THE EMOTIONAL BATTLE OF THE SEXES GAME: PSYCHOLOGICAL GAME THEORY APPLIED TO THE CHOICE OF TOURISM

Dr. Jose M. MAS, Vice-Rector for Academic Policy and Faculty
ESIC University; ESIC Business & Marketing School
E-mail: josemanuel.mas@esic.university

Dr. Anett ERDMANN, Director of the Academic Marketing Department
ESIC University; ESIC Business & Marketing School
E-mail: anett.erdmann@esic.university

Dr. Kathrin JASZUS, Assistant Professor *(Corresponding author)*
Trier University of Applied Sciences Business School
E-mail: jaszus@hochschule-trier.de

Abstract

Purpose - Beach or mountain? This study focuses on the complex decision-making process travelers face when choosing a destination, highlighting the significant but understudied role of emotions in destination choice, particularly how emotional expectations influence tourism evaluation. The aim is to derive insights for a strategic choice of image positioning.
Methodology, Design, and Approach - Using psychological game theory, the study examines the emotional responses of German tourists in their choice of tourism type on the Balearic Islands, through neuromarketing techniques (EEG, SCR, HVR) and a value assessment survey. This approach models tourists' decision-making processes in response to visual stimuli, incorporating perceived value and an "emotional care" parameter that accounts for the desire to meet the expectations of travel companions.
Results - The study reveals clear differences between equilibria based on purely self-reported value judgments and those incorporating neural responses, highlighting the complexity of emotional influences on travel decisions.
Originality - This research contributes to the field of tourism by detailing the interplay between emotional expectations, consideration, and trade-offs in travel decisions. It provides insights for the development of tailored marketing strategies that address emotional needs in order to increase satisfaction in shared travel decisions.
Keywords *Tourism advertising, psychological game theory, neuromarketing, value assessment, emotional assessment*

Original scientific paper
Received 06 March 2024
Revised 10 August 2024
Accepted 11 September 2024
https://doi.org/10.20867/thm.31.2.4

INTRODUCTION

A large proportion of consumers make their purchasing decisions for tourism products online. Online sales channels accounted for 70% of the global travel market by 2023 (Statista Market Insights, 2023a), and digital marketing strategies and the measurement of triggered emotions gain importance in the tourism literature (Bastiaansen et al., 2022; Garzon-Paredes & Royo-Vela, 2023; Hosany et al., 2021). Several studies have shown that governments are investing significantly in their online destination marketing, with the aim of improving the attractiveness or image of their destination (Matusse & et al., 2023; Tran & Thompson, 2015). For example, Spain, the world's second largest tourist destination after France (UNWTO, 2024), is still increasing its investment in digital marketing in the tourism sector, albeit on a downward trend (Statista Market Insights, 2023b). Regardless of marketing efforts, the image of a destination is always composed of two distinct components: a cognitive component, which is based on factual information, and an affective component, which encompasses the values, emotions, and feelings that individuals associate with destinations (Bastiaansen et al., 2022). For a successful campaign, it is crucial to be aware of both components of a destination's image (Hosany et al., 2021) and to select visual elements, such as photos or videos, that evoke positive emotions towards the destination (Fu et al., 2024). Traditionally, the affective component of an image has been measured by self-report questions within a questionnaire, for example, using semantic differential scales such as unpleasant-pleasant, sleepy-arousing, gloomy-exciting, and distress-relaxing (e.g., Baloglu and McCleary, 1999; Chew and Jahari, 2014). These scales are now being complemented or replaced by advanced neuromarketing tools that directly measure neural activity (De-Frutos-Arranz & López, 2022; Royo-Vela, & Garzón-Paredes, 2023). The affective component has become increasingly important in recent years, with research focusing more on understanding and using emotional responses to improve destination marketing strategies.

Given the diversity of tourists' preferences and the fact that travel decisions are often made jointly by travel partners (Koval & Hansen, 2023; Rojas-de-Garcia & Alarcón-Urbistondo, 2019), game theory can be a useful framework for exploring travel decision outcomes. Specifically, Battigalli and Dufwenberg's (2022) psychological game theory framework provides a basis for understanding tourists' decision outcomes by considering emotions and cognitive evaluations in interpersonal decision making. Game theory as a basis for interactive decision-making has been applied in the tourism sector mainly from the perspective of competitive interactions between tourist destinations (Tran & Thompson, 2015). For instance, considering gender, previous literature has been ambiguous respective the importance of websites and core hotel services offered (Ezzaouia et al., 2021; Yavas et al., 2015). Similarly, several authors have explored the influence of gender on the emotional response linked to decision-making (Reber & Tranel, 2017; Eriksson & Simpson, 2010; Mas et al., 2024b). Insights into strategic consumer choice are scarce (Brida et al., 2009), and outcomes or payoffs are typically measured based on observed historical data or intentional behavior, making it difficult to capture the affective component in consumers' choice of a particular type of travel (McCabe et al., 2016). The ability to measure emotions with neuromarketing technology makes it possible to use psychological game theory to consider consumers' strategic choices in the presence of these motivations.

This paper sets out to examine the value perception and decision-making processes associated with different types of travel, with a particular focus on the affective component of consumer information-gathering behaviour, based on visual stimuli. The information-gathering process and the individual attractiveness of certain types of tourism are seen as a precursor to decision-making, which is often a team decision (e.g. couples or friends). The aim is to derive insights for a strategic choice of image positioning.

In this context, we formulate three main hypotheses: (1) There are gender differences in the self-reported value assessment and neural-measured valuation of different types of travel; (2) When the travel choice is considered an interpersonal decision, there are differences in the strategic behavior of the sexes (dominant strategies, Nash equilibrium, Pareto optimum) depending on the valuation measure used; (3) A particular travel type can be achieved as Nash equilibrium if tourists care enough about the expected emotional response of the travel partner.

We developed a game-theoretic framework, using measures of neural activity (EEG, SCR and HRV) and self-reported value perceptions as payments, and analyzed the game structure and strategies from a customer perspective and a social welfare perspective. Specifically, a psychological game is developed that considers tourists' perceived value of travel types together with the expected emotional validation from their travel partners. The model is applied to Germans travelling to Spain. In 2022, 27% of Germans travelled domestically and 73% abroad, with Spain being the most popular foreign destination (12.9% of all trips abroad (FUR, 2023)).

The experiment was carried out by an international multidisciplinary research team at a neuroscience laboratory. The results show different optimal strategies depending on how the assessment of tourism types is measured (self-reported perceived value or neuronal measure of valence) and whether the expected emotional response of travel partners matters for the decision maker. Specifically, when only the self-reported perceived value is considered, a dominant strategy is identified for women and there is only a separating equilibrium (partners choose different types of travel). If the decision is made purely emotionally, based on one's own emotional responses, both partners have an identical dominant strategy (choosing the same preferred type of travel), and this strategy profile is a Nash equilibrium and Pareto efficient. Finally, considering the self-reported perceived value together with the satisfaction of partners' emotional expectations shows that different joint strategies can be achieved depending on the emotional concern of each travel partner (emotional care respective to the travel partner). The latter suggests implications for tourism advertising strategies to achieve consensus and travel partner satisfaction.

