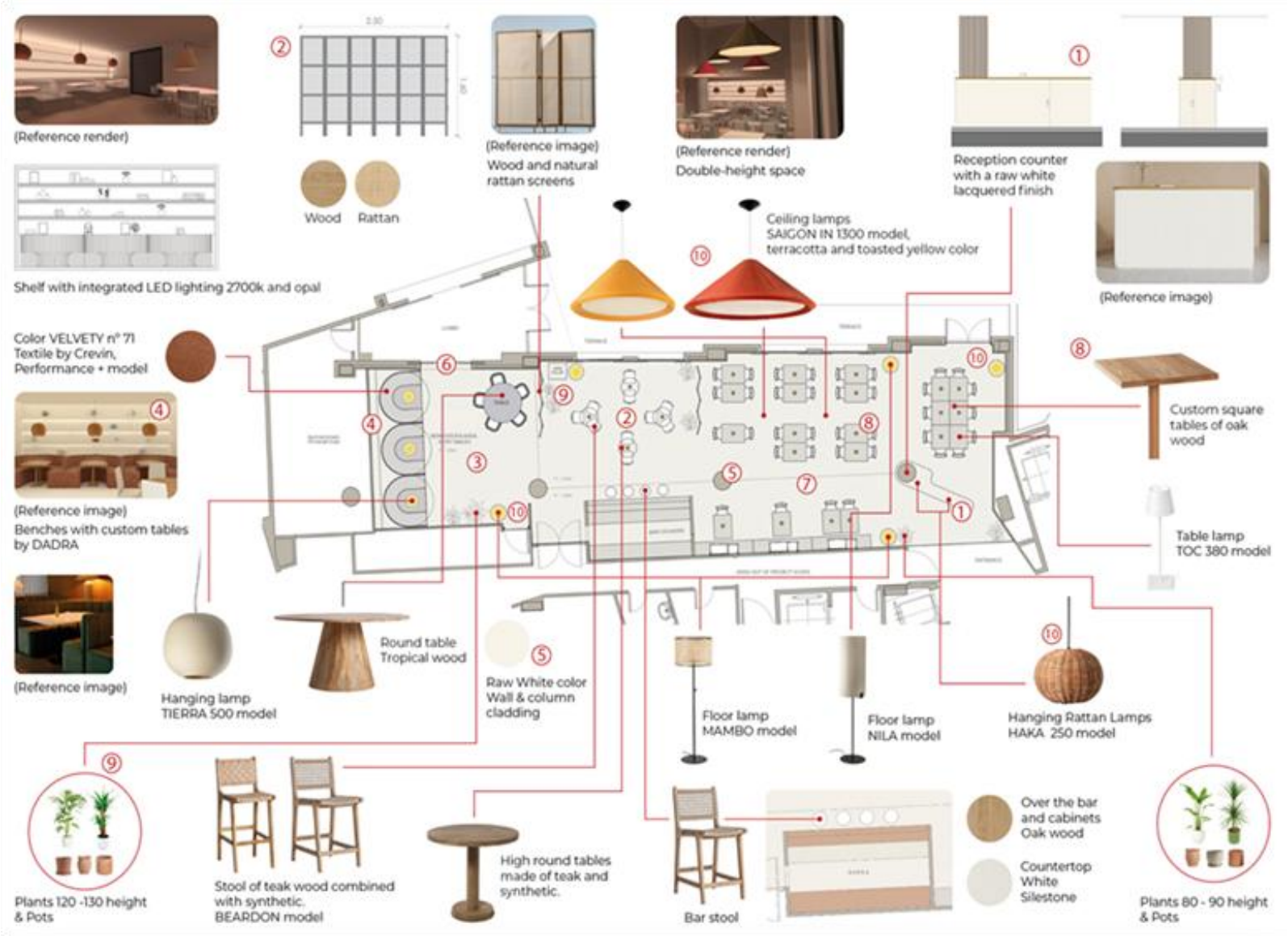

Figure 6. Future interventions proposal

4. DISCUSSION

The purpose of this study was to investigate how spatial stimuli influence the emotional, cognitive, and behavioural responses of both customers and staff, intending to propose design interventions that enhance multisensory experiences. In doing so, the study contributes to the growing body of knowledge in interior design, hospitality research, and neuroarchitecture while also advancing methodological approaches by incorporating AI-driven emotional data analysis for phygital food systems.

The neutral emotional responses observed in (1) Diagnosis phase of the study are a key finding that aligns with existing literature on sensory design, which highlights the complexity of multisensory dining experiences (Spence, 2019). Factors such as lighting, sound, texture, and aroma interact in subtle ways, and their influence may not always result in strong emotional shifts. Despite targeted interventions—modifications to lighting, textiles, and furniture—participants continued to report predominantly neutral emotional states. This suggests that while atmospheric changes can enhance the dining experience, they may not be sufficient to evoke pronounced emotional reactions.

One explanation for the persistence of neutral emotions could be the inherent difficulty in altering deeply fixed sensory preferences and responses in a short time frame. It is possible that participants' prior expectations or habitual dining experiences overshadowed the relatively modest changes made to the restaurant environment. This underscores the value of a long-term, iterative design approach, where ongoing modifications and real-time user feedback can help designers fine-tune their interventions to gradually shift emotional responses from neutral to more positive. Moreover, the finding that natural light and textile modifications did have some impact on emotional responses suggests that while these interventions are beneficial, they may need to be accompanied by a more immersive multisensory strategy.

The integration of AI in this study adds a novel dimension to the of customer experience. While Chen & Wang (2020) identified AI primarily as a tool for generating visual content in design, this research extends its application to emotional and physiological data collection. This shift from subjective impressions to evidence-based design represents a significant

methodological advancement. By incorporating AI to capture real-time emotional responses, designers can create spaces that are more attuned to users' needs and preferences.

Creativity also plays a central role in shaping restaurant environments. As Horng et al. (2013) emphasize, emotional impact is a key differentiator in hospitality design. In a competitive post-pandemic landscape, diners seek not only quality food but also to expand the frontiers of culinary innovation (Galarraga & Martinez de Albeniz, 2025). This study demonstrates how sensory-focused design, addressing elements such as noise reduction, lighting quality, and tactile materials, can contribute to customer satisfaction and commercial success. By engaging multiple senses, restaurants can offer immersive environments that go beyond taste alone.

Furthermore, the Living Lab methodology proved to be an invaluable tool for fostering open innovation and ensuring that the design interventions were rooted in real-world user feedback (Kanstrup et al., 2010). Schuurman et al. (2016) demonstrated that Living Labs are highly effective in encouraging collaboration between various stakeholders, including customers, staff, designers, and researchers. This study's findings support that claim, as the open innovation framework allowed for a dynamic, iterative process in which user feedback directly informed the design interventions. For example, staff members' contributions, such as their concerns about noise and lighting, were crucial to shaping the final design proposal. This collaborative approach ensures that the resulting space not only meets aesthetic and functional requirements but also addresses the practical needs of those who use it daily.

From a methodological perspective, combining the Living Lab methodology with neurocomputational tools to measure emotional and behavioural responses creates a phygital loop that deepens understanding of the gastronomic context and offers a promising avenue for future research. While traditional studies on interior design often rely on subjective surveys or post-occupancy evaluations, this study's use of real-time experience tracking provides a more granular and accurate understanding of how space influences behaviour and emotions. The ability to capture physiological responses—such as heart rate or skin conductance—enables researchers to gain insights into subconscious reactions that may not be evident through self-reported data alone. As neuroarchitecture continues to evolve, integrating these

advanced measurement tools with design methodologies like Living Labs could lead to more sophisticated and effective design interventions across a range of environments, from restaurants to hotels to office spaces.

The findings also have important managerial implications. For design contractors, the use of AI and Living Lab methodologies enables a more scientific and user-centric approach to interior design. This not only improves client satisfaction but also positions contractors as innovators in the field. For restaurant operators, understanding the emotional and physiological impact of spatial design offers valuable insights for enhancing the dining experience. By applying these insights, operators can foster positive emotions, increase customer retention, and ultimately drive revenue.

Perhaps most notably, the study highlights the economic potential of sensory design. Carefully crafted environments that respond to diners' emotional and sensory needs can encourage repeat visits and generate positive word-of-mouth. In a post-pandemic context, where differentiation is crucial, investing in sensory design and AI-based emotional tracking can help restaurants create spaces that are not only functional but also emotionally resonant and commercially successful.

Integrating neuroarchitecture principles can also play a crucial role in enhancing the well-being of both customers and staff while promoting design strategies with sustainable and socially responsible practices. Gaining a deeper understanding of how built environments affect human cognition, emotions, and behaviour, can play a crucial role in promoting more equitable, healthier and sustainable experiences. Moreover, the application AI and real-time data analysis into the design process also allows for continuous feedback and adaptation. This ensures that spaces evolve in response to user needs and environmental goals, aligning the business's design strategies with broader Environmental, Social, and Governance (ESG) objectives.

