EMOTIONAL AND COGNITIVE RESPONSE TO CULTURAL HERITAGE AND EF-FECTS ON VIRTUAL IMAGE OF DESTINATION: AN EXPERIMENTAL COMPARI-SON OF DATA WITH ENCEPHALOGRAMS AND MEASUREMENT SCALES

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Abstract: The research takes as a conceptual framework the construct of the image of the tourist destination, specifically in the emotional component on which there is not much research, and focuses on virtual destinations characterized by historical, cultural, and architectural heritage. The research compares, through the PLS-SEM technique for modeling partial least squares structural equations, the results obtained by electroencephalograms with the results obtained by applying a measurement scale with a survey, in both techniques, the cognitive and emotional responses of a group of subjects immersed in the virtual reality of heritage tourist destinations have been measured. Subsequently, these results are contrasted with those obtained based on the measurement scales of the cognitive and emotional components of the image. The results show that the cognitive and emotional response that architectural and cultural heritage provokes through virtual reality in individuals is high, interrelated, and positively affects the formation of the image of the historical heritage destination.

It is worth highlighting as a methodological element the performance of a neuroscience experiment in which cognitive and affective responses can be observed and measured using alpha α and beta β brain bioelectric waves.

Keywords: Image of the tourist destination; cognitive and emotional responses; measurement scales; historical heritage; neuromarketing; virtual reality.

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I. INTRODUCTION

The TDI tourist destination's image is essential in tourism research and management; the construct has been intensively investigated in recent decades and is known to be a multidimensional construct made up of cognitive and affective elements (Beerli-Palacio &

Martín-Santana, 2017; Elliot & Papadopoulos, 2016; Hernández et al., 2016; Huete Alcocer & López Ruiz, 2019; Kani et al., 2017; Lai et al., 2020; Marine-Roig & Anton Clavé, 2016)

During the COVID-19 pandemic, the global tourism industry has experienced a significant pause (Buckley & Cooper, 2021); however, tourists' vision continues to play an essential role (Jangra et al., 2021; Serrano-Arcos et al., 2021). Since we can have travel experiences to destinations through multimedia(Lupu et al., 2021), the platforms are increasingly crucial as entertainment tools (Njerekai, 2020). The consumption of multimedia content is increasing throughout the world and systematically generating, with the explosion of virtual tours, new questions in the fields of tourism marketing and destination management (Palazzo et al., 2021)

According to (Dongkyun Kim et al., 2017), understanding the interaction between culture and tourism is an exciting and essential research topic; however, it needs to be studied, and the results suggest that more conceptual work is needed (Duignan, 2021). The same happens with the methodologies and measurement scales of the TDI, which present the researcher with a vast set of procedures and tools, perhaps due to the variety of destinations (Authors, 2021). In this sense, few TDI studies use virtual reality, multivariate analysis, and neuroscience to investigate urban or rural cultural destinations in which heritage is present (WH Kim et al., 2017).

Since an essential part of the tourist product is the culture, cultural tourism plays a fundamental role in the attractiveness and image of destinations. The contribution of cognitive and emotional images to the perception of a destination is related to its local heritage (Huete-Alcocer et al., 2019). Intangible and material culture, such as historical and architectural heritage, can increase the cognitive response and, even more, the emotions toward a destination and, therefore, positively affect its image, attractiveness, and competitiveness (Folgado-Fernández et al., 2017; George, 2017). Namely, TDI's cognitive and emotional components can be studied through cities' historical, architectural, and cultural heritage. (Author, 2009)

Therefore, the general premise of this study is that the effect of historical heritage on the minds of tourists, precisely their cognitive and emotional responses, is intense and positive.

II. LITERATURE REVIEW AND HYPOTHESIS ESTABLISHMENT.

The image of the tourist destination TDI is of great importance for the territory because it motivates the interest, satisfaction, loyalty, or intention to act of tourists; it is a constantly changing construct that can be classified according to the conscious control that a person has on a space, it is an imaginative representation, feeling and impression about a destination that consists of three elements: cognitive image, emotional image and general image of the destination (Byon & Zhang, 2010; Elliot & Papadopoulos, 2016; Folgado-Fernández et al., 2017; Kani et al., 2017; Dohee Kim & Perdue, 2011; Lai et al., 2020; Leung et al., 2011; Lindblom et al., 2018; Luo et al., 2014; Marine- Roig & Anton Clavé, 2016; Martín-Santana et al., 2017; Qu et al., 2011; Rosa et al., 2018; Skavronskaya et al., 2017; Stylidis, Belhassen, et al., 2017; Stylidis, Shani, et al., 2017; Yap et al., 2018) (Authors, 2021, 2022)

measurement of the construct has widely investigated (Gómez et al., 2018); the literature is extensive and growing; however, the image of the destination is commonly defined as an emotional and cognitive response; it is a mental representation that tourists have of a place (Lai et al., 2020). It is essential to mention that the sites are far from being similar, so the conceptualization and research of the image of the tourist destination should allow the development of reliable and valid measurement scales that adjust to the destination is frequently measured through scales multi-attribute, both Likert-type and semantic differential intervals. (Authors, 2021, 2022)

Previous studies consider that there is a hierarchical sequence between cognitions and emotions and that both generate the image that will, in turn, affect behavior (Chiu et al., 2016; Ryan & Cave, 2005). Thus, emotional responses are different from cognitive attributes, but they are directly associated, forming emotions from cognitions in a hierarchical or sequential process, traditionally accepted (Baloglu & Mccleary, 1999; Beerli & Martín, 2004; Nghiêm-Phú, 2014; San Martín & Rodríguez del Bosque, 2008). However, neuromarketing has made it possible to observe that cognitive and emotional responses do not always arise sequentially. However, it can also act parallel (Authors, 2021, 2022). The belief that cognition precedes emotion has been discredited by other fields, such as psychology (Zajonc, 1980), neuroscience (Ledoux, 1989), and advertising research (Ambler & Burne, 1999). 9) . Thus, it may be essential to conduct research that will shed light on how cognition and emotion interact in the formation of the image of a tourist destination since the cognition-emotion relationship could be simultaneous or inverse instead of the accepted cognition-emotion sequence (Lazarus, 1991; Zajonc, 1980). Furthermore, emotion is the primary motivator of purchasing behavior (Royo & Serarols, 2005). Huete Alcocer and López Ruiz (2019) found in heritage destinations that the emotional component is more relevant than the cognitive in forming the image.