1. LITERATURE REVIEW

1.1. Destination Image and Consumer Value-Based Decision Making

Destination image is recognized as one of the core concepts in the tourism management literature and has been intensively studied over the last decades (Beerli-Palacio & Martín-Santana, 2017; Lai et al., 2020; Garzon-Paredes & Royo-Vela, 2023). Defined as "the sum of beliefs, ideas, and impressions that a person has about a destination" (Crompton, 1979, p. 18), destination image is the general perception or mental image that potential visitors have about a particular destination and plays an important role in tourists' choice of preferred destination. It is known to be a multidimensional construct (Trang et al., 2023). The two-dimensional approach applied here considers the cognitive and the affective elements to be crucial for the image of the destination (Baloglu & McCleary, 1999; Fu et al, 2016). While the cognitive component is based on facts mainly related to the physical or functional characteristics of a destination, the affective component refers to the emotional and value-based responses that potential tourists have towards a destination (Beerli & Martin, 2004; Garay, 2019). This includes the feelings and emotions that a destination evokes, which in turn influence tourists' perceptions and decisions (Fu et al., 2024).

Especially in digital marketing, images play a crucial role in promoting destinations and different types of travel, from attraction to engagement to purchase and repurchase intent (Hou & Pan, 2023). Therefore, it is important to choose the right images to effectively market the destination and/or the type of travel. Traditionally, literature has emphasized the cognitive component of destination image (e.g., Chaudhary, 2000; Crompton, 1979; Bigné, 2009). This involves the cognitive evaluation of destination attributes such as accessibility, safety, or entertainment (Trang et al., 2023). In recent years, the affective component has become increasingly important in choosing the right visuals to market a destination or a specific type of travel. This component aims to explain the emotional responses that a potential tourist associates with a destination, such as joy, relaxation, or gloom (Bastiaansen et al., 2020; McCabe et al., 2016; Omo-Obas & Anning-Dorson 2023). Destination marketing that links positive emotions to a destination or mode of travel by targeting the affective image of the destination may be more effective in influencing destination choice than marketing that is more cognitively oriented (Bastiaansen et al., 2020).

In the consumer decision-making process, the evaluation of benefits versus sacrifices in one or more dimensions is referred to in marketing as value-based decision-making (e.g., Sánchez-Fernández & Iniesta-Bonillo, 2007), which corresponds to the more rational concept of utility rooted in economics. Hartman (1973) distinguishes between rational aspects, utilitarian use (extrinsic value) and emotional appreciation (intrinsic value). These or similar distinctions have found wide application in many disciplines and are consistent with the cognitive and affective components of the value assessment of tourist destinations as introduced above. Therefore, when considering interdependent travel decisions, it is expected that an individual's value or utility will be divided into two parts: a rational and an emotional part.

One of the crucial elements in choosing a type of travel or destination is the fact that the decision is often made by a couple or a group, especially a family (Rojas-de-Garcia & Alarcón-Urbistondo, 2019), with couples being the driving force behind the choice of destination or type of trip (Kozak & Karadag, 2012; Koval & Hansen, 2023). Previous literature has been ambiguous regarding gender differences in assessing the importance of aspects such as websites and core hotel services offered. (Ezzaouia et al., 2021; Yavas et al., 2015). Regarding the influence of each member of the couple in the decision-making process, Davis and Rigeaux (1974) distinguish between husband-dominant, wife-dominant, and joint strategies. While in the first two cases one person is clearly the decision maker, in the third case the travel decision is made collectively. When both sides feel that their wishes have been considered in the travel decision, perceived satisfaction increases (Rojas-de-Garcia & Alarcón-Urbistondo, 2019). Considering only what one member of the couple wants does not take into account the different emotional and stated values of the sexes, if there are differences in evaluation. Therefore, it is hypothesized that:

h1.1. The self-reported perceived value of various types of travel differs significantly by gender.

h1.2. The neural responses to the attractiveness of various types of travel differ significantly by gender.

1.2 The Role of Emotions in Tourism Research

The importance of emotions in tourism literature is growing (Al-Nafjan et al., 2023; Bastiaansen et al., 2018; Hosany et al., 2021). Traditionally, researchers use self-report measures such as questionnaires to assess respondents' emotional states (Hosany et al., 2021). Participants are asked to (numerically) rate the emotions evoked by stimuli, such as photos of destinations or specific types of travel. While this method is inexpensive and easy to use, it carries the risk of emotional bias due to various factors (Volo, 2017). To obtain unbiased data and capture objective emotional responses in real time, researchers can use neural tools. These tools directly record the brain's emotional responses to marketing stimuli (Lei et al., 2022).

In tourism research, considering stakeholder decision-making from a strategic perspective, i.e., considering the interdependence of decision-makers, using a game theory framework can provide valuable insights (Aday & Johnston, 2015). Much of this literature considers investment and competition by region (Huawen Shen, 2021). For example, Tran and Thompson (2015) analyze the interaction between China and Japan in terms of competitive tourism efforts, where the outcome structure is a zero-sum or win-win game. Non-cooperative game theory has also been used to study the competitive use of resources in tourism, building on the prisoner's dilemma (Mosetti, 2006). However, research on consumer decision-making in tourism using a game theory approach is scarce and limited to studies of transport choice. From a consumer perspective, Brida et al. (2009) state that the tourist's choice depends on the attributes as well as the choice of other tourists. At the same time, as mentioned above, the role of emotions in tourism choice is receiving increasing interest (Hosany, 2012). Whether rational assessment and emotional considerations lead to different outcomes in tourism choice is an empirical question. Therefore, we set up the following hypothesis:

h2. The optimal coordination of travel partners on a tourism type depends on the measurement of value assessment, either through self-reported perceived value and/or neural responses to the attractiveness of travel types

1.3. Interdependent Decision-Making in Tourism Using Game Theory

In a game theoretic setting, which models the interaction between individuals, utilities (benefits) are traditionally material and do not depend on emotions. Nevertheless, emotional experiences are an important source of utilities that shape behavior but have long been neglected in economic decision-making (Battigalli & Dufwenberg, 2022). In recent years, emotions and motivational beliefs have gained interest in economic decision-making (Bénabou & Tirole, 2016), as well as in tourism choices.

A fundamental assumption in economics is that people act out of self-interest. However, there are situations where self-interest makes everyone worse off and motivational aspects become relevant. In this context, psychological game theory (PGT) provides a framework for incorporating motivations into strategic decision-making (Battigalli & Dufwenberg, 2019) and has recently gained interest in the social sciences (Azar, 2019). PGT incorporates human motivations into social decision-making. As in traditional games, players' strategies are analyzed in terms of the best response, which is analyzed through a formal equilibrium or by identifying potentially dominant strategies and using iterative elimination of dominant strategies. A dominant strategy is one that gives the player a higher payoff for any given response from the other player (Myerson, 1991). When motivational aspects come into play, players do not necessarily choose a dominant strategy, which at first sight could be interpreted as irrational behavior. Berg et al. (1995) show in a game theoretic framework of the investment game that despite the existence of dominant strategies, players used strategies of trust and reciprocity. That is, the players take into account the trust and reciprocity of the partner in their utility function. In the same line, considering explicit aspects such as aversion to disappointment (or guilt aversion), a player's utility function depends on the expectations of others and how these are fulfilled by a certain outcome (Battigalli & Dufwenberg, 2022). Yoeli and Hoffman (2022) emphasize that social pressure is one of the factors that shape strategic behavior, with decision-makers becoming motivated reasoners. The authors argue that concern for others' reactions and seemingly altruistic behavior may have different hidden motivations (e.g., signaling, reputation, persuasion, affiliation, etc.).