Finally, this study offers valuable insights into the relationship between spatial design and multisensory experiences in restaurant contexts. The findings underscore the importance of incorporating AI and neurocomputational tools into the design process to gain a more comprehensive understanding of how space impacts emotional and behavioural responses. The Living Lab methodology further strengthens this

approach by fostering collaboration and grounding design decisions in real-world feedback. While the study focused on restaurant environments, its implications extend to the wider hospitality industry. Sensory design and emotion-driven spaces may become key differentiators for businesses seeking to attract and retain customers in an increasingly competitive market. Future research should continue to explore the intersection of AI, neuroarchitecture, and multisensory design, with the goal of creating spaces that not only meet functional needs but also enhance emotional well-being and user satisfaction.

5. CONCLUSIONS

The study has a significant impact on the occupational outlook of those working in and managing restaurant spaces. By incorporating AI and neuroscience technologies, the research offers objective insights into customer experiences, revealing how physical-environmental adjustments influence emotional responses. These findings exhibit a scalable phygital system where advanced technology and physical design merge to create adaptive dining environments. The practical use of phygital loops in real contexts empower hospitality operators and design contractors to make data-driven decisions that enhance the dining atmosphere and improving job satisfaction and operational efficiency for restaurant staff.

The co-creation workshops involving various stakeholders, from designers to staff members, highlight the collaborative effort required to implement meaningful changes. These sessions foster innovation and ensure that modifications are both practical and positively received, contributing to a more cohesive and effective work environment. Within this collaborative framework, the availability of new data sources has facilitated the development of shared languages enabling interdisciplinary collaboration among interior design manufacturers, interior designers, and restaurant managers. As a result, the configuration of technological tools has supported the integration of different perspectives and interpretations of empirical evidence regarding the performance of different interior design configurations in relation to gastronomic objectives.

Although the study focuses on restaurant spaces, its findings have broader implications for other hospitality areas, such as hotel lobbies, guest rooms,

and conference facilities. The integration of AI-driven emotional data and spatial design strategies could be applied to optimise these settings, tailoring them to enhance guest experiences, improve employee productivity, and support various operational goals. For instance, lobbies could be redesigned to create welcoming and calming atmospheres for arriving guests, while meeting spaces could incorporate personalised sensory elements to enhance relaxation and comfort.

Furthermore, the use AI and neurocomputational tools in this study paves the way for the adoption of augmented analytics in hospitality design. These technologies enhance the human capacity to interact with data at a more contextual and granular level, enabling designers and managers to make real-time adjustments based on continuous data collection. Future research could explore the integration of extended reality (XR) technologies, and Internet of Things (IoT) devices to further improve spatial design. For instance, actionable analytics could allow space managers to visualise potential changes in real time, while IoT devices could continuously monitor and adjust environmental factors such as lighting, temperature, and sound to optimise customer experiences. This increased data availability would also support further research into the intersection of neuroarchitecture and ESG management in hospitality spaces.

5.1. Limitations and future lines of research

This study is not without limitations. Although the Living Lab methodology provides a novel approach and offers innovative insights into the analysis, the process requires further refinement. Due to conditions inherent to the broader project in which this research was embedded, the sample sizes across phases were not fully consistent. It is also recommended to expand the customer survey base, as doing so would likely strengthen the analysis by enabling statistical validation that contrasts emotional analytics with direct customer responses.

Moreover, the nature of the project did not allow for structural modifications in the restaurant redesign, which likely influenced the outcomes observed in the implementation phase. For this reason, future research should consider assessing more substantial, structural design changes in restaurant environments to compare results and generate clearer emotional contrasts. Such an approach would help further decode the drivers of well-being for

both customers and staff, and it could become a valuable tool for practitioners seeking to improve design and customer experience with limited resources. Finally, it would be highly beneficial to analyse the perspectives of restaurant managers and decision-makers to broaden the scope of the study by incorporating their views. Doing so would help reduce the current gap between staff-centred insights and management perspectives.

6. ACKNOWLEDGEMENTS

This chapter was part of a competitive project called *Gastrosense*, co-financed by the Innovative Business Groups Program (AEI) of the Spanish Ministry of Industry and Tourism, with support from the European Union through the Recovery, Transformation and Resilience Plan.

CHAPTER 4

REDESIGNING THE HOTEL BREAKFAST BUFFET SERVICESCAPE THROUGH EMOTIONAL ANALYTICS: A LIVING LAB CASE STUDY[56]

[5] **This chapter was presented in the following congresses:**

- **EUROCHRIE 2025:** Hospitality & Tourism Innovation: Exploring Inspiration Across Industry Lines. *The Hague, The Netherlands*
- **OLLD 25:** Open Living Lab Days Conference. *La Velha, Andorra*

[6] This article was submitted to the **Journal of Innovation Management (SJR, Q3)** in February 2026. The manuscript is currently under review, and the authors are awaiting the journal's response.

ABSTRACT

While emotions are central to hospitality experiences, the buffet breakfast, an emotionally charged and frequent guest touchpoint, remains underexplored in this sense. This study investigates how both physical and social elements of the breakfast servicescape influence guest emotions, and whether targeted redesigns can enhance the emotional quality of the experience. Conducted at the Alimara Hotel in Barcelona, the research adopts a Living Lab approach grounded in mixed-method triangulation, integrating second-by-second emotional tracking via non-intrusive neurosensors, multiple stakeholders input gathered during co-creation sessions and structured questionnaires, and principles from evidence-based design. The study unfolded across four phases: initial emotional mapping, collaborative spatial analysis, implementation of design and product adjustments, and a post-intervention evaluation. Results show that prior to the intervention, guests predominantly experienced disappointment, disinterest, and dissatisfaction. Post-intervention, neutral and satisfied emotional states arose and staff improved workflow and accessibility. This study demonstrates the feasibility of applying neuromarketing tools and emotional analytics in a real hotel setting, validates Living Lab's approach as an innovative ecosystem for hospitality environments, and highlights the value of integrating guest-affective data with staff perspectives to inform spatial and service design. By extending servicescape theory to a high-autonomy and emotionally significant touchpoint, this research offers a multidisciplinary framework for evidence-based innovation in hospitality.

Keywords: Breakfast Buffet; Emotional Analytics; Hospitality Experience; Living Lab; Servicescape Redesign

1. INTRODUCTION

Emotions are central to the hospitality experience. Unlike purely functional services, hospitality encounters are inherently affective, shaped by the physical and social environments in which they occur. Guests' emotional responses play a critical role in shaping satisfaction, memory, and loyalty (Liljander & Strandvik, 1997; Mano & Oliver, 1993). In this context, the servicescape, including both physical design and human interactions, becomes key for influencing customer emotions (Bitner, 1992; Line & Hanks, 2020). As prior literature in hospitality and service design suggests, the emotional valence of these experiences not only reflects the quality-of-service delivery but also acts as a predictor of future behavioural intentions. Given this centrality of emotions, a pressing challenge for hoteliers is how to proactively design or redesign hospitality spaces to elicit more positive emotional responses, ultimately contributing to enhanced guest satisfaction and revenue generation. While traditional approaches often rely on architects' or designers' intuition, this method may lack empirical grounding and fail to capture the dynamic and subjective nature of emotional experience.

To address the limitation of intuition-driven design, there is a need for design approaches that test potential interventions in real-life contexts and iteratively incorporate stakeholder inputs. Living Labs (LLs) are user-centred, open innovation ecosystems that operate in real-life contexts and rely on multi-stakeholder participation and iterative prototyping, making them conceptually aligned with such design requirements. Their use and characteristics have been widely explored in the academic literature (Almirall et al., 2012; Hossain et al., 2019; Schuurman, 2015; Westerlund et al., 2018), as they offer a proactive way to engage actors from the quadruple helix (industry, academia, government and citizens) to co-create solutions that incorporate multiple perspectives and enrich the innovation process (Arnkil et al., 2010). Hossain et al. (2019) identifies eight key characteristics that are essential to LLs development: (i) real-life environments; (ii) stakeholders; (iii) activities; (iv) business models and networks; (v) methods, tools and approaches; (vi) innovation outcomes; (vii) challenges; and (viii) sustainability. These dimensions reflect the fundamental ethos of LLs as transformative agents capable of driving societal change and addressing wicked problems (Schuurman et al., 2025). Many companies recognize LLs

as a valid mechanism to support their innovation processes, improve services, or test new business solutions (Guzmán et al., 2013). However, there is limited evidence on how LLs can be applied within the context of hotels.