A key element to consider, therefore, is the emotional component of the image. Emotional evaluation of an image is related to experience, while cognitive evaluation is related to visual and environmental information (Zhou & Lin, 2012). In other words, the emotional image is created by the contextual quality, and the cognitive image by the quality of the representation; consequently, cognition and emotion are positively related to the image of a destination (Lindblom et al., 2018). That is, environments and places produce cognitive and emotional effects on the traveler (Baloglu & McCleary, 1999). Thus, the image of the tourist destination influences the tourist by creating a public image based on cognitive and emotional dimensions (Shafiee et al., 2016).

The data obtained on Spanish tourism reflect the vital role that cultural tourism plays in the attractiveness of tourist destinations; consequently, a large part of the tourist product is culture. (Huete Alcocer & López Ruiz, 2019) . In this way, the contribution of cognitive and affective images to the image of a destination is related to its local heritage, traditions, and historical, architectural, and cultural heritage. These have the opportunity to enhance the image of the site's destination and, therefore, its ability to attract visitors (Hernández et al., 2016). Therefore, the cognitive and emotional elements of the image of a destination have the opportunity to be examined through historical, architectural, and cultural heritage (authors). Cultural heritage gives life to local and national identities as it creates interdependencies between neighbors and societies worldwide. (Theodosiou et al., 2010) .

2.1 Using virtual reality to investigate heritage

Travelers have a mental image of the destination, which may have unique properties, but there is also a public image of the destination (Obenour et al., 2005). Therefore, the application of neuroscience and virtual reality represents a fundamental leap in investigating the image of destiny and the generic effect. A psychological mechanism influences behavior; its effects are significant due to the modality and controllability of virtual trips' emotional and cognitive scales. According to (Park & Njite, 2010), also cited by (Gholitabar et al., 2018), by linking tourism with virtual reality, heritage has a defining socio-psychological meaning linked to national identity through attributes of experience.

It is possible to pool data from the target image using hybrid techniques of artificial intelligence and evolutionary arithmetic algorithms. However, only with a broader understanding of the relationship between virtual reality and the image of destination tourism will opportunities be better exploited. Virtual reality offers a variety of promising applications in areas ranging from administration to entertainment. It allows people to have virtual reality-like experiences and perform various tasks by achieving predetermined goals using simulated scenes (Hyun & O'Keefe, 2012). In addition, they allow for improved motor, functional and cognitive performance of a person (Aminov et al., 2018), can be exciting and fun, and increase motivation (de Rooij et al., 2016).

Image creation is critical when the product is a destination since the tourist can only try it after buying it. Virtual reality allows for overcoming this limitation. In addition, virtual reality offers the opportunity to generate alternative experiences that can be useful for heritage conservation. Its use will continue to grow in applications and importance (Guttentag, 2010).

Based on these results found in previous research on the image of the tourist destination and the relationship between cognition and emotion, the hypotheses of the six models to be studied in this article are presented below; three models use data taken with electroencephalography to stimuli of virtual reality, and three models use data collected with the measurement scale through the survey to those same virtual reality stimuli.

Model No.1 Through neuromarketing, when the virtual cognitive image is hierarchized into the virtual affective image and the virtual image of the destination.

H1: The cognitive image (component) positively influences the emotional image (component).

H2: The cognitive image positively influences the image of the destination.

H3: The emotional image positively influences the image of the destination.

Model No.2 With measurement scale, when the virtual cognitive image is hierarchized into the virtual affective image and the virtual image of the destination.

H4: The cognitive image positively influences the emotional image.

H5: The cognitive image positively influences the image of the destination.

H6: The emotional image positively influences the image of the destination.

Model No.3 Through neuromarketing, the virtual affective image is hierarchized into the virtual cognitive image and the virtual image of the destination.

H7: The emotional image positively influences the cognitive image.

H8: The cognitive image positively influences the image of the destination.

H9: The emotional image positively influences the image of the destination.

Model No.4 With measurement scale, when the virtual affective image is hierarchized into the virtual cognitive image and the virtual image of the destination.

H10: The emotional image positively influences the cognitive image.

H11: The cognitive image positively influences the image of the destination.

H12: The emotional image positively influences the image of the destination.

Model No.5 Through neuromarketing, when the virtual cognitive image and the virtual affective image affect the image of the virtual destination in parallel.

H13: The cognitive image positively influences the image of the destination.

H14: The emotional image positively influences the image of the destination.

Model No.6 With measurement scale, when the virtual cognitive image and the virtual affective image influence the image of the virtual destination in parallel.

H15: The cognitive image positively influences the image of the destination.

H16: The emotional image positively influences the image of the destination.

III. MATERIALS AND METHODS

3.1 Participants

The present study uses experimentation with neuromarketing techniques through electroencephalography and virtual reality in a sample of 25 people, randomly selected between the ages of 21 and 60 years; each participant gave their written consent and was informed that cooperation is not mandatory and that they reserve the right to withdraw at any time (Doborjeh, Doborjeh, and Kasabov 2018). It is important to note that previously the virtual tourists were not aware of any investigated cultural heritage site.