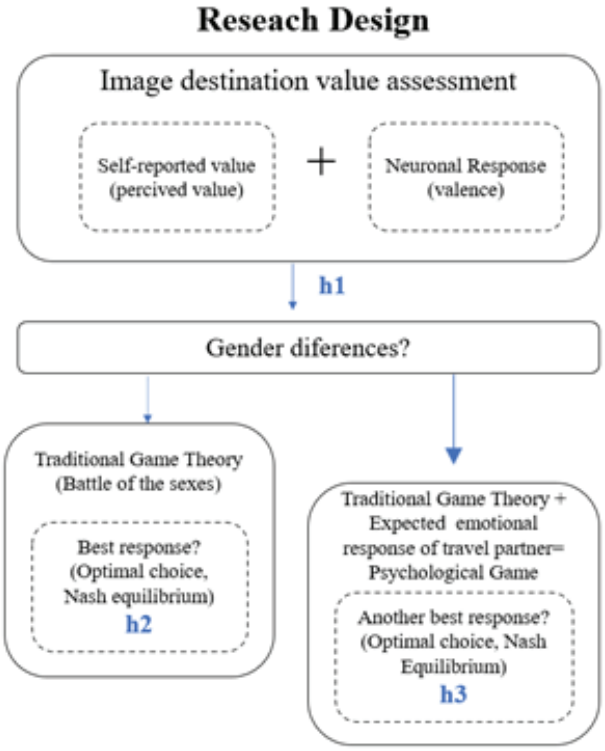
In the context of the tourism decision of travel partners, we focus on psychological motivation in terms of satisfying the expected emotional response of others, interpreted as caring (altruism) or as hidden persuasion. In the context of studying cooperation in the presence of conflicting interests, different classical game structures have been studied depending on the payoff matrix (e.g., Prisoner's Dilemma, Battle of the Sexes, Chicken Game). The coordination game "Battle of the Sexes", originally introduced by Luce and Raiffa (1957), is an interesting framework when considering the different tastes of tourists but the goal of sharing the holiday experience with friends or loved ones. Specifically, the structure of the Battle of the Sexes game assumes that each player prefers to coordinate with the other player on different outcomes but wants to coordinate on the same choice (which implies higher payoffs than choosing different actions). The classic example is the choice of women or men to go to the theater or a football match, where each prefers a different option, but both want to go together. There have been many variations, with the key aspect being the structure of the preferences. For example, Rigakis et al. (2021) use the battle of the sexes to model tourist trip recommendations for different groups, explicitly considering the individual preferences of group members with the aim of keeping the groups together during the trip. While the authors focus on a recommendation system, the motivational aspects of the tourists' decision process remain unconsidered. Therefore, we propose the following hypotheses:

h3.1. Consideration of the expected emotional response of others (caring or persuasion) can alter travelers' optimal choices of tourism types.

h3.2. A particular travel type can be achieved as Nash equilibrium if tourists care enough about the expected emotional response of the travel partner.

Figure 1 shows the conceptual framework for the research design.

Figure 1: **Research Design**



2. MODEL FRAMEWORK

2.1. A Psychological Game of Tourism Type Choice

The analysis of tourism type choice between men and women is approached by setting up a stylized model describing the situation of tourism type coordination, which is modelled in a psychological game theory framework, adapted from Battigalli and Dufwenberg (2022), using the representation in strategic form. Following the standard notation for a game structure (Myerson, 1991), the game is described as $G(N,(a_i)_{i\epsilon N},(u_i)_{i\epsilon N})$, with N = 2 player types, $(a_i)_{i\epsilon N}$ = {T1, T2, ...Tj} are the available actions for each player, which are j possible tourism types. Players' utility $(u_i)_{i\epsilon N}$ is defined in two different ways. First, we define utility in terms of one's own value assessment (measured either through a self-reported valuation or a neural response valuation) and a fixed disutility for outcomes where no coordination is achieved between travel partners. Second, following recent advances in psychological game theory, utility is defined as the addition of one's own value assessment and the sensitivity of the decision-maker of satisfying the expected emotional response of the travel partner.

In what follows, we set out the game theoretic framework, assuming that players have common knowledge of the rules and outcomes.

2.1. Traditional Game

Consider a game G_1 in which the prospective tourist chooses the type of travel T and his payoff is purely material, depending on his own decision (a_2) and the decision of the travel partner (a_1). The baseline model considers only each player's own payoffs:

$$u_2 = v_2(a_2)$$

The actions taken by both players are a strategy profile, and a common strategy is defined as a coordination outcome where both players choose the same action (tourism type). A strategy profile is a Nash equilibrium if the best response of type 1 (BR_1) to the choice of type 2 is also the best response of type 2 (BR_2) to the choice of type 1. For example, to obtain the strategy profile (T1, T1) as a Nash equilibrium, we need that $BR_1(T1) = T1$ and $BR_2(T1) = T1$.

We now introduce a fixed guilt effect (disutility) in the decision-maker's utility for situations where a joint outcome is not achieved. In the model, this is reflected by a 'care parameter' Z = (X, Y), where X is the fixed care parameter for the woman and Y is the fixed care parameter for the man. That is, men face a fixed disutility Y if they don't match the woman's preference, and women face a fixed disutility X if they don't match the man's preference. The payoffs are expressed as follows:

$$u_2 = v_2(a_2) - Z$$

As in the standard game, the model is solved by the formal definition of a Nash equilibrium. Note, however, that the best response of the players is now a function of the care parameter X or Y, and hence the equilibrium depends on these fixed parameters (disutility).

2.2. Psychological Game

Considering the care for the opponent in terms of motivated beliefs, following Battigalli and Dufwenberg (2022), the players' utility is described as their own value assessment of a tourism type, adding a care function that reflects the concern about meeting the expected emotions of the opponent. That is, the emotions of the travel partner enter the players' utility function. This implies the following belief-dependent utility:

$$u_2 = v_2(a_2) - \theta_2[E(e_1|-a_2) - e_1(a_2)]$$

where theta is what we call the 'emotional care parameter', which indicates how much player 2 suffers when the partner's positive emotions are below the emotions that other choices would have elicited. We define $\theta = (\beta, \alpha)$, where β is the emotional care parameter for the woman and α is the emotional care parameter for the man. Following Battigalli and Dufwenberg (2022), expectation is modelled as the average of the lowest and highest values that the other could receive from alternative choices, i.e.

$$E(e_1|-a_2) = (e^{max}_{1,-a_2} - e^{min}_{1,-a_2})/2$$

Note that here the 'material utility' is based on reported value perceptions ('what she/he states'), whereas the belief-dependent utility is based on measured emotions ('what she/he feels'). Intuitively, you can think of the emotions that a particular decision evokes in your travel partner, compared to the expected emotions of alternate choices. Emotions are measured here in terms of valence, analogous to Battigalli and Dufwenberg (2009), as the cost or reward associated with an emotion and abstracting from other emotional aspects. Solving for the equilibrium strategy profile, the best response of player 1, given the action of player 2, can be expressed as follows:

$$v_2(a_2) - \theta * \left(E[e_1|-a_2] - e_1(a_2)\right) \geq v_2(a_j) - \theta * \left(E\left[e_1| - a_j\right] - e_1(a_j)\right) \forall j$$

Note that the best response is a function of the emotional care parameter θ. Thus, achieving a particular common strategy as a Nash equilibrium depends on the emotional care parameters of the two players.