Triangulation involves examining the same phenomenon through multiple complementary data sources to enhance validity and depth (Decrop, 1999). To explore the practical application of this triangulated approach, the study focuses on a real-world case: the breakfast buffet restaurant of a four-star urban hotel in Barcelona, the Alimara Hotel. In this study, triangulation is applied to the redesign of the buffet breakfast restaurant by integrating real-time emotional insights with stakeholder-driven design processes. Specifically, guests' second-by-second emotional responses to physical and social servicescape elements are captured using non-intrusive neuromarketing sensors. These emotional data are combined with staff insights gathered through co-creation sessions to identify friction points within the existing design. The resulting evidence-informed spatial redesign intervention modifies both spatial configuration and selected product elements. Drawing on Almirall et al. (2012), who conceptualize LLs as open innovation ecosystems grounded in iterative multistakeholder engagement, a post-intervention phase then evaluates whether the redesigned servicescape is associated with shifts in guests' emotional patterns and perceived operational improvements.

By embedding this process within a LL framework, the study demonstrates how emotionally grounded, multistakeholder redesign processes can inform innovation in hospitality environments and potentially serve as a transferable model for similar service contexts. In the context of hospitality, this framework enables collaboration among multidisciplinary stakeholders, including a neurotechnology startup, architects, interior designers, academic researchers, Living Lab specialists, hotel staff, and guests.

The rest of the paper is structured as follows. It reviews the relevant literature on emotions in service experiences, with a particular focus on hotel breakfasts. It also examines relevant LL case studies and their various arenas of work and defines relevant interdisciplinary fields grounded in neuroscience that offer a framework for understanding how environmental stimuli shape emotions in real time. The methodology section presents a triangulated and multistakeholder approach through different phases. The

results from the different phases are presented and finally, the paper concludes by discussing the outcomes of the redesign, practical implications for both hospitality managers and interior designers, and directions for future research on emotion-driven service environments.

2. RELATED LITERATURE

2.1. Emotions in hospitality experiences

Emotions are recognized as key elements of the perceived quality of service experiences. To understand how experiences generate value, it is essential to define the emotional processes involved. Emotions are mental states elicited by cognitive appraisals of events or thoughts (Bagozzi et al., 1999), and, as embodied physiological responses, they often manifest through facial expressions and bodily reactions. Pine & Gilmore (2001) conceptualize the experience economy as one in which companies design services as theatrical performances, where services are the stage and goods function as instruments to create emotionally charged and memorable encounters. These experiences engage customers on a personal level, prompting subjective interpretations and responses. Consequently, the value of an experience lies in the emotional sensations it evokes. As Poulsson & Kale (2004) argue, the perceived utility of an experience is shaped by both the intensity of the encounter and the degree of emotional resonance it generates for the individual consumer.

Beyond shaping the service experience itself, emotions also play a critical role in post-consumption evaluations, most notably in determining customer satisfaction. According to Ali et al. (2016), emotions are strong determinants of guest satisfaction in resort hotels settings, aligning with Mano & Oliver (1993) view of satisfaction not as a singular affective response, but as a complex emotional state influenced by other positive and negative emotions. Expanding on this perspective, Liljander & Strandvik (1997) argue that negative emotions strongly influence satisfaction outcomes. Their findings indicate that while moderate emotional responses may have little impact, intense negative emotions tend to significantly diminish satisfaction. In contrast, even strong positive emotions do not necessarily produce a corresponding increase in satisfaction, suggesting an imbalance in the emotional contribution to customer satisfaction.

Within the context of hotel stays, meals, and particularly breakfast, are emotionally significant experiences that shape guest perceptions and

satisfaction. Leite-Pereira et al. (2019) emphasize that meals contribute to both positive and negative emotional memories, which subsequently influence overall evaluations of the stay. Subsequent research by Leite-Pereira et al. (2022) further reinforces the importance of hotel breakfasts by demonstrating that they play a role not only in guest satisfaction but also in hotel choice and customer loyalty. Given that breakfast is frequently included in the accommodation rate, its perceived importance is elevated. Moreover, Leite-Pereira et al. (2020) found that breakfast is mentioned in more than half of guest reviews on booking platforms, underscoring its prominence in post-stay reflections through electronic word-of-mouth. These online reviews are crucial in shaping consumer decision-making, as they help reduce information asymmetry between prospective guests and hospitality service providers (Manes & Tchetchik, 2018; Mo et al., 2015).

Existing research has examined hotel breakfast primarily from the perspectives of pricing, product offerings, and guest behaviour. Anguera-Torrell & Nicolau (2025) demonstrated that the likelihood of booking a breakfast-included hotel room is dependent on the accommodation rate. Illescas-Manzano et al. (2025) further found that hotel category and online reputation enable managers to set higher breakfast prices. Shifting focus from pricing to product offering, Lee et al. (2018) identified guest preferences for specific food and beverage breakfast items such as fruit bowls, waffles, scrambled eggs, and coffee. Expanding on this, Leite-Pereira et al. (2023) identified differences in terms of breakfast product preferences based on demographic factors such as age, gender, and country of origin. Another critical area of research is the food waste in buffet-format hotel breakfasts. Juvan et al. (2018) identified concrete guest and breakfast characteristics that lead to higher food waste, such as buffet layout, crowdedness, and guest nationality. Despite these diverse lines of research, emotional responses during the hotel breakfast experience remain largely underexplored.

Earlier studies have demonstrated that both physical and social elements of the servicescape can shape the dining experience, particularly in fast-casual restaurant settings (Line & Hanks, 2020). Bitner (1992) conceptualized the servicescape as the set of environmental features in which a service encounter occurs. These features encompass both physical components (e.g. layout, lighting, and ambiance) and social components, including human presence and interpersonal interactions. Staff performance has been identified as a core

element of service delivery in economic exchanges, directly influencing customer perceptions and satisfaction (Grandey et al., 2005). Hotel buffet breakfasts present a distinct setting characterized by high guest autonomy and self-service dynamics. These intrinsic features make the breakfast setting particularly relevant for studying how physical and social factors shape real-time guest emotional responses. Emerging fields such as neuromarketing and neuroarchitecture offer potential frameworks for decoding emotional responses that traditional guest satisfaction measures may overlook.

2.2. Living Labs as innovation ecosystems in tourism

LLs are open innovation environments that facilitate the co-creation, testing, and prototyping of technological, product, and service solutions in real-life contexts. This is made possible through the iterative nature of their methods and tools, as well as the multidisciplinary approach applied to analyse the complexities of such solutions. Beckett & O'Loughlin (2024) highlight the leverage of mutual learning and the joint creation of knowledge, which enables a more holistic understanding of specific issues. Similarly, Guzmán et al. (2013) point to the importance of adopting win-win strategies, defined through the clear identification of contributions from every participant. This helps ensure complementarity and allows for the achievement of more complex outcomes. In the same line, Leminen & Westerlund (2025) propose further research on how LLs can continue to implement effective forms of co-creation to optimize efforts.

Definitions of LLs have evolved considerably over the past two decades. A key driver of this evolution has been the creation and consolidation of the European Network of Living Labs (ENoLL), an international association that brings together a large and diverse set of LL initiatives. This has allowed this phenomenon to be studied in greater depth and complexity, both in terms of its conceptualization (Guzmán et al., 2013; Leminen & Westerlund, 2019), its inherent characteristics (Ballon & Schuurman, 2015; Hossain et al., 2019), and its diverse applications across multiple fields such as education (Choe & Kim, 2024; Fortiş & Petcu, 2022; Stuckrath et al., 2025), agriculture (Beaudoin et al., 2022), sustainability (Evans et al., 2015; Jernsand, 2019), and social innovation (Battisti, 2014; Cossetta & Palumbo, 2014; Dekker et al., 2020). ENoLL identifies five major categories of LLs according to their objectives and ambitions: (i) Grand Societal Challenges, (ii) Policies,

Governance, Collaboration and Innovation Ecosystems, (iii) Business and Emerging Technologies, (iv) Inclusive Societal Engagement, and (v) Campus/University LLs. This variety of categories illustrates the versatility and capacity of LLs to tackle wicked problems (Schuurman et al., 2025).

In the field of tourism, several studies have sought to better understand how LLs can optimize and improve the quality and complexity of solutions within this socially and structurally complex phenomenon. Cigir (2018) argues that involving users and hotel guests increases the capacity of LLs to sustain tourism innovation. Other studies (Calzada, 2019) focus on single-case analyses, such as the implementation of a Tourism Living Lab in Zumaia (Basque Country) to co-create solutions to mitigate the phenomenon known as "tourism-phobia,", or Guimont & Lapointe (2016), who underlies how the LL process can empower key players in a tourist destination. Another relevant approach is found in Mandić et al. (2025), who examines the potential of LLs to foster cultural tourism in the post-COVID context. What these studies share are the specific contexts and characteristics in which they are situated.