3.2 Materials and procedure

The data collection method is carried out in an equipped physiological laboratory, virtual reality (VR) glasses, headphones, and an iPhone smartphone. The phone is inserted into a virtual reality device to project videos of tourist sites that have architectural heritage inside, obtaining data directly from the brain on the impact of virtual reality emulating tourist destinations; then, each subject answers an electronic questionnaire with the measurement scale, scale shown in table 1. The objective is to compare the data of the electroencephalogram with the survey's data. The scale for measuring rural-cultural destinations was developed, applied, and validated by (Author, 2005, 2009) for measuring the image in three heritage destinations of different sizes.

Table 1. The measurement scale for tourist destinations.

Code	Observables-variables.	Factor
C1	It is a place with the presence of symbolic elements.	
C2	It has a diversity of monuments.	
C3	It is a place with a rich heritage.	Cognition
C4	It is a place with historical richness.	
C5	It is a place with diverse artistic or architectural styles.	
E1	I have had the feeling of personal or intellectual enrichment.	
E2	I have had the feeling of disconnecting, of being in a different and refreshing place.	
E3	I have had the feeling of living something authentic.	Emotion
E4	I have had a feeling of admiration for past architecture and conservation over time.	
E5	I have had the feeling of filling myself, of enriching myself.	

Adapted from (Author, 2005, 2009)

For the construction of the image, the conceptualization formed with the sum of cognition plus emotion is used.

3.3 The multimedia stimulus of virtual reality

Technology can be crucial in customer satisfaction and should be explored and used to create a superior experience (Lakshmi & Ganesan, 2010). Brain activity and visual stimulation provided by virtual reality can be studied quantitatively to determine the impact of architectural and cultural heritage.

Each person studied is immersed through virtual reality glasses in a sequence of video clips of tourist destinations that imitate Spanish historical architecture. The electroencephalogram is operated on the subject's head, taking data directly from the skull. Thus, with the help of electroencephalography and the subsequent modeling of structural equations, the cognitive and emotional impact caused by the Spanish historical-cultural architectural heritage is measured through virtual reality. The Spanish virtual destinations evaluated in this experiment are detailed in the following table with the respective projection times in the VR devices.

Table 2. Virtual destinations were evaluated in the experiment.

Accumulated time. Start-end	Spain-destinations
00:00-00:37	Holy Cross Square
00:37-01:39	the main square of Madrid
01:39 -02:00	Knifemen's Arch
02:00-02:30	Gates of the San Miguel market
02:30 -03:01	Calle Mayor and Church of the Sacramento
03:01-03:33	Town Square
03:33-04:02	Segovia Viaduct
04:02-04:33	Temple of the Patron of Madrid
04:33 -04:59	armory square
04:59-05:23	Solar of the Plaza de la Armería
05:23-05:54	Madrid's royal palace
05:54 -06:19	Center of the Plaza de Oriente
06:19 -06:50	Monastery of the Incarnation
06:50-07:21	Ramales Square
07:21-07:48	square of Santiago
07:48 -08:15	Adrada Castle
08:15-09:15	Leon, Spain
09:15-10:15	swag house
10:15-11:11	Basilica of San Isidro
11:11-12:08	Leon Cathedral
12:08 -13:06	straw square

It is interesting to investigate the tourist's behavior through stimuli that emulate a possible visit to a destination endowed with cultural heritage and thus evaluate the conceptions in the human mind. (Sirgy & Su, 2000); it is possible to use the advantages of navigability in a virtual travel experience. It is known from previous studies that virtual reality significantly influences the emotional and cognitive dimensions of the experience (Choi et al., 2018), which facilitates the investigation of the concept (Choi et al., 2018; Sirgy & Su, 2000). Due to technological advances, distance has lost its traditional role as a cognitive filter between the subject and the site, resulting in tourist cultural spaces filled with images and icons. Tourist destinations are forced to overcome the new challenges offered by virtual reality media.

3.4 Modelling of structural equations. PLS procedure, confirmation path analysis, and data adequacy

A study was carried out using the PLS partial least squares regression algorithm because it works well with small samples; the data processing program is SMART-PLS. (Avila & Moreno, 2007) . Partial Least Squares Structural Equation Modelling PLS-SEM is a second-generation multivariate study procedure that currently has fundamental approval in the scientific society, mainly in social and economic sciences. Being a robust and flexible option, it allows working with estimations of simultaneous equations through several regressions to increase the explanatory capacity of experimental verification of the theory; the development of computer programs has also contributed to its use. It is accurate for PLS applied when data is collected from small samples. In this case, the experiment used 25 subjects.

All the models studied for this article are reflexive because the indicators are highly interchangeable and correlated. It is worth mentioning that the trajectory weighting scheme configured by default in Smart PLS allows higher R^2 values to be obtained. The path coefficients vary between (-1 and 1). Weights close to 1 are the most robust trajectories, and those close to 0 are the weakest. Likewise, the trajectory coefficients must exceed the value of 0.20 to be considered valid.

The coefficient of determination (R^2) measures the linear relationship between two quantitative random variables; for example, if an endogenous variable has a value of 0.710 in R^2, it symbolizes that the model explains 71% of the variance of this variable.