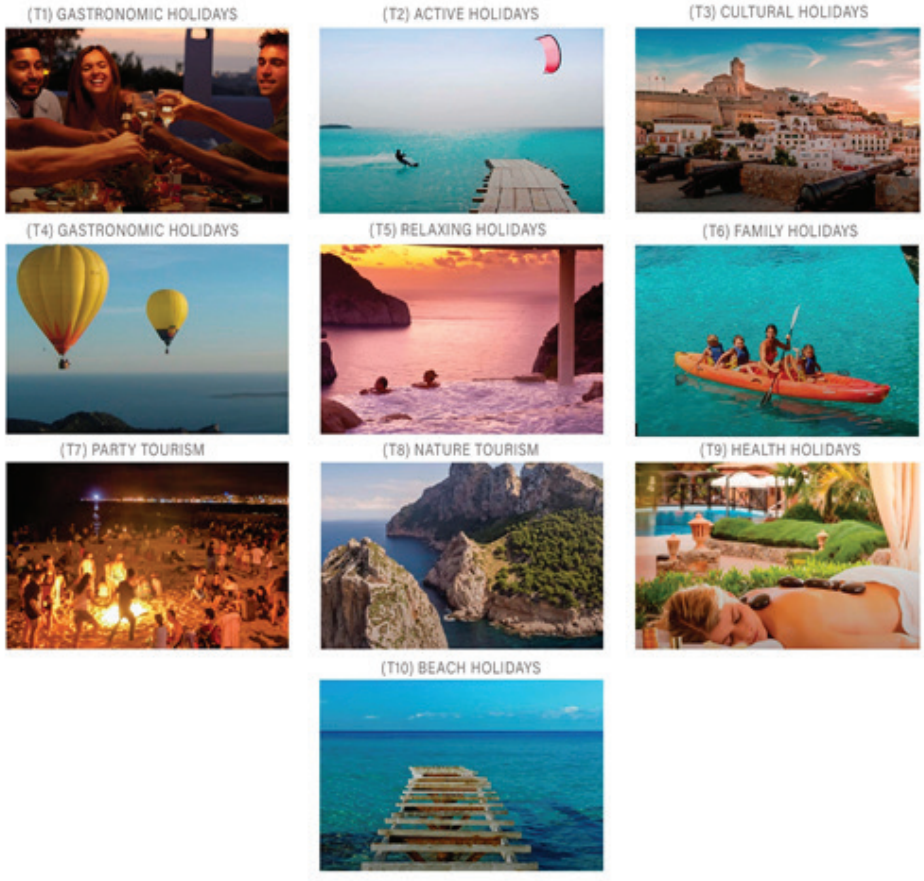
3. EXPERIMENT AND DATA

To verify the hypotheses, based on the outlined mechanism of emotional game theory, an experiment was carried out by an international research team using a neuroscience laboratory with Bitbrain technology, under ethical and confidentiality guarantees. The task given to the participants consisted of the controlled visualization of a series of static stimuli (pictures) containing different messages (tourism types), as illustrated in Figure 2.

The sample for the study consists of 50 people in Germany. The sample is gender balanced. The age of the individuals ranges from 20 to 65 years, with an average age of 34 years. All individuals have higher education and belong to the middle social class. 44% of the respondents had never visited the Balearic Islands. This sample size is standard. All test subjects stated that they had normal or corrected vision and hearing and were not taking any psychotropic medication (Bastiaansen et al., 2022). Furthermore, all participants gave written informed consent before we started the study. This was in accordance with ethical research standards.

Subjects were randomly selected and placed in a quiet room with appropriate lighting conditions. After reading the instructions and confirming written informed consent, subjects were instructed on the function of the EEG helmet and finger sensor, and the helmet sensors were adjusted. Once the sensors were able to make contact, the subjects were shown pictures to determine their general emotional arousal level (e.g., pictures of babies or puppies, poor neighborhoods, cockroaches). After a two-minute rest period, during which the subjects concentrated on a black screen, they were shown pictures of ten different types of travel that could be taken to the Balearic Islands. We have selected images from the Balearic Islands, as this is the main tourist destination for Germans in Spain (López, 2024). All the images came from the website of the Balearic Islands Tourism Strategy Agency (https://www.illesbalears.travel/). The classification of the travel types was taken from the Reiseanalyse (FUR, 2023) an annual survey of German travel behavior. The respondents were presented with one photo for each of the following categories: (T1) gastronomic tourism, (T2) active holidays, (T3) cultural holidays, (T4) adventure holidays, (T5) relaxing holidays, (T6) family holidays, (T7) party tourism, (T8) nature tourism, (T9) health holidays, (T10) beach holidays.

Figure 2: **Stimuli used in the experiment**



Source: Balearic Islands Tourism Agency (https://www.illesbalears.travel/) (2022).

The laboratory used consists of three sensors: (1) A 12-channel EGG sensor ((Fp1, Fp2, AF7, AF8, F3, F4, P3, P4, PO7, PO8, O1, O2), REF (A1) and DRL (Fpz)) located in the prefrontal, frontal, parietal, and occipital areas, allowing the precise measurement of frontal alpha asymmetry, alpha-ERD / occipital ERS, P300, N400, CVN, with the BitBrain trademark Dry Diadem; (2) An electrodermal sensor (EDA) to measure the galvanic skin response; (3) A cardiovascular activity sensor (BVP), both trademarks of BitBrain, and finally the analysis software SennsLab and SennsMetric of BitBrain. The configuration of this laboratory is widely used in other scientific studies (Mora et al., 2020; Moya et al., 2020; Garcia-Madariaga et al., 2019; Antelis et al., 2013; Loscertales et al., 2012).

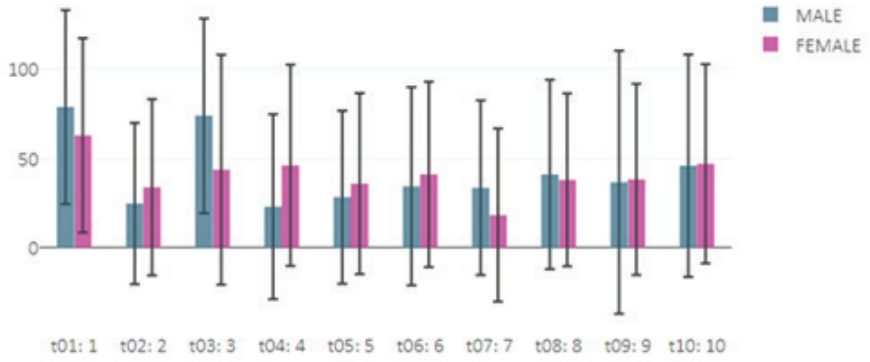
Our research focuses on analyzing two variables: self-reported perceived value and valence as a neural response to the perceived attractiveness of travel types. Valence measures the degree of attraction experienced in the presence of a stimulus or situation. It varies from the extreme 'positive/pleasant' to the extreme 'negative/unpleasant' (Mas et al., 2024a, Aldayel et al., 2020; Ogino & Mitsukura, 2018). Therefore, after analyzing the involuntary response using neuromarketing techniques, participants were asked to sort the images according to their personal travel preferences, assign them values from 1 to 10 and complete a questionnaire.