There is also a strand of research based on multiple case studies. For example, Dickinger & Kolomoyets (2024) analyses six LLs using a three-phase mixed-method approach and highlights the importance of establishing a set of collaboration principles to mitigate potentially conflicting goals. Similarly, Koens et al. (2024) examines two urban LLs and, while acknowledging their unique potential in tourism contexts, emphasizes that their primary value lies not in providing ready-to-implement solutions but in offering a space where different stakeholders can identify possible solutions and define alternative futures. Despite progress in studying tourism phenomena through the lens of LLs, there is still limited literature explaining the potential of this approach in the search for and development of solutions related to hospitality management. This study examines a case that has enabled the identification of innovative solutions for understanding and approaching the redesign of hotel spaces through the emotional responses of users. This has not only made it possible to identify solutions from a hotel management perspective but has also fostered exploration in other service areas such as interior design and neuromarketing, reinforcing the suitability of the LL approach.

2.3. Neuromarketing and Neuroarchitecture

Neuroscience becomes particularly relevant within the servicescape framework where fields such as neuromarketing and neuroarchitecture help explain how design and sensory cues drive emotional responses. While neuromarketing applies neuroscientific methods to analyse human behaviour regarding marketing exchanges (Lee et al., (2007), neuroarchitecture integrates them to investigate how the built environment influences human cognition, emotions, and behaviour (Lee et al., (2022). These interdisciplinary fields, including physiological and neurological measurement methodologies, can generate evidence-based insights for the design of spaces that support health, performance, aesthetics, and emotional wellbeing.

Previous studies underscore the applied value of integrating neuro-based insights into designing different servicescapes. Vecchiato et al. (2015) explored, through brain activity measurements, emotional and physical responses from individuals towards architectural environments, contributing to a space design more oriented to pleasantness and comfort. Also, Rosenbaum et al. (2019), by performing an EEG study, they were able to show that biophilic retail design triggers positive neural responses such as reduced stress, increased engagement and attention, and excitement.

The following study builds on this potential by using neuro-sensor technology to examine guest emotional responses within the breakfast servicescape. A mixed-method approach combines neurophysiological tracking with staff input to capture how physical and social features influence guest experience. This enables a more nuanced understanding of emotional dynamics and supports evidence-based improvements to space and service redesign.

3. METHODOLOGY

The methodology employed was diverse and multifaceted, grounded in a LL approach and a multi-stakeholder perspective. The study was structured into four phases, which are described below:

3.1. Phase 1: Data Collection Through Neuromarketing Sensors

Emotional and behavioural data were collected between October and November 2024 using an observational methodology based on second-by-

second emotion tracking in a real-world buffet breakfast setting at the Alimara Hotel in Barcelona, Spain. Emotional responses were captured through non-intrusive neuroanalysis sensors powered by an artificial intelligence engine (Golineuro AI). These sensors were installed at strategic locations at the breakfast restaurant of the hotel to ensure spatial coverage. These sensors detect micro expressions and convert them into binary-coded data representing discrete emotional and cognitive states, including their corresponding intensity levels. Importantly, these sensors do not store video images, thereby preserving guest anonymity and ensuring ethical compliance. Emotional data is complemented by contextual observational records, and both types of data were captured separately for weekdays and weekends, to account for potential variations.

Within this framework, data related to spatial utilization and operational performance were systematically collected to characterize customer behaviour in the service environment. In particular, emphasis was placed on circulation patterns and movement speed, and a probabilistic usage map of the space was developed to identify areas of varying activity intensity. The occupancy levels at the different buffet breakfast stations were measured, along with the proportion of time each station remained occupied within the restaurant. Further operational metrics were calculated, including the average number of customers per table and in queue, the mean waiting time prior to service, and the proportion of customers who abandoned the queue. The average duration of stay within the restaurant, the percentage of customers who used the restroom facilities, and the mean daily customer volume were also determined. Together, these measures provided a comprehensive overview of spatial dynamics and service efficiency.

Building on this behavioural analysis, perceptual engagement with the servicescape was examined through the assessment of attention and attraction patterns. Specifically, attention index (ranging from 1 to 10), which represents a standardized measure of the intensity of visual engagement with a spatial element, and the average attention time (expressed in seconds) were measured for each spatial zone, thereby enabling the identification of servicescape elements that generated stronger and more sustained attention effects. A comparable procedure was applied to attraction patterns. For each zone, attraction indices (ranging from 1 to 10) and average attraction times

(expressed in seconds) were calculated, enabling the identification of spatial features that most effectively drew and retained customer engagement.

With respect to emotional responses, predominant emotions were identified at an overall level and across key stages of the customer journey: upon entering the dining area, while waiting at the reception desk, and upon exiting the restaurant. In addition, the prevailing emotional reactions associated with key servicescape elements (such as natural and artificial lighting, furniture, and the buffet offering) were systematically recorded. Finally, emotional variations throughout the customer journey during the breakfast experience were mapped, enabling the construction of a dynamic representation of affective responses across sequential touchpoints. These findings enabled to identify the affective trajectories throughout the breakfast experience.

Finally, the analysis extended to the social interactions of the service encounter. Predominant emotional responses during customer–staff interactions were identified, and both the average duration of these interactions and the corresponding levels of engagement were measured. Emotional responses emerging from interactions among customers were likewise systematically recorded. This assessment was further complemented by an evaluation of the staff experience, operationalized through the calculation of a stress index (ranging from 1 to 10) to quantify the levels of occupational strain associated with service delivery. Collectively, these analyses offered an integrated understanding of the spatial, perceptual, emotional, and social factors shaping the overall breakfast experience.

3.2. Phase 2: Staff and Stakeholders Insights Collection for Redesign

In this phase, the intervention team actively incorporated staff perspectives as a key input to the spatial redesign of the buffet area. Kirillova et al. (2020) argue that aesthetic pleasure derived from workplace design is positively linked to employee subjective well-being, especially when employees perceive the space as unified, varied, and moderately typical. Thus, before executing any spatial modifications, a co-creation session was carried out, bringing together nine participants: one restaurant manager, four staff members, three researchers, and one interior designer. The session lasted four hours and used cognitive mapping as its main tool, following Kitchin's (1994) recommendations for its suitability in living environments. Additionally, a customer experience map was developed for each identified segment. The

primary objective was to gain a deeper understanding of the space's challenges and opportunities from a multi-stakeholder perspective. These insights helped ensure that the redesign was not only guest-centric but also staff-inclusive, while maintaining the aesthetic perspective of professionals.

3.3. Phase 3: Implementation of the Redesign

The spatial redesign was implemented based on the triangulation of three key inputs: (1) aggregated emotional and attentional data from guests captured via the neuroanalysis sensors in Phase 1, (2) insights and practical suggestions gathered from the staff and stakeholders in Phase 2, and (3) design principles aligned with evidence-based hospitality architecture.

3.4. Phase 4: Post-Implementation Staff Feedback and Final Analysis

A new round of data collection was conducted to evaluate the impact of the intervention following the iterative approach from the LL methodology. This involved two parallel strategies:

- Quantitative replication of neuromarketing sensor analysis: Emotional and attentional data from guests were collected again, using the same measurement instruments and placement protocols from Phase 1, ensuring methodological consistency. This allowed for a pre/post comparison of guest emotional and cognitive responses to the redesigned environment.
- Qualitative feedback from staff: Employees who had been involved in the initial consultation were asked to provide feedback on the functionality, emotional climate, and guest reactions they observed in the new setting. This was done through a structured anonymous questionnaire. Ten members staff were invited to comment not only on their own workflow but also on perceived guest behaviours (e.g., hesitation, satisfaction, frustration) as observed during service.

4. RESULTS

4.1. Use of the Space

During the week, the buffet breakfast dining room receives an average of 70 guests per day: 61 on weekdays and 92 on weekends. The average number of people waiting in line is two throughout the week, which explains why guests

spend 7% of their time in the reception area. This is a positive figure, as no instances of guests abandoning the queue were observed. Regarding table occupancy by number of diners, most tables are occupied by a single guest (53%), with a slightly higher percentage on weekdays (56%) compared to weekends (46%). Meanwhile, the average group size varies between three guests on weekdays and four on weekends. The average length of stay is 427 seconds on weekdays, increasing to 634 seconds during weekends.

4.2. Attention/Exploration Patterns

Attention patterns are relatively similar on weekdays compared to weekends. The overall attention index stands at 7.7/10: 8 during weekdays and 7 on weekends. The lowest attention index is observed in the reception area, with a value of 1 on weekdays and 2 on weekends. In the buffet access area, the central corridor, and the table area, the attention index remains consistent, ranging between 8 and 9 throughout the week. Overall, the mean attraction index is 2.7. General attraction time averages around 3 seconds on weekdays and 4 seconds on weekends. The highest attraction index is observed in the central corridor area, with a value of 2 on weekdays and 3 on weekends, where guests display an average attraction time of 2 seconds on weekdays and 3 seconds on weekends.