SmartPlS also allows to apply of a Blinfolding analysis, which is a resampling technique; it allows to calculate of the values of the Stone-Geisser test (Q^2); a sample reuse technique that starts with the first data point and skips D, data points at the indicators of endogenous constructs, the systematic pattern of data elimination and prediction depends on the skip distance D. Therefore, the number of rounds of bandaging is always equal to the skip distance D, the procedure estimates the parameters of the PLS model using the remaining data points. The estimates are used to predict missing data points, and the difference between the data points and the estimates is used to calculate the Q^2 measure; in a structural model, a value greater than 0 for a given latent endogenous variable indicates the relevance of the trajectory model for this construct if the value is 0 or negative it means that the model is irrelevant.

When the SEM-PLS algorithm is run, missing data points are treated as missing values.

A full bootstrapping with 5000 subsamples applied was used in the bootstrap confidence interval method with bias correction and acceleration (BCA). The two-tailed type of test, the significance level of 0.05, the schism of path weights (Path), 5000 maximum interactions, and the stopping criterion (10^- X) = 7.

The software used is SmartPLS, and the latent variables evaluated are cognition, emotion, and image.

IV. RESULTS

Next, the analysis of the target image model is presented and evaluated in all its forms.

4.1 Model 1 neuromarketing:

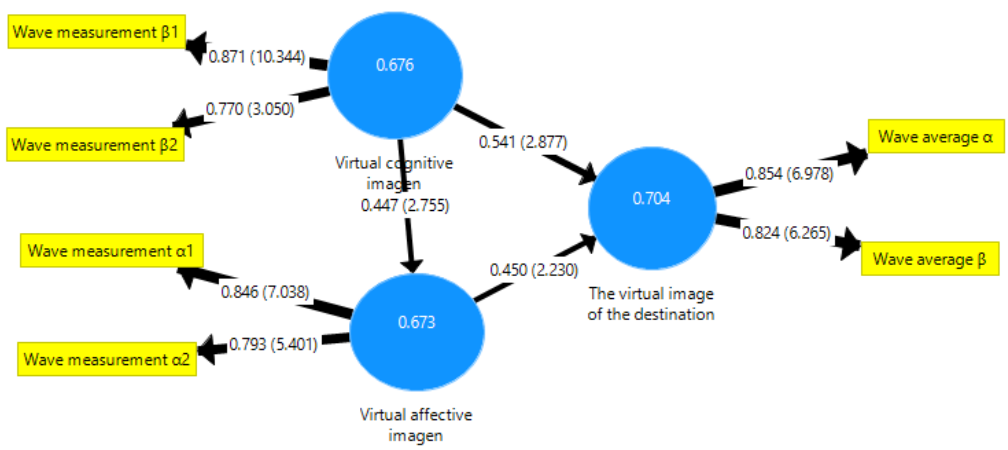

Figure 1. Structural model 1

Table 3. Discriminant validity model 1.

Factor		F1	F2	F3
F1.	Cognition	0.822	N/A	N/A
F2.	affect-emotion	0.447	0.820	N/A
F3.	Image	0.742	0.692	0.839

Model 1 confirms discriminant validity since the indicators that make up the constructs measure their construct to a greater extent.

Table 4. Reliability and convergent validity model 1

Factor	Indicator	Burden	Weight	P-value	t-value	bird
F1.	α1		0.846	0.000	7,038	0.673
	α2		0.793	0.000	5,401	
F2.	β1		0.871	0.000	10,344	0.676
	β2		0.770	0.002	3,050	
F3.	$\bar{X}\alpha$	0.854		0.000	6,978	0.704
	$\bar{X}\beta$	0.824		0.000	6,265	

BIRD. Mean-variance extracted

The results of the convergent validity of model one are also favorable; likewise, the average variance extracted is more significant than 0.5 in each latent variable, so it is confirmed that the observable variables that make up the latent variables measure more than half of each construct.

Table 5. Hypothesis contrast model 1

Hypothesis	standardized beta	P-value	t-value
H1:	0.447	0.006	2,755
H2:	0.541	0.004	2,887
H3:	0.450	0.026	2,230

All the hypotheses of model 1 are accepted, and the values of t are more significant than the critical value of 1.96.

4.2 Model 2 survey measurement scale:

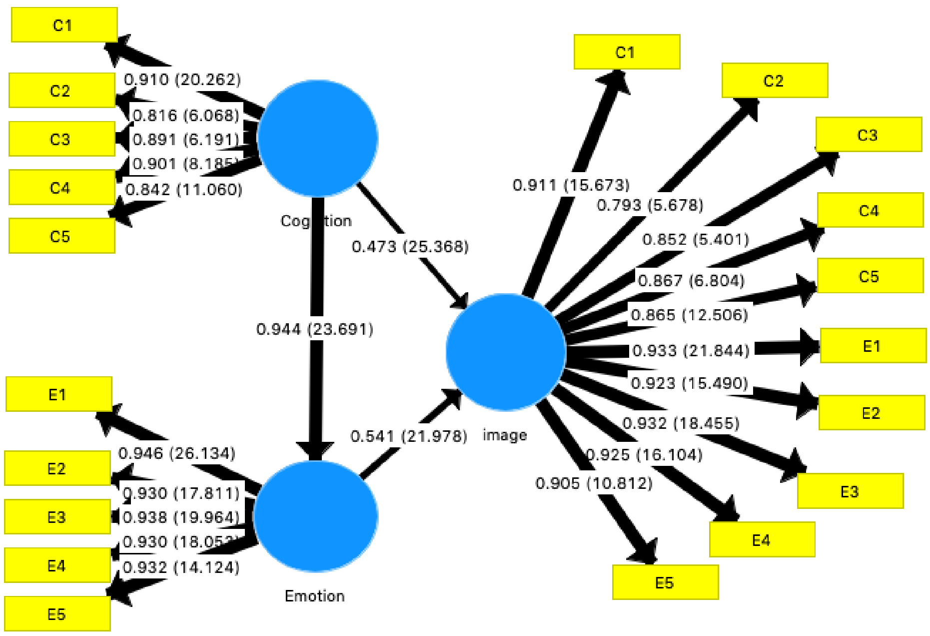

Figure 2. Structural model 2

Table 6. Discriminant validity model 2.