Self-reported perceived value evaluates benefits versus sacrifices. It is measured as a latent construct using an adapted, validated scale that has found wide application in the context of purchase intention (based on the original work of Kim et al., 2007 and many applications, e.g., Erdmann et al., 2021; Sánchez-Fernández & Iniesta-Bonillo, 2007).

4. RESULTS

Figure 3 shows the distribution of measured neural responses for the different stimuli between males and females. The boxplot shows gender differences for the presented stimuli. Descriptively, we can see that the stimuli related to gastronomic tourism (T1), cultural holidays (T3) and party tourism (T7) have generated a greater emotional evaluation in male individuals, whereas the stimuli related to adventure holidays (T4), relaxing holidays (T5) and family holidays (T6) have generated a greater emotional evaluation in female individuals.

Figure 3: **Emotional appraisal (Valence) by gender**



To test for statistically significant differences between the two types of tourists, we test for the existence of a difference between the means for the value assessment by the two types of tourists. Visual inspection of the data suggests an approximately normal distribution of the data, although not for all self-reported values. However, with the goal of practical applicability for hypothesis testing, we accept that real-world distributions are not exactly normal and provide additionally to traditional frequency-based testing complementary Bayesian inference for increased robustness.

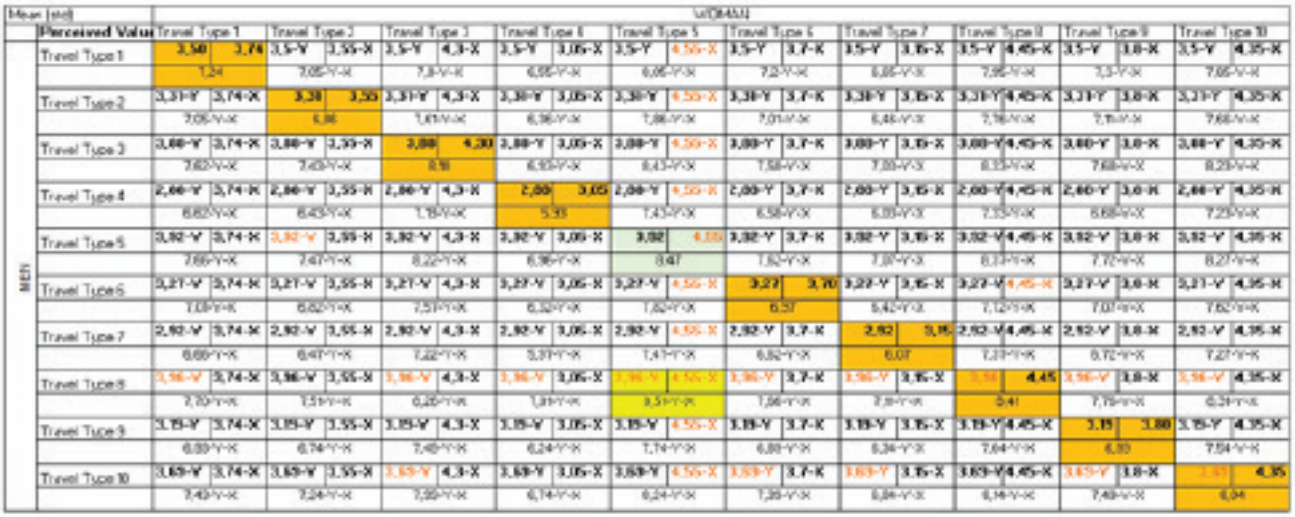
First, we perform a two-tailed Student's t-test. Table 1 shows the corresponding p-value for each type of tourism, and we reject equality of means if the p-value is greater than 0.05 (5% significance level) or 0.10 (10% significance level). The test results confirm statistically significant differences in the reported scores of T3, T5, T8, T9, and T10 (H1), while the observed differences in emotional response are not significantly different for the two types of travelers. Second, with the intention of overcoming some of the problems of traditional frequency statistics, we compute the Bayes factor test, following Hsu & Chen (2020). Bayesian inference is increasingly used in psychological analysis (Van De Schoot et al., 2017), and Biel and Friedrich (2018) even argue that any nonsignificant result from traditional hypothesis testing should be supplemented with Bayes factor analysis, especially for small samples. Therefore, we report the Bayes factor (BF) for each case, which quantifies the likelihood ratio between the data supporting a difference in means (H1) versus equality of means (H0), with BF > 1 indicating stronger evidence of a difference in means. Note that except for two types of tourism (T=8, T=10), the self-reported value is closer to the hypothesis of equal means for men and women (H0). That is, the self-reported value for nature tourism (T8, mountain vacation) and for beach vacation (T10) is likely to occur under different value distributions for men and women.

Table 1: **Difference in means of value assessment between genders**

p-value	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
valence (neural response)	0.1269	0.7700	0.6490	0.2228	0.8439	0.9074	0.4504	0.2212	0.4082	0.5595
perceived value (self-reported)	0.4857	0.5389	0.0832	0.6806	0.0267	0.2361	0.5576	0.0692	0.1004	0.0209
BF	0.3583	0.3604	0.7726	0.3245	0.7864	0.6580	0.4206	2.3801	0.4342	1.6693