In contrast, the reception area, buffet access area, and table area maintain a low attraction index, consistently at 1 throughout the week, together with their average attraction times. The element with the highest attraction index in this space is lighting, with a value of 4.7 throughout the week. However, the menu does not generate attraction. Regarding the elements present in the space during the guest journey, the buffet, the staff, and the door attract guests' attention. In terms of attraction generation, the buffet is the main focal point.

4.3. Emotional analysis through neuromarketing sensors

In the initial data capture using neuromarketing sensors, the predominant guest emotion during the breakfast experience was disappointment. Although guests entered the space with positive anticipation, emotional tracking revealed a decline as they interacted with the different elements of the restaurant. First, guests interact with the buffet, which is the initial point they approach in their experience after passing through the dining room staff checkpoint. This first interaction evokes a feeling of disappointment. They

then move toward the tables, and at this stage, the predominant emotion shifts to displeasure. This could be because guests do not perceive the spatial design as emotionally appealing. At this point, movement patterns indicate that guests return to the buffet area, but this time to the western side, where the predominant emotion is one of dissatisfaction, which briefly shifts back to displeasure. This return to the previous emotional state may occur because the buffet layout is linear. This means that upon entering the space, guests encounter the buffet primarily along the right side of their surroundings and, therefore, cannot immediately see all available options at first glance (See figure 1). This aligns with Bitner's (1992) conceptualization of the servicescape, where environmental design elements shape emotional responses during the service encounter.

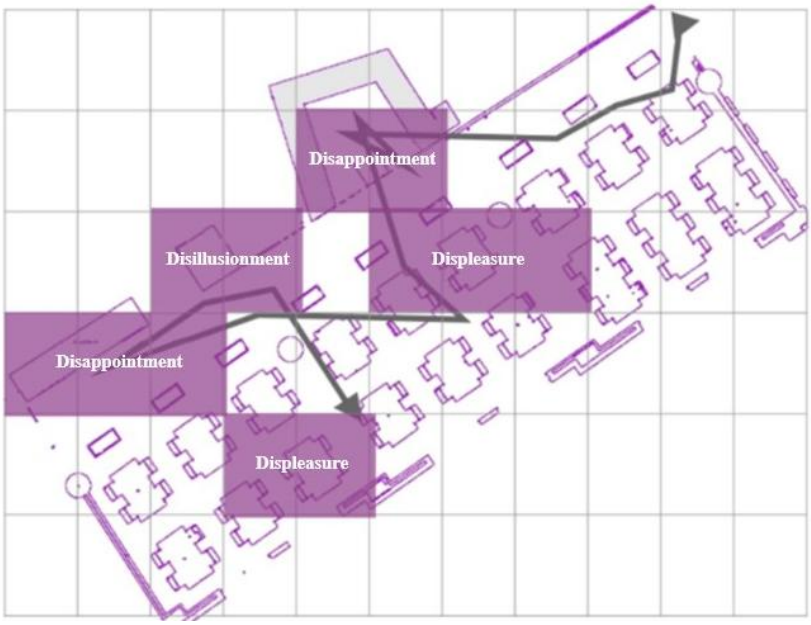

Figure 7. Emotions within space before intervention

Analysis of the emotional data revealed that the most pronounced decline in guest emotional state occurred specifically at the buffet area. This pattern points toward a possible disconnect between guest expectations and their actual experience, particularly related to the variety or presentation of food offerings. These findings are consistent with Bitner's (1992) framework of the servicescape, which emphasizes that environmental design features—such as layout, aesthetics, and organization—play a critical role in shaping

guests' emotional responses during their interaction with the service environment. The observed drop in positive emotions at the buffet underscores the importance of aligning physical design elements with guest expectations to enhance satisfaction and overall experience.

Similarly, lighting (natural and artificial) and furniture contributed to negative emotional responses. Conversely, social interactions presented a more positive emotional landscape. Engagements with staff were frequently associated with emotions of interest and joy, and guest-to-guest interactions similarly demonstrated a predominance of positive effect, which aligns with the argument of Grandey et al. (2005) on the influence of customer-staff interactions and their impact on customer satisfaction. Staff experience was also positive, as the estimated stress index was 3. Three recurring guest friction points emerged: (1) the reception desk visually blocked part of the buffet, complicating orientation; (2) negative emotions were observed during the consumption of coffee and juice, possibly linked to quality; and (3) visual rejection was noted toward cold cuts, likely due to presentation.

Given that the predominant identified emotion was disappointment, second-level data for a subsample of individuals were used to assess whether selected time-varying contextual factors could account for variation in disappointment. In particular, a random subsample of 390 individuals was obtained through systematic random sampling, in which every fifth guest during the pre-intervention month was selected for inclusion in the sample. Then, for each of these individuals, second-level data were obtained whenever their predominant emotion was disappointment, and the emotional activation of that emotion, measured on a 0–100 scale, was recorded. Moreover, for each of these seconds, information was obtained regarding the guests' activity status (standing, wandering, or sitting), staff activity (in position, clearing tables, restocking the breakfast buffet stations) and the buffet fullness (high, medium, or low). Using these data, the following equation was estimated using ordinary least squares:

$$\begin{aligned} disappointment\_activation_{it} = {} & \beta_1 guest\_sitting_{it} + \\ & \beta_2 guest\_wandering_{it} + \beta_3 staff\_clearing\_tables_{it} + \\ & \beta_4 staff\_restocking\_buffet\_stations_{it} + \\ & \beta_5 low\_buffet\_fullness_t + \beta_6 medium\_buffet\_fullness_t + \Upsilon_i + \\ & \varepsilon_{it} \end{aligned} \quad (1)$$

where $disappointment\_activation_{it}$ measures the intensity of the disappointment experienced by guest *i* during second *t*; $guest\_sitting_{it}$ is a dummy variable equal to one if the guest *i* was sitting at second *t*; $guest\_wandering_{it}$ is a dummy variable equal to one if the guest *i* was wandering at second *t*; $staff\_clearing\_tables_{it}$ is a dummy variable equal to one if staff members were clearing tables during second *t* for guest *i*; $staff\_restocking\_buffet\_stations_{it}$ is a dummy variable equal to one if staff members were replenishing food during second *t* for guest *i*; $low\_buffet\_fullness_{it}$ is a dummy equal to one if the buffet fullness level was low at second *t* for guest *i*; $medium\_buffet\_fullness_{it}$ is a dummy variable equal to one if the buffet fullness level was medium at second *t* for guest *i*. Υ_i are individual-level fixed effects to account for any individual-level characteristic that may have an impact on the emotional activation; and ε_{it} is the error term. Regarding guest activity, while *standing* serves as the reference category, β_1 captures the changes in the level of disappointment activation when the guest *i* is sitting at second *t*, relative to standing. β_2 captures the corresponding change when the guest is wandering in the restaurant, again relative to standing. With respect to staff activity, *in position* serves as the reference category. β_3 explains the effect of the buffet clearing tables on disappointment activation when staff are clearing tables for guest *i* at second *t*. β_4 captures the effect when staff are restocking the buffet stations, relative to the same reference category. Regarding buffet fullness, *high buffet fullness* serves as the omitted (reference) category. β_5 captures the change in disappointment activation when buffet fullness is low for guest *i* at second *t*, relative to high buffet fullness. β_6 captures the change in this emotional activation when buffet fullness is medium, relative to the same reference category.

Table 2 presents the results of estimating Equation (1) and shows that no single coefficient is statistically significant. This suggests that neither guest activity, staff activity, nor buffet fullness level has a direct relationship with the intensity of disappointment activation. In this sense, it can be concluded that these elements are not correlated with the intensity of this negative emotion and, hence, that it is likely the design per se and the gastronomic offer that generate this negative emotion.

Table 5. Coefficient estimates for emotional activation

VARIABLES	(1) Disappointment
Guest activity	
Wandering	0.052
	(0.074)
Sitting	0.028
	(0.066)
Staff activity	
Clearing tables	0.054
	(0.064)
Restocking buffet stations	0.014
	(0.059)
Buffet fullness	
Low buffet fullness	-0.100
	(0.078)
Medium buffet fullness	0.040
	(0.063)
Individual fixed effects	Yes
Clustered standard errors at the individual level	Yes
Observations	75,082
R-squared	0.005

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.4. Insights from staff and stakeholders

The co-creation session revealed a set of perceptions regarding the strengths, weaknesses, and opportunities of the breakfast restaurant space. These insights provided an essential complement to the emotional and behavioural data collected through neurosensors, offering a grounded understanding of how staff, managers, and design professionals experience the servicescape in their day-to-day interactions (See figure 2).