	Factor	F1	F2	F3
F1.	Cognition	0.873	N/A	N/A
F2.	affect-emotion	0.944	0.935	N/A
F3.	Image	0.984	0.988	0.892

Model 2 does not confirm the discriminant validity since the correlation of the constructs is more significant with the other latent variables and not with the same construct.

Table 7. Model 2 reliability and convergent validity

Factor	Indicator	Burden	Weight	P-value	t-value	bird
F1.	E1		0.946	0.000	26,134	0.874
	E2		0.930	0.000	17,811	
	E3		0.938	0.000	19,964	
	E4		0.930	0.000	18,053	
	E5		0.932	0.000	14,124	
F2.	C1		0.910	0.000	20,262	0.762
	C2		0.816	0.000	6,068	
	C3		0.891	0.000	6,191	
	C4		0.901	0.000	8,185	
	C5		0.842	0.000	11,060	
F3.	E1	0.933		0.000	12,048	0.795
	E2	0.923		0.000	21,729	
	E3	0.932		0.000	14,798	
	E4	0.925		0.000	21,181	
	E5	0.905		0.000	14,979	
	C1	0.911		0.000	17,178	
	C2	0.793		0.000	5,234	
	C3	0.852		0.000	4,787	
	C4	0.867		0.000	6,537	
	C5	0.865		0.000	8,093	

BIRD. Mean-variance extracted

Model 2 confirms the reliability and convergent validity satisfactorily, the weights and loads are significant, values of P and t are accepted, as well as the value of the average variance extracted > 0.5

Table 8. Hypothesis test model 2

Hypothesis	standardized beta	P-value	t-value
H4:	0.473	0.000	25,368
H5:	0.944	0.000	23,691
H6:	0.541	0.000	21,978

All the hypotheses of model 2 are accepted, and the values of t are more significant than the critical value of 1.96.

4.3 Model 3 neuromarketing:

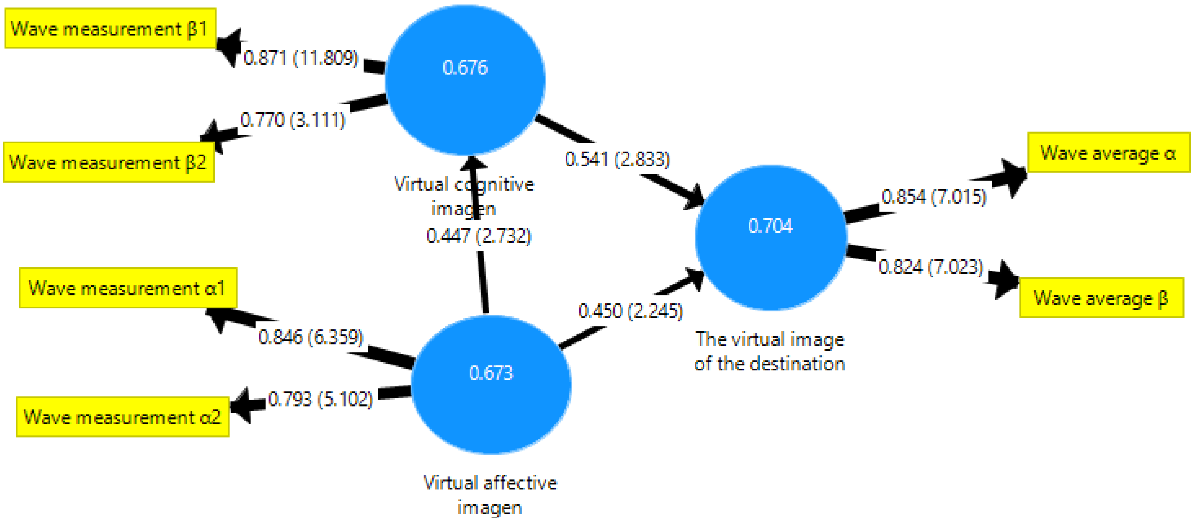

Figure 3. Structural model 3.

In this structural model, emotion hierarchically influencing cognition and the image of the TDI tourist destination is analyzed, with the database taken through neuromarketing.

Table 9. Discriminant validity of model 3 with neuromarketing.

Factor		F1	F2	F3
F1.	Cognition	0.822	N/A	N/A
F2.	affect-emotion	0.447	0.820	N/A
F3.	Image	0.742	0.692	0.839

Model 3 confirms discriminant validity since the indicators that make up the constructs measure their construct to a greater extent.

Table 10. Discriminant validity model 3 neuromarketing

Factor	Indicator	Burden	Weight	P-value	t-value	AVE
F1.	α1		0.846	0.000	6,359	0.673
	α2		0.793	0.000	5,102	
F2.	β1		0.871	0.000	11,809	0.676
	β2		0.770	0.002	3,111	
F3.	$\bar{X}\alpha$	0.854		0.000	7,015	0.704
	$\bar{X}\beta$	0.824		0.000	7,023	

AVE. Mean-variance extracted

Model 3 confirms the reliability and convergent validity since the weights and loads are significant > 0.77; P values less than the critical value of 0.05 are accepted, and the t statistic also exceeds the value of 1.96; likewise, the value of the mean-variance extracted AVE is significant > 0.5 in all factors.

Table 11. Hypothesis contrast model 3

Hypothesis	standardized beta	p-value	t-value
H7:	0.447	0.006	2,732
H8:	0.450	0.025	2,245
H9:	0.541	0.005	2,833

All the hypotheses of model 3 are accepted, and the values of t are more significant than the critical value of 1.96.