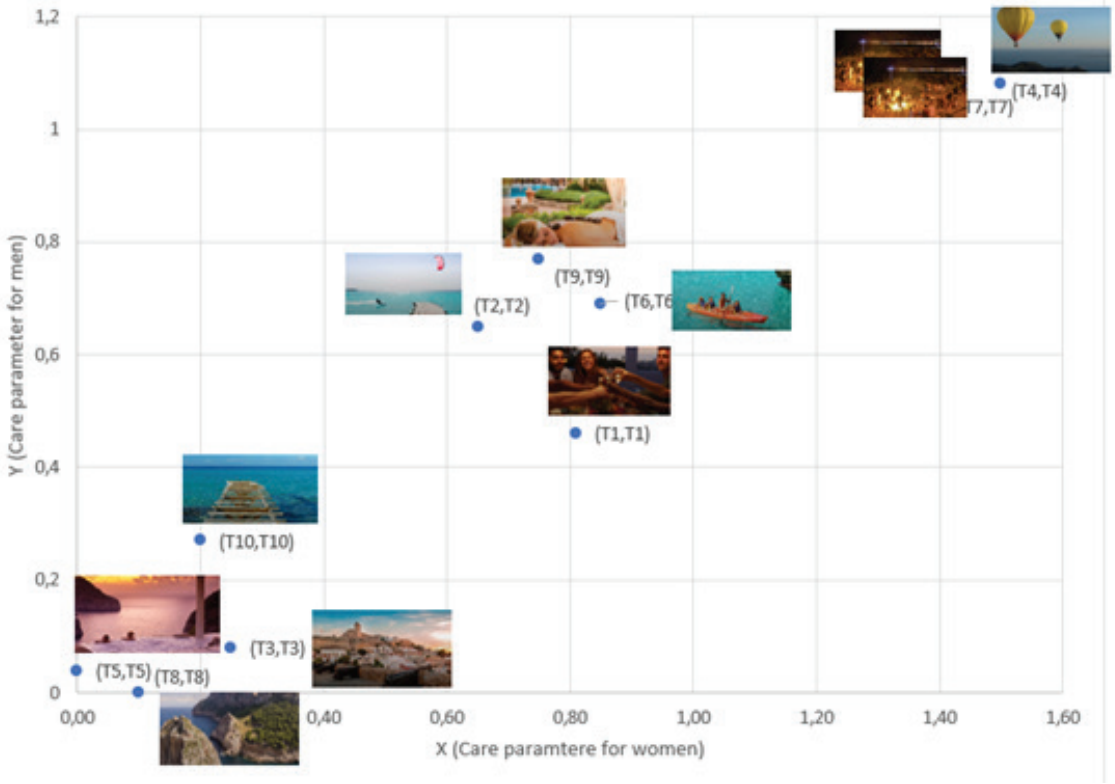
In the following, we present the results from the analysis of the tourism game. Table 2 represents the payoff matrix based on self-reported value assessment. For the case X = Y = 0 (model 1), we identify a dominant strategy (T5) for women and no dominant strategy for men (H2.1 confirmed only for woman). The Nash equilibrium (T8, T5) is not a common strategy, but the Pareto efficient outcome. That is, none of the coordination outcomes (diagonal) is a Nash equilibrium. Additionally, we find that the coordination outcome (T5, T5) is the one with the highest joint utility but is not achieved as equilibrium outcome if players consider only their self-reported value assessment.

Table 2: **Payoff table (self-reported value assessment)**



For the purpose of interpreting model 2, Figure 4 illustrates the necessary fixed care parameters for the tourism partners to achieve a common strategy as a Nash equilibrium.

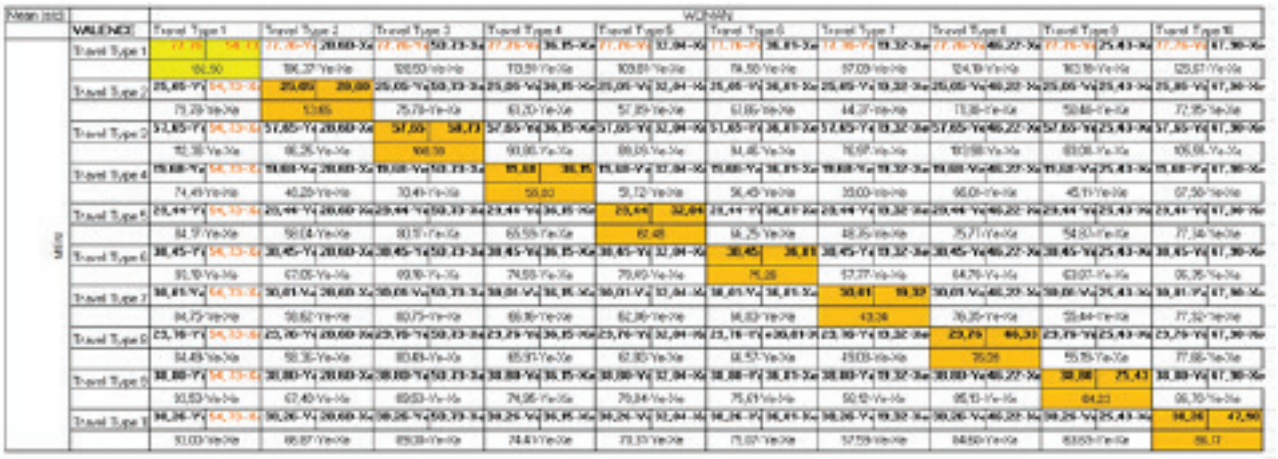
Figure 4: **Coordination equilibrium depending on fixed care parameters of players (based on self-reported value)**



The results of the self-assessment can be divided into four main groups: NE easily achievable if one player cares a little (T5, T5), (T8, T8); NE easily achievable if both players care a little (T3, T3), (T10, T10); NE achievable if both players care (T2, T2), (T9, T9), (T6, T6), (T1, T1); NE requiring both players to care a lot (T7, T7), (T4, T4). Thus, the results suggest that the achievement of a particular joint strategy as NE depends on how much the travel partners care about fulfilling the emotional expectations of the other type (H2.2).

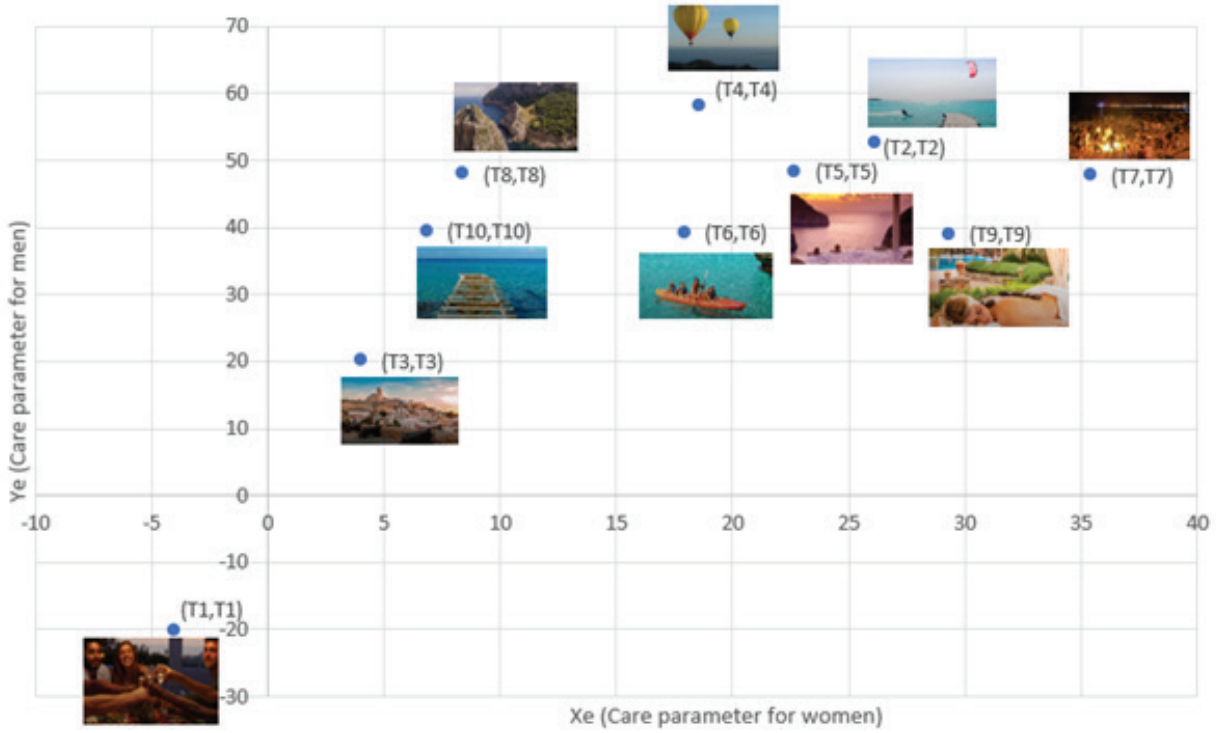
Analogously, but based on neural measures (valence), Table 3 reports the corresponding payoff matrices and Figure 5 illustrates the necessary fixed care parameters to maintain a joint strategy as NE.