Participants identified several positive attributes of the restaurant that contribute to the overall guest experience and operational performance. The space was described as highly flexible, allowing it to accommodate different activities and formats as required by hotel operations. The abundance of

natural light and the presence of large exterior windows were valued features, contributing to a pleasant atmosphere. Staff highlighted the effectiveness of the kitchen's location, which facilitates circulation and supports rapid service delivery. Certain aesthetic and spatial elements were also positively regarded, such as the improved curtains, the sense of spaciousness created by the double-height ceiling, and the existence of more private seating areas. The presence of a staff member to welcome guests at the entrance was perceived as a positive touchpoint. Some participants appreciated the aroma of freshly prepared food and the pleasant sensory experience in the bakery section of the buffet.

Despite these strengths, the cognitive map revealed several challenges that hinder both guest comfort and operational effectiveness. The entrance was consistently identified as problematic: the small doorway, the partial opening of only one panel, and the obstructive placement of the podium created a congested and uncomfortable arrival experience. Some participants noted that the visibility of individuals inside the restaurant upon entering may create a sense of social pressure or discomfort for guests. The buffet area was frequently described as chaotic, with limited space, insufficient clarity in food presentation, and inadequate signage. Specific zones, particularly the coffee area, were associated with feelings of stress or discomfort due to cramped layout and circulatory constraints. Concerns also emerged regarding food odours, which some staff considered overwhelming. Spatial distribution, especially around certain tables, was deemed insufficient, contributing to crowding. The private dining room was strongly criticized, described as narrow, outdated, cold, and uninviting, with furniture considered antiquated and a lack of proximity to restrooms. Its name was also perceived as meaningless and lacking identity.

Figure 8. Cocreation session, cognitive mapping

Participants pointed to several aesthetic weaknesses of the main dining area: dull and outdated colour schemes, sombre artwork, antiquated furniture, and linen that did not align with the desired ambiance. Issues related to temperature control were also noted, with the room occasionally becoming uncomfortably warm. The mezzanine area visible from the double-height space generated unease for some participants due to its elevated position and contrasting heights. The overall style of the restaurant was perceived as inconsistent with the hotel brand identity. Additionally, poor signage often caused guests to mistake the restaurant for part of the lobby, contributing to confusion and operational inefficiencies.

Participants identified several opportunities to enhance both guest experience and operational efficiency. The potential to establish a connection with the outdoor garden was seen as a significant asset, applicable both to the main dining room and the private dining area. Relocating the entrance podium to improve accessibility and flow was a recurring suggestion. A comprehensive revision of the room's colour palette was proposed, including walls, furniture, and table linens, to create a more vibrant and contemporary atmosphere. Many participants advocated for incorporating abundant plant life, preferably natural rather than artificial, and even replacing framed photographs with a vertical garden installation. Opportunities for brand alignment were highlighted, particularly through integrating the hotel's identity, linked to the concept of fire (*Alimara, the name of the hotel, refers to the fire that was traditionally lit between distant locations as a means of sending a signal*), into the design.

The buffet could be reorganized into multiple stations rather than being confined to a single linear arrangement, improving circulation and visibility. Enhancing product display and strengthening signage were also mentioned as key steps. Participants also pointed to the potential of digitalizing the restaurant entrance as a means of enhancing operational innovation. The private dining room, despite its current shortcomings, was viewed as an underutilized space with potential for reactivation through strategic redesign. Finally, participants suggested improving ambient music quality and addressing visual discomfort related to the mezzanine area.

4.5. Implementation of the Redesign

The implemented redesign of the buffet breakfast restaurant reflected the insights from both neuroanalytic tracking and co-creation with hotel staff and project stakeholders. which provided concrete, actionable inputs. The central buffet was relocated to the back wall and was consolidated into three gastronomic offer zones, improving circulation and enabling immediate overview of the gastronomic offer. To improve layout efficiency, the intervention included the removal of a wall at the rear of the breakfast area. On the product side, robusta was replaced by arabica coffee and fresh orange juice substituted the concentrated version, addressing triggers of negative emotions identified earlier. These interventions directly responded to the emotional and operational insights identified in the baseline and co-creation phases, aiming to reinforce guest satisfaction and staff functionality while ensuring spatial coherence.

Table 6. Time based dynamics of emotional states before and after the redesign intervention

Phases	General	Entering room	Waiting at desk	Leaving the room
Before intervention	Disappointment	Anticipation	Disinterest	Neutral
After intervention	Anticipation	Interest	Satisfaction	Neutral

Following implementation, emotional and behavioural data were recollected in June 2025. Neutral emotions were detected more predominantly during the

post-implementation. Compared to the baseline, neutral emotions became more prevalent, and guests experienced satisfaction before exiting the buffet breakfast restaurant. Negative emotions regarding lighting and furniture were substituted by more neutral evaluations. Emotional responses during social interactions remained consistent: interest and joy continued to dominate both guest-staff and guest-guest encounters. However, some friction remained in relation to coffee, marking it as an ongoing area for potential refinement.

Figure 9. Emotions within space after implementation

As part of the post-implementation evaluation, staff perceptions were captured through a structured questionnaire to complement guest emotional data. Staff reported the new buffet layout as more accessible, and the table layout facilitated service and movement. They also experienced increased guest satisfaction, though opinions on the new coffee were mixed, confirming the persistence of some friction around this product. This final assessment was critical to understanding whether the intervention had led to lasting improvements in the guest experience and employee well-being. Staff responses were aligned with some of these perceptions, especially those related to spatial improvements. All participants evaluated the new buffet location positively (100%) and the removal of the rear wall received a

similarly favourable response (90%). In contrast, perceived improvements in guest experience and reactions to the adjustments in the food offer received more mixed evaluations. Perceptions of guest satisfaction following the buffet layout were moderately positive (60%). Regarding food-related changes, 90% of respondents rated the impact of the vegan corner positively, whereas only 40% of the staff considered the guest reaction to the new coffee offering as favourable, suggesting that this product remains a point of friction. These findings are summarized in the table below, which provides a breakdown of staff responses across the evaluated adjustments.

Table 7. Staff evaluation of the post-intervention breakfast service

Question	Very Negative (1)	Negative (2)	Neutral (3)	Positive (4)	Very Positive (5)
Spatial and infrastructural adjustments					
Accessibility of buffet location	0 (0%)	0 (0%)	0 (0%)	1 (10%)	9 (90%)
Impact of wall removal	0 (0%)	0 (0%)	1 (10%)	3 (30%)	6 (60%)
Table arrangement and circulation	0 (0%)	0 (0%)	2 (20%)	3 (30%)	5 (50%)
Guest experience and staff interaction					
Guest satisfaction changes with buffet layout	1 (10%)	2 (20%)	1 (10%)	1 (10%)	5 (50%)
Impact on interaction with guests	0 (0%)	0 (0%)	2 (20%)	3 (30%)	5 (50%)
Food offer adjustments					
Guest satisfaction with coffee change	0 (0%)	2 (20%)	4 (40%)	2 (20%)	2 (20%)
Impact of the vegan corner	0 (0%)	1 (10%)	0 (0%)	6 (60%)	3 (30%)

5. DISCUSSION

This study sought to examine the redesign of a hotel breakfast space through a multi-stakeholder LL lens. Over a methodological triangulation that combined emotional analytics, co-creation sessions involving active participation from all stakeholders, and evidence-based spatial redesign, the discussion of results is organized into two main parts: first, the key findings related to emotional responses within the breakfast buffet servicescape; and

second, the contribution of the LL approach in shaping both the process and the outcomes of the intervention.

5.1. Emotional responses within the breakfast buffet servicescape

The study conducted an analysis of guests' emotions during the hotel breakfast experience using non-invasive emotional tracking sensors. First, it is worth highlighting the novelty of applying this type of neurotechnology in this context, as it provides an alternative to more traditional forms of emotional analysis such as surveys or online review mining (Leite-Pereira et al., 2020, 2023; Manes & Tchetchik, 2018; Mo et al., 2015). The ability to measure emotions without directly questioning guests offers a distinct layer of insight and opens possibilities for new ways of inferring emotional responses. Research on hotel breakfasts has conventionally focused on pricing and product offering, extensively explored by Anguera-Torrell & Nicolau (2025); Illescas-Manzano et al. (2025) and Lee et al. (2018). Likewise, Leite-Pereira et al. (2023) identified differentiated breakfast preferences based on demographic factors such as age, gender, and country of origin. Despite these diverse lines of inquiry, emotional responses during breakfast experiences have not been previously examined. This study addresses that gap and expands current analytical perspectives by considering emotions as universal components across all users.