4.4 Model 4 survey measurement scale:

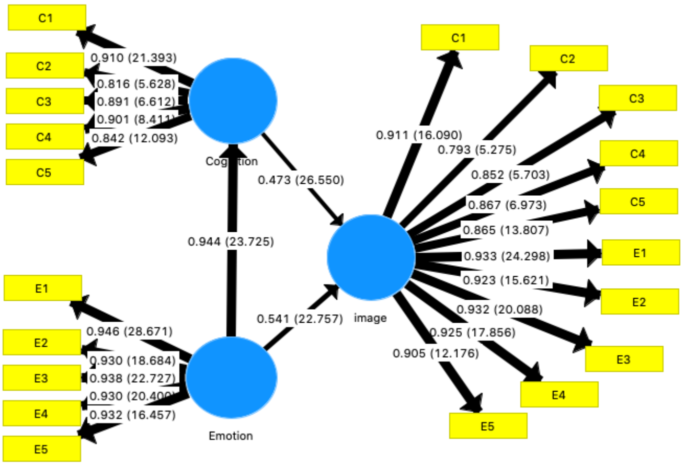

Figure 4. Structural model 4

This structural model is analyzed, the emotion hierarchically influencing cognition and the image of the TDI tourist destination, with the database taken through a survey.

Table 12. Model 4 of discriminant validity measurement scale by a survey.

Factor		F1	F2	F3
F1.	Cognition	0.873	N/A	N/A
F2.	affect-emotion	0.944	0.935	N/A
F3.	Image	0.984	0.988	0.892

Model 4 does not confirm discriminant validity either since the correlation of the con-structs is more significant with the other latent variables and not with the same variable.

Table 13. Model 4 reliability and convergent validity

Factor	Indicator	Burden	Weight	P-value	t-value	bird
F1.	E1		0.946	0.000	28,671	0.874
	E2		0.930	0.000	18,684	
	E3		0.938	0.000	22,727	
	E4		0.930	0.000	20,400	
	E5		0.932	0.000	16,457	
F2.	C1		0.910	0.000	21,393	0.762
	C2		0.816	0.000	5,628	
	C3		0.891	0.000	6,612	
	C4		0.901	0.000	8,411	
	C5		0.842	0.000	12,093	
F3.	E1	0.933		0.000	24,298	0.795
	E2	0.923		0.000	15,621	
	E3	0.932		0.000	20,088	
	E4	0.925		0.000	17,856	
	E5	0.905		0.000	12,176	
	C1	0.911		0.000	16,090	
	C2	0.793		0.000	5,275	
	C3	0.852		0.000	5,703	
	C4	0.867		0.000	6,973	
	C5	0.865		0.000	13,807	

BIRD. Mean-variance extracted

However, model 4 does confirm significant data for reliability and convergent validity; the weights and loads are more significant than 0.793, and P and t values are accepted, as well as the AVE value.

Table 14. Hypothesis contrast model 4

Hypothesis	standardized beta	p-value	t-value
H10:	0.944	0.000	23,725
H11:	0.473	0.000	26,550
H12:	0.541	0.000	22,757

All the hypotheses of model 4 are accepted; the values of t are more significant than the critical value of 1.96.

4.5 Model 5 neuromarketing:

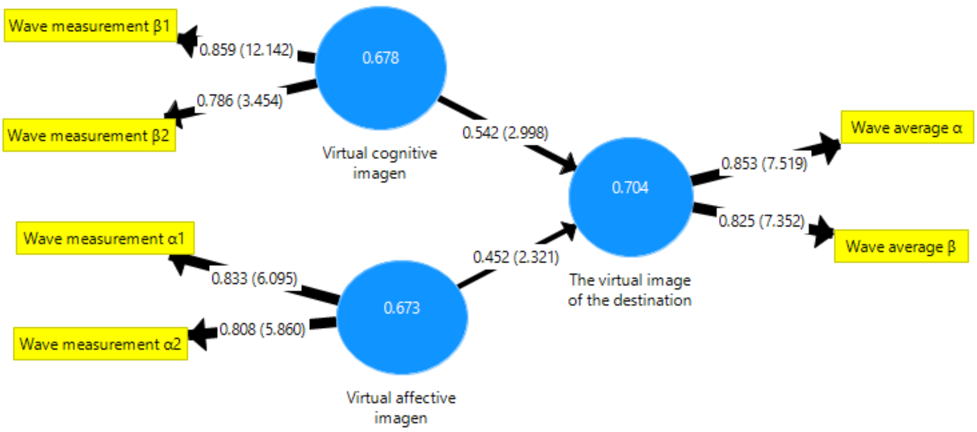

Figure 5. Structural model 5

Table 15. Discriminant validity model 5

		F1	F2	F3
F1.	Cognition	0.823	N/A	N/A
F2.	affect-emotion	0.442	0.821	N/A
F3.	Image	0.741	0.691	0.839

Model 5 also confirms discriminant validity since the indicators that make up the constructs measure their construct to a greater extent.

Table 16. Reliability and convergent validity model 5

Factor	Indicator	Burden	Weight	P-value	t-value	AVE
F1.	α1		0.833	0.000	6,095	0.673
	α2		0.808	0.000	5,860	
F2.	β1		0.859	0.000	12,142	0.678
	β2		0.786	0.001	3,454	
F3.	$\bar{X}\alpha$	0.853		0.000	7,519	0.704
	$\bar{X}\beta$	0.825		0.000	7,352	

AVE. Mean-variance extracted

Model 5 confirms the reliability and convergent validity; the weights and loads are significant, P and t values are also accepted, and an AVE value > 0.5.