Table 3: **Payoff table (neuronal measured value)**



Considering the case Xe = Ye = 0 (model 1), the payoff structure based on the measured valence shows that T1 is the dominant strategy for both travel partners (H2.1 confirmed for both). Therefore, the joint strategy profile (T1, T1) is a Nash equilibrium of the tourism game based on measured emotions (H2.2) and the equilibrium is also the Pareto efficient outcome (H2.3).

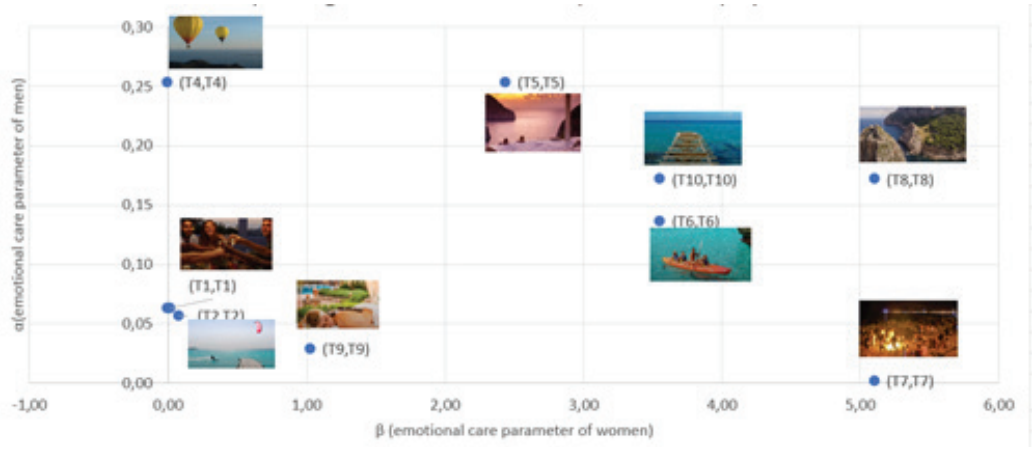
Figure 5: **Coordination equilibrium depending on fixed care parameters of players (based on neuronal measured valence)**



The fact that the care parameters take on positive values (Xe > 0, Ye > 0) confirms the superior performance of (T1, T1) in terms of emotional response, with the care parameters for both players being in the negative range, i.e., since the care parameters are positive, this result is always achievable. Note that those strategies that were difficult to achieve based on self-report are also difficult to achieve on the basis of emotional evaluation (T7, T7), (T4, T4). The strategy profile (T3, T3) is relatively easy to achieve when both players care a little.

Finally, we analyze the psychological game, where the payoff is measured as both the self-reported perceived value and the expectation of satisfying the emotional response of others (model 3). Figure 6 illustrates the results.

Figure 6: **Coordination equilibrium depending on the emotional care parameters of players**



The psychological game shows that (T1, T1) is easy to achieve as NE if the man takes a little care to meet the expected emotions of the woman. Achieving (T7, T7) or (T8, T8) as NE requires a lot of care from the woman. Table 4 shows the care parameters for all the models that make it possible to maintain a common strategy as NE.

Table 4: **Thresholds for fixed and emotional care parameters to sustain a coordination outcome as pure Nash equilibrium**

Model	Fixed guilt effect				Emotional care function	
Variables (measurement)	Perceived value (self-reported)		Valence (neural measurement)		Perceived value & Expected satisfaction of emotional response of travel partner (self-reported & neural measurement)	
	X	Y	Xe	Ye	beta (β)	alpha (α)
BR(T1) = T1	0.81	0.46	-4.00	-20.12	0.02	0.06
BR(T2) = T2	0.65	0.65	26.13	52.72	0.08	0.06
BR(T3) = T3	0.25	0.08	4.00	20.12	-0.01	0.06
BR(T4) = T4	1.50	1.08	18.59	58.08	-0.01	0.25
BR(T5) = T5	0.00	0.04	22.69	48.32	2.44	0.25
BR(T6) = T6	0.85	0.69	17.92	39.32	3.55	0.14
BR(T7) = T7	1.40	1.04	35.41	47.75	5.10	0.00
BR(T8) = T8	0.10	0	8.40	48.00	5.10	0.17
BR(T9) = T9	0.75	0.77	29.30	38.97	1.03	0.03
BR(T10) = T10	0.20	0.27	6.83	39.50	3.55	0.17

5. DISCUSSION AND CONCLUSION

5.1. Discussion

Starting from the basic model, the player's payoff considers only his own evaluation, without taking into account any fixed disutility for actions that don't match, nor any emotional care effect. A clearly female- or wife-dominated strategy can be identified, with relaxing holidays (T5) as the preferred type of travel. Note that this is consistent with Davis and Rigeaux (1974). The optimal solution in this non-cooperative game arises when both partners take different types of trips. In this case, the highest utility for women is achieved by participating in relaxing holidays (T5) and for men by participating in nature tourism (T8). This leads to a Nash equilibrium at (T8, T5). The Pareto efficient outcome is also found in the combination of T8 and T5.

Given that a travel decision is usually a joint decision (Rojas-de-Garcia & Alarcón-Urbistondo, 2019; Koval & Hansen, 2023), the outcome of a potential travel partner should not be neglected when choosing a type of travel (T). The calibration of model 1, which is based on travelers' self-reported or neural measures of attractiveness, takes this effect into account by considering a fixed disutility for a strategy profile with different actions. If both partners are unwilling to accept a possible disutility and therefore prefer to choose the type of travel completely on their own, then X = Y = 0, which would bring us back to the baseline model. On the other hand, if the partners are interested in each other, they are willing to deviate somewhat from their own preferences and accept some disutility.

Considering first the self-reported valuation, a joint decision on the type of trip is possible with a small degree of concession. If the man satisfies the woman's needs with Y = 0.04, the new Nash equilibrium is at (T5, T5; welfare = 8.47). Joint nature tourism (T8, T8; welfare = 8.41) is also possible without major compromises. In this case, the care parameter for women would be higher with X = 0.10. The third highest benefit for both participants, with a welfare of 8.18, is achieved by realizing a cultural holiday (T3, T3). If X > 1.5 and Y > 1.08, all joint trips are in equilibrium, with women having to make greater concessions than men.

Continuing with the neural measurement, a common strategy (coordination equilibrium) can be seen for model 1. Both women and men emotionally value participation in gastronomic tourism (T1) the highest and it is a dominant strategy for both. This leads to a Nash equilibrium and a Pareto efficient outcome for participation in gastronomic tourism (T1, T1). In model 2, considering Xe and Ye and thus the potential emotional outcome of the travel partner, a joint type of trip can be found when Xe = 4 and Ye = 20.12. All joint trips are in equilibrium when Xe > 35.41 and Ye > 58.08. Joint participation in gastronomic tourism (T1, T1; welfare = 132.50), followed by cultural holidays (T3, T3; welfare = 8.38) and beach holidays (T10, T10; welfare = 86.17), achieve the highest benefit. In contrast to the use of self-reported data, men must make more concessions here than women.