The results reveal a clear emotional shift between the first and second measurement phases. This suggests that modifications in spatial and design elements of the breakfast configuration have measurable implications for guests' emotional responses, reinforcing the arguments of Line & Hanks (2020), who demonstrated that the physical and social elements of the servicescape shape the dining experience. Another relevant finding concerns the influence of staff participation, identified by Grandey et al. (2005) as a decisive factor shaping customer perception and satisfaction. The results of this study support this view and suggest that, in highly competitive hotel markets, where differentiation may not reside in food offering, the role of staff may serve as a more significant and not necessarily more costly driver of guest satisfaction. Finally, the study expands on the work of Vecchiato et al. (2015), confirming that analysing emotional responses in built environments, and subsequently redistributing spatial elements associated

with comfort, can enhance individuals' responses toward higher emotional well-being.

5.2. Contributions of the Living Lab approach

From a LL perspective, the study brings forward two main considerations. First, it aligns with the findings of Cigir (2018), reinforcing the idea that tourism innovation is amplified when both staff and hotel guests are actively involved. Similarly, the results support the importance of integrating mixed-methods approaches to obtain a more comprehensive view, as well as establishing clear collaboration structures to mitigate potential conflicts in objectives, as expressed by Dickinger & Kolomoyets (2024). Furthermore, Koens et al. (2024) emphasize that the true value of LLs does not lie in producing ready-to-market solutions, but in mobilizing stakeholders to collectively make sense of "wicked problems" and imagine alternative futures. In this regard, the present study provides a nuanced perspective: although the redesign produced concrete and transferable outcomes, its deeper contribution was the development of shared interpretation and iterative understanding of the breakfast experience in hotels.

Secondly, the study aligns with Beckett & O'Loughlin (2024) and Guzmán et al. (2013) in recognizing mutual knowledge building and win-win strategies among stakeholders as fundamental factors for success. The process generated concrete value for all participating actors and broadened their perspectives across hospitality management, interior design, and customer experience. The implementation of a mixed-method approach, starting with emotional analysis to enrich the co-creation session, also resonates with Leminen & Westerlund (2025), who proposes the adoption of more effective approaches to co-creation to optimize collaborative efforts.

6. CONCLUSIONS

This study contributes to the growing body of research on emotions in hospitality by examining how physical and social elements of the breakfast servicescape shape guest experiences in real time. The baseline emotional mapping revealed that disappointment was the predominant emotion during the breakfast experience, particularly concentrated around the buffet area, where guests' initial anticipation declined upon interaction with concrete elements of the gastronomic offer and spatial layout. The findings confirm that environmental features such as buffet layout, lighting, and product

quality are consistently associated with guest emotions. The most pronounced decline in emotional valence occurred at the buffet stations, suggesting misalignment with guest expectations. At the same time, social interactions with staff consistently generated positive emotional responses, with interest and joy dominating guest-staff and guest-guest encounters, underscoring the central role of human engagement in hospitality service encounters. While exploratory regression analyses revealed limited statistical significance, indicating that observed time-varying contextual factors such as guest activity, staff activity, and buffet fullness did not significantly explain the intensity of disappointment, they highlighted the complexity of modelling real-time affective states and pointed to the need for further methodological refinement.

The redesign phase demonstrated the value of integrating guest emotion tracking with staff voice. Relocating the buffet, adjusting furniture and lighting, and improving product quality reduced sources of negative emotion and supported smoother operations. Post-implementation results showed a shift from disappointment, disillusionment, and displeasure toward interest and satisfaction, with neutral emotional states becoming more prevalent. Guests no longer exhibited the same pronounced emotional drop at the buffet stations, and satisfaction emerged before exiting the space, suggesting improved alignment between guest expectations and environmental cues. Staff confirmed greater efficiency and accessibility, reporting improved circulation and clearer spatial organization, which reinforced the operational outcomes of the intervention.

In addition, the study advances methodological understanding in three important ways. First, it demonstrates the feasibility and value of using non-intrusive emotional tracking in real hospitality environments, capturing second-by-second changes in affective states across different spatial touchpoints, thereby complementing rather than replacing traditional voice-of-the-customer capturing. Second, it highlights the relevance of multistakeholder co-creation in shaping meaningful interventions, confirming that staff knowledge is critical for identifying operational constraints, validating emotional insights, and ensuring design feasibility. Third, by applying an iterative LL process, the study reinforces the potential of this ecosystem to bridge experiential, operational, and design-based perspectives. By triangulating guest emotional data, staff voice, and

evidence-based spatial redesign within a LL framework, this study illustrates how hospitality environments can be systematically evaluated and improved.

6.1. Implications for hospitality and tourism research and practice

This study demonstrates the potential of combining neuromarketing tools, observational methods, and staff perspectives to capture emotions in real service contexts. The exploratory regression analysis highlights both the promise and the limitations of modelling second-by-second emotional responses, pointing to the need for methodological refinement and replication across different hospitality settings. By focusing on the breakfast buffet, the research extends the literature on servicescapes to a touchpoint that is frequent, emotionally charged, and underexplored. Future research should build on this approach by refining methods for capturing real-time emotional dynamics and by examining how design interventions at other key hotel touchpoints shape both guest experiences and staff workflows.

The project shows how evidence-based redesign can address sources of guest dissatisfaction while supporting staff efficiency and well-being. The relocation of the buffet, adjustments to lighting and furniture, and upgrades in product quality reduced negative emotions and improved guest satisfaction at a key moment of the stay. At the same time, staff reported greater ease of movement and more positive guest reactions. For managers, the findings underline the importance of linking physical design decisions with both guest emotional data and employee voice to create sustainable improvements. More broadly, the study illustrates a replicable approach that hotels can adopt to balance operational functionality with affective value, thereby strengthening satisfaction and loyalty.

The study also presents several limitations. The pre/post design does not isolate the marginal effect of each change and may be influenced by seasonal or guest-mix variations. Emotional labels are dependent on the sensor provider's taxonomy and may not capture all nuances of affective experience. The exploratory regressions, while indicative, explain only a small share of emotional variance, pointing to the inherent complexity of second-by-second affective dynamics in naturalistic settings. Future studies should consider experimental or staggered designs, larger samples, and cross-property comparisons to refine the causal inference capabilities of this approach.

7. ACKNOWLEDGEMENTS

This chapter was part of a project called *Neuroturistic*, which received funding from the Ministry of Industry and Tourism through the grants for "Última Milla" digitalization projects in companies within the tourism sector, LINE 2.

CHAPTER 5

CONCLUSIONS

5. CONCLUSIONS

The overall purpose of this thesis was to develop a human-centred innovation framework for the hospitality sector by integrating social sustainability, multisensory wellbeing, and emotional design across different dimensions which, when examined in isolation, appear unrelated, yet when analysed holistically, share substantial common ground. One of the central aims was to examine the phenomenon of human-centred innovation through multiple methodological lenses: experimentation, Living Lab methodologies, and neurotechnologies. This allowed a holistic understanding of research processes. Each chapter addresses a different layer of human-centricity. Rather than proposing a hierarchical structure, the thesis enables a horizontal perspective through which phenomena can be analysed from the viewpoint of the users involved.

In the second chapter, *Freelance or Hired? Consumer Preferences for Online Food Delivery Riders' Conditions*, social sustainability lies at the core of the analysis, with riders and customers as the primary focus. The online experiment demonstrates that users of OFD platforms perceive greater value and higher satisfaction when they know that the couriers delivering their food are formally employed according to current labour legislation. This introduces a new paradigm for understanding the Gig Economy. Most scholars have concentrated on the legal classifications underlying platform work. Yet economic dynamics are often more revealing: as long as there is demand for a service, supply will continue to adapt to meet it. From this perspective, the research does not seek to alter the structural rules of the game; instead, it investigates consumer behaviour to identify potential social improvements.

The assumption is that the main demographic using these services is likely to feel especially connected to, or even implicated in, processes of labour flexibilization and precarity. The key question, therefore, is whether supply can incorporate a socially sustainable dimension and whether consumers see perceive this as a value. This is one of the most significant conclusions of the first chapter: while customer satisfaction and perceived value improve when fair working conditions are communicated, tipping behaviour does not change significantly, suggesting that consumers do not associate tipping with a fair contractual framework.

The methodological approach also allows for a degree of causal inference. Importantly, the sample used in the experiment aligns with the sociodemographic profiles reported by OFD platforms themselves (primarily Gen Z, millennials, and, to a lesser extent, other age groups). This strengthens the robustness of the debate and encourages new approaches to platform–consumer communication.