Table 17. Model 5 reliability and convergent validity

Hypothesis	standardized beta	p-value	t-value
H13:	0.542	0.003	2,998
H14:	0.452	0.020	2,321

All the hypotheses of model 5 are accepted, and the values of t are more significant than the critical value of 1.96.

4. 6 Model 6 survey measurement scale:

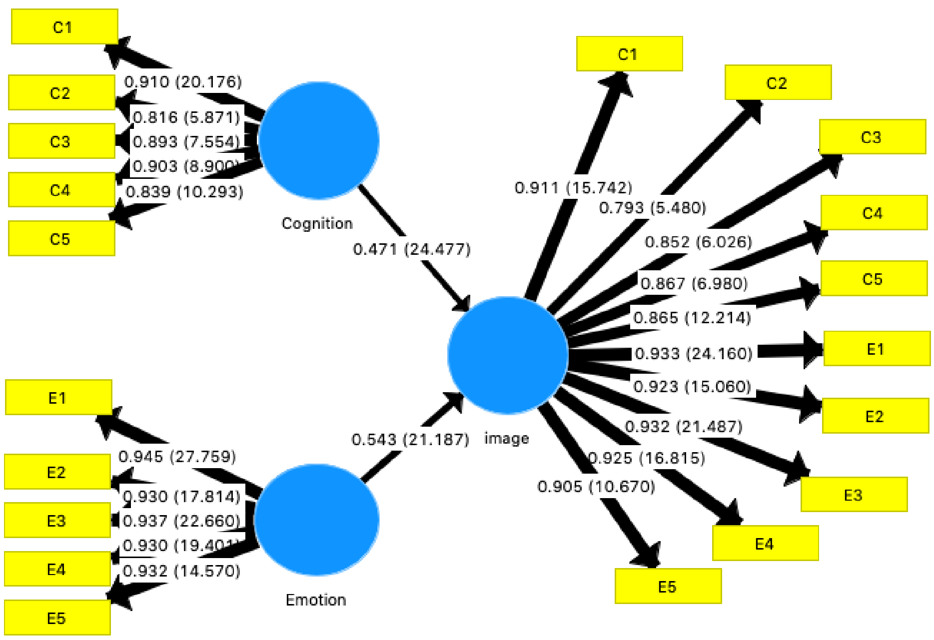

Figure 6. Structural model 6 survey measurement scale.

Table 18. Discriminant validity model 6

	Factor	F1	F2	F3
F1.	Cognition	0.873	N/A	N/A
F2.	affect-emotion	0.944	0.935	N/A
F3.	Image	0.984	0.988	0.892

Model 6 does not confirm the discriminant validity either; it can be said that in the structural models that use a measurement scale with a survey, the correlation of the con-structs is not favorable and is more significant with the other latent variables and not with the same construct.

Table 19. Reliability and convergent validity model 6

Factor	**Indicator**	**Burden**	**Weight**	**P-value**	**t-value**	**bird**
	E1		0.945	0.000	27,759	
	E2		0.930	0.000	17,814	
F1.	E3		0.937	0.000	22,660	0.874
	E4		0.930	0.000	19,401	
	E5		0.932	0.000	14,570	
	C1		0.910	0.000	20,176	
	C2		0.816	0.000	5,871	
F2.	C3		0.893	0.000	7,554	0.762
	C4		0.903	0.000	8,900	
	C5		0.839	0.000	10,293	

F3.	E1	0.933	0.000	24,160	0.795
	E2	0.923	0.000	15,060	
	E3	0.932	0.000	21,487	
	E4	0.925	0.000	16,815	
	E5	0.905	0.000	10,670	
	C1	0.911	0.000	15,742	
	C2	0.793	0.000	5,480	
	C3	0.852	0.000	6,026	
	C4	0.867	0.000	6,980	
	C5	0.865	0.000	12,214	

BIRD. Mean-variance extracted

However, in model 6 and all the models studied to confirm the reliability and convergent validity, the weights and loads are significant, statistical values of P and t are accepted, and the value of AVE is> 0.5.

Table 20. Hypothesis contrast model 6

Hypothesis	standardized beta	p-value	t-value
H15:	0.471	0.000	24,477
H16:	0.543	0.000	21,187

All the hypotheses of model 6 are accepted, and the values of t are more significant than the critical value of 1.96.

The 16 hypotheses are accepted, and the t values are significant in all models > 1.96; likewise, the mean variances extracted are substantial > 0.67 in all factors of all models. All weights and loads are also significant; the models studied with neuromarketing confirm discriminant validity; however, those studied using a measurement scale with a survey do not confirm discriminant validity.

The convergent analyses of reliability and validity show that the average variance extracted is > 0.5 in all the models, which indicates that the constructions explain more than half of its variation than the other indicators that compose it.

Research confirms that the models are likely; every single guess is favorable. The analysis shows that the emotional and cognitive impact of a historical destination recreated with virtual reality positively influences the image of the virtual destination. Heritage's positive emotional and cognitive impact o

n the virtual tourist is confirmed.

The image of the construction of the destination is a sum of the indicators of cognition and image. Therefore, the same indicators are used for the construct. However, in terms of discriminant validity, some indicators correlate with other measures independent of the variable they intended to measure in the survey models, presumably due to the particularity of the destination image model since the endogenous virtual destination image construct is formed with the same indicators that influence the latent variables of cognition and emotion.