Considering the self-reported valuation and the satisfaction of the expected emotions of the travel partner, PGT comes into play. Looking at the NE and Pareto efficient solutions, we find that consensus to participate in gastronomic tourism (T1, T1) is easy to achieve. Men need to be slightly more responsive to women's needs (a = 0.06; b = 0.02). For participation in active holidays (T2, T2) as well as cultural holidays (T3, T3), an agreement between the travel partners can also be reached with relatively few concessions. In the case of active holidays (T2), women have to make concessions. The opposite is true for cultural holidays (T3). All joint trips are in equilibrium if a > 0.25 and b > 5.10. Transferred to the specific type of travel, this means that women must make the biggest concessions for joint party tourism (T7, T7) or nature tourism (T8, T8).

5.2. Theoretical contribution

This paper adds to the literature by making a methodological contribution to consumer value-based decision-making in tourism, considering self-reported data and measures of neural activity jointly, based on psychological game theory. The few game-theoretic approaches that exist in the tourism literature to date focus on competitive interactions between destinations and are generally based on observed historical data (e.g., Tran & Thompson, 2015; Sheng, 2011). The model developed here takes a game-theoretic approach, where the players are potential tourists, and the data are based on emotional evaluations of different types of travel. This contributes to the growing importance of emotions in tourism (Al-Nafjan et al., 2023; Volo, 2021) and the increasing popularity of psychological science in general (Azar, 2019). The focus is on the expected emotional response of potential travel partners, interpreted as caring (altruism) or covert persuasion. In the same way, it contributes to previous studies that suggest that there are differences in the emotional response associated with decision-making processes on the gender variable (Reber & Tranel, 2017; Eriksson & Simpson, 2010; Mas et al., 2024b).

5.3. Managerial implications

In practice, the combination of EEG and psychological game theory in the context of tourism marketing can help to develop innovative and effective strategies for destinations and related businesses. This combination enables marketers, tourism boards and destination marketing organizations to gain insight into the neural responses of consumers and at the same time use them as a basis for strategic decision-making. The resulting well-designed advertising campaigns are more attractive, competitive, and persuasive.

On an operational level, for example, EEG data can be used as neurofeedback for web designers to understand the brain responses (Flanagan & Saikia, 2023) of tourists during the information or booking process. By combining EEG data with psychological game theory, tourism companies can improve their web design to appeal to tourists' emotions and influence the decision-making process. When men and women decide to travel together, the combination of these methods can ensure that couples are not only engaged, but also psychologically satisfied with their interactions. To give a concrete example, based on the results of the cases analyzed in this paper, when the Balearic Islands promote certain types of travel to potential German tourists, the communication should be based on images T1, T2, T3, T9, which require less commitment in terms of the travel partner's emotions. Men who meet women's emotional expectations should be the target of T4 communication. Similarly, the communication of T7 (and T8) should be directed at the women, appealing to their desire to satisfy the men's emotional expectations. An image of the proposed destination that builds consensus between travel partners, while incorporating the partner's emotional expectations into their own value assessment, is expected to accelerate purchase decisions, increase satisfaction, and build loyalty.

The combination of EEG data and psychological game theory can also be used to improve tourism applications and online platforms through user experience (UX). For example, developers can optimize user interfaces so that they are not only visually attractive, but also psychologically and emotionally appealing (Marques et al., 2021). In addition, EEG data can be used in conjunction with game theory algorithms to predict tourist behavior. By understanding neural responses to different stimuli (e.g., choice of travel type or pricing strategies), businesses can predict and effectively influence certain decision-making processes of tourists.

In summary, the introduction and diffusion of EEG in tourism opens new opportunities for destinations and related businesses (Beerli-Palacio & Martín-Santana, 2017; Lai et al., 2020; Garzon-Paredes & Royo-Vela, 2023). By analyzing the competitive landscape and the decision-making processes of tourists, promotional campaigns can be designed to be attractive, competitive,

and persuasive (Hou & Pan, 2023). Recommendations and/or packages can be tailored to the emotions and psychological preferences of tourists and can also take into account the needs of others (Sánchez-Fernández & Iniesta-Bonillo, 2007). This increases the likelihood that tourists will choose one destination or type of travel over others. Specifically, we propose to use the framework of a psychological game, taking into consideration the tourists' own value assessment of travel alternatives together with the expected emotional validation from their travel partners.

5.4. Limitations and further research.

A limitation of the study is that we focus directly on the measurement and consideration of differences across groups in their value perception, which determines the choice of tourist destinations given the measured payoffs of the travelers. While our study contributes to bridging the gap between neural responses and subjective value assessments, we acknowledge the inherent complexity of interpreting neural responses to visual stimuli which is limited based on reduced form analysis. Therefore, it would be interesting to consider a set of exogenous determinants of tourism choice (e.g., economic conditions, travel trends and alternative destinations, price and promotions, culture, etc.), which are expected to enter travelers' utility functions. For further research, it would be valuable to set up a full structural model that provides causal inferences on what drives self-reported value and psychophysiological value assessments. However, this goes beyond the scope of the current paper and given the constraints of our experimental setting and available resources.

Despite all the advantages of using EEG in tourism, there are also some limitations to using psychological measures in tourism marketing research (e.g., Bastiaansen et al., 2022; Li et al., 2018). Like most studies conducted using EEG technology, our study is very limited in size, with only 50 participants. The relatively small number of participants may limit the general applicability of our findings. This implies limited generalizability due to the lack of representativeness within the sample, a limitation highlighted by Li et al. (2018). The demographic, socio-economic and cultural diversity of the participants may not be representative of the general population. This study includes only German tourists, which means that it does not consider cultural factors that may influence the choice of destination or the choice of a particular type of travel by tourists from other countries. In addition, subjects' behavior under laboratory conditions may differ from their behavior in real-life situations. Compared to other neuromarketing tools, such as functional magnetic resonance imaging (fMRI), the disadvantage of using EEG is that it is difficult to determine the origin of the brain wave (Boksem & Smidts, 2015). So-called activation maps, which show which parts of the brain are responding to a stimulus (Al-Kwifi, 2015), cannot be produced using EEG technology alone. Finally, the effort and cost of such a study must be taken into account. At least one hour per person is required to complete the experiment.

Regardless of these limitations, the present study shows that the combination of EEG-based data and psychological game theory can be used as a concrete tool to select images of different types of travel that ensure that couples are psychologically satisfied with their choice of travel, which is known to have a strong influence on travel and recommendation. Further research could elaborate a concrete campaign based on our findings or investigate whether cultural differences influence the emotional perception of images.

For future research, to control for cultural differences, we are carrying out experiments in different countries, which is expected to provide additional insights into the understanding of reported value assessments and measured emotions in response to visual stimuli of tourism images.

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Please cite this article as:
Mas, J.M., Erdmann, A. & Jaszus, K. (2025). The Emotional Battle of The Sexes Game: Psychological Game Theory Applied to the Choice of Tourism. Tourism and Hospitality Management, 31(2), 215-228, https://doi.org/10.20867/thm.31.2.4