The third chapter, *Multisensory and Environmental Well-being in Gastronomic Spaces: A Computational Neuroscience Case Study*, maintains the dual focus on staff and users, but in the context of restaurants, involving restaurant employees and customers alike. Here, the aim was to analyse how built-environment experiences and multisensory perceptions influence wellbeing. The Living Lab methodology was particularly relevant, as it enabled a distinct structure for analysing such a complex phenomenon and facilitated a multistakeholder approach, ensuring that multiple relevant perspectives shaped a comprehensive analytical framework. The results show that modifications to lighting, textiles, and acoustics can significantly enhance the multisensory perception of a gastronomic space. These findings are highly relevant to the restaurant industry, where improving user experiences requires a deep understanding of the specific triggers that shape them.

Furthermore, the use of non-invasive neurotechnologies proved especially valuable for understanding users' emotions in real time. By implementing two phases—diagnosis and intervention—each involving direct engagement with all actors, the study was notably enriched by the diversity of viewpoints and allowed improvements to be introduced throughout the process. Crucially, the study highlights the role of staff in shaping the customer experience and underscores that while the restaurant industry often prioritises operational improvements linked to taste, technique, and culinary performance, staff wellbeing has a significant impact on the emotional experience of customers. This is one of the most relevant conclusions of the chapter and reinforces the idea that human-centred innovation can generate benefits that go beyond simply improving the customer's direct experience.

These findings also reaffirm the value of Living Lab methodologies for hospitality and gastronomy, as they expand the analytical scope and include

a wider range of users, despite being rarely applied in such contexts. As such, this chapter offers important contributions that merit further exploration.

The final essay, *Redesigning the Hotel Breakfast Servicescape through Emotional Analytics: A Living Lab Case Study*, mirrors the human-centred focus of the previous chapters, engaging both staff and guests. It explores how analysing users' emotions can inform the redesign of a hotel breakfast buffet to improve operational efficiency and customer wellbeing. One of the main conclusions is that enhancing the analysis and traceability of emotional responses can streamline redesign processes and improve the wellbeing of all actors involved. Through methodological triangulation and the multistakeholder approach inherent to Living Labs, the study benefits from a wide range of methodological tools that keep user wellbeing as both the starting and ending point of the research. Second-by-second emotional tracking also enables the identification of statistically relevant insights, reinforcing a multi-layered understanding of the same research object.

The hotel breakfast buffet is one of the most common and emotionally significant touchpoints in a hotel stay. Shedding new light on the emotional mechanisms at play in this space is essential not only for identifying new ways to enhance guest satisfaction but also for generating competitive advantages for hotels. This essay suggests that the breakfast area should not be taken for granted, as it presents multiple opportunities, both for improving customer satisfaction and for creating new revenue streams.

Regarding contributions, these can be broadly categorised into theoretical, methodological, and practical.

5.1. Theoretical Contributions

Demonstrating that human-centred innovation has measurable effects on behaviour, wellbeing, and emotions constitutes the primary theoretical contribution. Although people-centred design is well established in the literature, there remained a theoretical gap concerning innovation in the context of hospitality, which this thesis seeks to address.

The first essay provides a substantive contribution by integrating social sustainability into the established stream of research linking sustainability with consumer behaviour. While prior studies have examined how

environmental or general sustainability concerns shape consumer decisions, the social dimension has remained largely underexplored in the context of OFD platforms. By placing social sustainability at the centre of the analysis, this essay provides the theoretical groundwork needed to examine its influence on consumer behaviour, thereby opening new conceptual and empirical avenues for future research.

The second essay proposes a multisensory-emotional framework for hospitality based on empirical evidence: the parametric model. Exploring customer emotions and linking them to spatial redesign remains unusual in the literature, yet the findings are encouraging. This contribution expands the dialogue between two relatively recent but increasingly influential disciplines: food design, an emerging holistic field concerned with food systems and human experience, and neuroarchitecture, which examines how built environments affect physical, emotional, and psychological wellbeing.

The final essay advances the theoretical understanding of servicescapes by extending the concept from static spatial attributes to dynamic, real-time configurations measured through emotion-tracking technologies. While traditional servicescape literature conceptualises the environment as relatively fixed, this essay introduces a framework for analysing how continuous fluctuations in spatial and sensory elements influence guest experience. This shift from static to dynamic servicescapes represents the core theoretical contribution, opening new possibilities for modelling, predicting, and designing experiential outcomes in hospitality settings. Although the empirical results are preliminary, the potential for further research is both evident and promising.

5.2. Methodological Contributions

Key methodological contributions include the use of controlled online experiments to study issues of labour justice and social sustainability, an approach rarely seen in the field, which offers a more integrated way of analysing legislative reforms with direct consumer impact.

The second and third essays, meanwhile, demonstrate the potential of Living Lab methodologies for analysing gastronomic and hospitality spaces as innovation platforms. This is particularly relevant given the economic importance of these sectors in Southern Europe and in emerging economies.

Also noteworthy is the pioneering use of second-by-second neuro-analytics in a real hospitality context. The methodological innovation lies not simply in the technology itself but in its triangulation with stakeholder approaches and user and staff surveys, allowing for a richer, more comprehensive research design.

5.3. Practical Contributions

The first essay offers clear practical implications for digital platform management and for policymakers. OFD platforms can use these findings to adopt more transparent communication strategies regarding employment conditions—an approach that is likely to be perceived positively by users. Moreover, platforms may reconsider their arguments concerning labour flexibility and self-employment. The findings suggest that consumers may respond favourably to more traditional contractual models, offering platforms the opportunity to reposition themselves ethically and competitively. Policymakers, in turn, may use these insights to justify more comprehensive labour regulations without adopting an adversarial stance, appealing instead to both social and market-level improvements.

The second essay provides practical insights for hotel firms, managers, and contract designers. Hotels may significantly improve their restaurant environments by focusing not only on operational efficiency or gastronomic quality but also on multisensory and staff wellbeing, thus shifting a paradigm that has long been theorised but rarely demonstrated empirically. Designers, manufacturers, and architects can draw on these findings to validate design hypotheses that previously relied largely on intuition.

The third essay presents practical implications for hotels redesigning breakfast layouts. The study shows that focusing on the emotional and behavioural dynamics occurring during this daily touchpoint can substantially improve guests' overall experience. With minimal changes and an approach easily transferable to other businesses, guest wellbeing (measured through attention, movement patterns, and satisfaction) can be significantly enhanced. This can support hotel brands when opening new properties, offering design guidelines grounded in empirical evidence.

5.4. Global Limitations

Each essay contains specific limitations, but several cross-cutting constraints should be noted. The research is situated primarily in Barcelona, meaning that its social and economic context may limit external generalisability. Chapters two and three were conducted at the Alimara Hotel which, although advantageous as a real-world setting, requires caution when extrapolating findings to other contexts.

Some tools such as non-invasive neuro-sensors, neural-network headsets, and pulse-tracking devices, represent advanced technological applications that may be difficult to replicate elsewhere. Certain phases of the project were supported by national innovation funding schemes, which may further complicate replication.

Similarly, the use of Living Lab methodologies in operational environments can be seen both as a strength and a limitation, as operational demands restricted the scope of more structural interventions. For instance, in the third essay, the methodology could be applied in other hotel areas such as the lobby or event spaces, potentially revealing additional insights which, due to time and operational constraints, were not explored. Limited time for observing long-term post-implementation effects also constrained the analysis.

Finally, the emotion-tracking technology used relies on a specific taxonomic framework defined by the provider. As such, the affective interpretation is contingent on this taxonomy and does not represent the full complexity of human emotional experience.

5.5. Future Research

Several future research directions emerge from the contributions and limitations identified. First, the initial essay could be expanded through an international comparative study examining OFD labour legislation and perceptions of labour justice. This is particularly relevant given the European Commission's current interest in adapting the Spanish Rider Law to a broader context.

The second essay suggests the need for further analysis of evidence-based spatial redesign through more structural interventions and longer observational periods. This could inform an expanded parametric model

incorporating additional environmental variables. Similarly, research could advance towards "responsive experiences" where space dynamically adapts to real-time affective data. The latter is an approach with significant potential, especially considering evolving definitions of luxury among younger generations.

Finally, this thesis highlights the growing relevance of Living Lab methodologies in hospitality. Exploring their application across other hotel areas (lobbies, spas, check-in areas, housekeeping) could broaden the potential of human-centred innovation in hospitality and support the sector's evolution towards the experience economy.

Final Reflection

This thesis demonstrates that innovation in hospitality only reaches its full potential when it is designed for people and with people. Data, emerging technologies, and experimental methodologies acquire meaning only when they serve wellbeing, fairness, and human experience. By examining behaviours, emotions, and real environments, this research proposes a renewed lens: innovation should not focus solely on processes or tools, but on what sustains every act of hospitality: the human relationship.

The future of hospitality will depend on our ability to uphold this simple yet profound idea: that the most memorable, transformative, and valuable experiences are always, and inevitably, human.

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