The new version of SmartPLS includes a new criterion to assess discriminant validity, heterotrait-monotrait (HTMT). The criterion indicates discriminant validity when the correlations between constructs are less than 0.70. It is a recommended criterion, especially for small samples, such as the one used in this study. However, this criterion still needs to be met in some indicators of the models that use survey measurement. This criterion identifies the indicators of the measurement scale that correlate the most with each other. Discriminant validity can also be assessed with a cross-load analysis. Since the above criteria are not met in the models evaluated with a survey, we also apply this analysis, which, to be valid, must indicate that the indicator's load must be the highest in the measured variable and not in another.

Table 21. Cross loads of models evaluated by measurement scale

Indicator	Cognition	Emotion	Image
C1	0.914	0.878	0.915
C2	0.795	0.723	0.774
C3 _	0.917	0.779	0.863
C4	0.922	0.777	0.864
C5	0.907	0.819	0.880
E1	0.873	0.942	0.930
E2	0.866	0.923	0.917
E3	0.907	0.919	0.934
E4	0.859	0.925	0.915
E5	0.802	0.936	0.894

In total, eight observable variables of the survey measurement scale meet the discriminant validity criterion through cross-load analysis: C2, C3, C4, C5, E1, E2, E4, and E5.

Table 22. Cross-loading of models evaluated by neuromarketing

indicator wave	Image	affect-emotion	Cognition
Average-α	0.854	0.780	0.502
Average-β	0.824	0.365	0.755
Measurement-α1	0.586	0.846	0.417
Measurement-α2	0.549	0.793	0.309
Measurement-β1	0.664	0.441	0.871
Measurement-β2	0.550	0.276	0.770

All the observable variables or indicators of models that use neuromarketing meet the discriminant validity criterion by cross-load analysis.

Table 23. R^2 and Q^2 contrast model

Model	factors	R^2		Q^2		
		R^2	adjusted R^2	SSO	SSE	Q^2 (=1-SSE/SSO)
1	F1				50	
	F2	0.199	0.165		44,541	0.109
	F3	0.713	0.687		27.45	0.451
2	F1			130	51,860	0.601
	F2	0.891	0.887	130	30,162	0.768
	F3	1	1	260	78,445	0.698
3	F1	0.199	0.165		44,541	0.109
	F2				50	
	F3	0.713	0.687		27.45	0.451
4	F1	0.891	0.887	130	50.21	0.613
	F2			130	130	
	F3	1	1	260	67.52	0.740
5	F1			50	50	
	F2			50	50	
	F3	0.714	0.688	50	27,521	0.45
6	F1			130	130	
	F2			130	130	
	F3	1	1	260	67.56	0.74

R^2 values are higher in models 2, 4, and 6. The Stone-Geisser (Q^2) test values calculated using the Blinfolding resampling technique show that all the models are positive, relevant, and significant; however, higher values are found in models 2 and 6. These values indicate that the model that best explains the formation of the image is number 2 on the measurement scale when the virtual cognitive image generates the virtual affective image and the virtual image of the destination, directly and indirectly, through the emotional component. The models based on the data obtained through the electroencephalogram present the same results, with an R^2 of 0.713 and high relevance (Q^2>0) for the three models.

V. CONCLUSIONS.

Research in the TDI framework that simultaneously uses virtual reality, multivariate analysis, and neuroscience to investigate urban or rural cultural destinations in which heritage is present is innovative.

The historical and architectural heritage can increase the cognitive and emotional response to a destination and, consequently, its image, its attractiveness, and its competitiveness; it can be affirmed through this study that the cognitive and emotional components can be studied through heritage, historical, architectural, and cultural.

This research demonstrates that it is possible to measure the impact of cultural and architectural heritage emulated with virtual reality in the mind of a tourist; in the form of cognitive and emotional responses through brain bioelectric waves with the help of electroencephalography, as well as with scales of measurement as has traditionally been done. In both cases, the impact on the formation of the image of the tourist destination can be measured. This research has sought to open a debate to evaluate several significant developments in modern tourism communication meaningfully. It has shown that it is possible to measure TDI with neuroscience and virtual reality tools and techniques since audio-visual stimuli can be analyzed Psychophysiologically by the impact they cause on brain bioelectric waves.

Brain bioelectric waves can vary according to the stimulus design, significantly affecting the results of the multivariate analysis and structural equations. For now, the model that best explains the results according to the analysis performed is model 2. Model 2 measures the formation of the image from the cognitive and emotional components measured by multi-item scales and proposes a traditional hierarchical cognition-emotion sequence. Regarding the models based on electroencephalogram neuromarketing measurements, the three models show similar results, and it cannot be affirmed that one sequence is better than another. That is, how cognitions and emotions act for the formation of the image of the destination could be in parallel or inversely to what has traditionally been understood; cognition precedes emotion.

VI. LIMITATIONS

The electroencephalogram data collection tool can be improved; with state-of-the-art EEG equipment, more specific information about the attitudes of the human brain towards virtual reality stimuli can be collected. With this optimization, it is possible to accurately detect data to study the synchronization of electroencephalography with virtual reality and decide at what moments of the video clip the stimulus increase, as well as the specific area of the brain that is activated.

VII. FUTURE LINES OF RESEARCH

A possible future line is the design and study of virtual reality video clips for more specific purposes of communication, as well as stimulation, and to determine at what moments of the video clip the stimulus increase and the specific brain area that is activated.

Familiarity is another topic to investigate, using two samples to compare brain waves, survey measurement scales, and structural equation models; one sample may be familiar with the location, and the other not.

A significant line of future research is identifying whether the emotional response is after the cognitive, prior, or parallel. This question can be found and compared to the timelines of the electroencephalogram with the projection time of the virtual reality video to study the alpha and beta waves generated when the study subject searches for something specific in VR. That is, to study the Russell space of brain bioelectric waves caused by a visual stimulus identified in the timelines of electroencephalography and VR projection.

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