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SENSE OF URBAN AND ARCHITECTURAL ENVIRONMENT

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Abstract

Introduction: In this study, we aimed to explore how different spaces affect people and influence their emotions from a neuro-architectural perspective. The **purpose of the study** was to investigate how navigating historical and modern architectural environments impacts individuals both cognitively and physiologically. **Methods**: People's reactions to historical and modern environments were explored and then analyzed using quantitative data and various analysis methods. Three different architectural environments were designed, and the participants were allowed to navigate these environments in a virtual reality setting. The participants were asked to select images from modern or historical pictures, and then they were subjected to the Beck Depression Inventory and the Positive and Negative Affect Schedule tests. In addition, physiological data were collected from 164 participants using electroencephalography, eye tracking, and galvanic skin response devices. As a **result**, when the participants were evaluated based on their preferences for modern or historical environments, they were found to prefer a combination of historical and modern environments. It was determined that people exhibit different cognitive responses in different architectural environments. This is an important finding for re-designing the built environment.

Keywords: neuroarchitecture; architectural environment; people's behavior; built environment.

Introduction

The quality of the components that make up the architectural environment also determines the type of environment. The quality of that environment is reflected in all units, from cities to the minuscule elements. A city is defined as an artificial physical environment that represents an organized system far beyond the natural and primitive life mechanisms (Kuban, 1994). Social, economic, and administrative elements play a role in the formation of a city, starting with social memory. In addition, it is necessary to discuss the role of fabric in shaping the city from ancient times to the present, as it reflects the character of a city. The factors such as the adjacent or separate arrangement of buildings, their distribution across the topography, and parcel sizes make the character of the city visible. The diverse street layout in a residential area, the quality of the structures, and the way they interact reflect the character of a city. The basic elements that reflect the original architecture, repetitive urban objects, monumental structures, and groups of buildings are among the elements that make up the city skyline. Over time, cities become modern as they evolve with the development of technology and the changing needs of humans. Since the industrial revolution, the ongoing modernization movement has been spreading into the historical fabric, and even encroaching upon the historical urban fabric in some parts of the city.

Due to its form, the historical urban fabric can be defined as the environment built by humans over a long period of time. If we look at the city from this perspective, it offers a wealth of important information, including archaeology, architecture, and art history.

The expectations, desires, and even relationships of users in urban life define the identity of that city. The built environment, shaped by the tangible (concrete) and intangible (abstract) interactions of city dwellers, generates urban values through the formal and structural characteristics of buildings. These urban values differentiate cities from each other and create their unique atmospheres. Urban values include the environment and events in which city dwellers share a common memory, integrating with nature, space, and objects. In addition to the main structures that have survived from ancient times to the present day, historical sites that are not monumental but have a documentary character and have witnessed a certain period or social development also gain importance as cultural treasures.

Another important issue is how to make sense of the environments and events that contribute to urban identity. Many restorers and architectural historians have worked on this subject. However, what is missing is an understanding of what people expect in the historical fabric of the city and what kind of urban fabric they want to see. This is because the expectations of people from urban fabric, both in their place of residence and during their visits for tourism purposes, have been widely discussed (Edwards et al., 2008; Selby, 2004). Studies have progressed from various perspectives. Various studies, ranging from urban design strategies (Alawadi, 2017; Yang and Yamagata, 2020) to crowd behavior (Li et al., 2009), and from the design of recreational areas (Rathnayake, 2015) to urban policies (Al-kheder et al., 2009; Bartolini, 2014; Popp, 2012), were conducted. However, cognitive studies on people's navigation behavior within the city were found to be incomplete. This is because when people visit a city, they sometimes experience something that goes beyond physical or sensory features. Ebejer (2014) refers to this phenomenon as the "sense of place". In urban design literature, the sense of place is often attributed to three elements: the physical environment, activities, and meaning (Salah Ouf, 2001; Soini et al., 2012). The meaning of buildings, spaces, and even cities is subjective and can be read and interpreted differently by different people based on their past and culture. As a result of a comprehensive review of the literature, the study proposes two different hypotheses:

• H1: There is a relationship between gender and preferences for navigating modern or historic urban areas.

• H2: In a modern + historical city, the navigation behavior exhibited by the same participants will not change.

Methods

The basic requirement for inclusion in the research is that the participants selected for the study should not have any history of taking depression medication. The participants were required to sleep for at least 8 hours the night before the experiment and to refrain from smoking or consuming alcohol and stimulant beverages. A total of 164 people participated in the experiment (88 males, 76 females), and the average age of the participants was 22.78 years. All participants started the experiment after all the devices were installed. However, 4 participants were unable to complete the experiment due to the dizziness they experienced. Therefore, these 4 participants were excluded from the experiment.

The experiment was conducted using both psychological and neurophysiological measurement methods, along with a virtual reality application. Three different areas within the city were designed for the experiment. The first area features modern architecture, the second area showcases historical buildings, and the third area is a modern + historical area (Fig. 1).

In these three areas, the participants could navigate through the virtual reality application using the Wii controller. The participants were allowed to navigate all three areas for particular time. However, none of the participants exceeded the allocated time. The experiment was conducted in stages, with approximately 2–3 hours allocated for each participant, and the necessary permissions were obtained from the dean of the faculty. The experiment was completed in a total of 11 months. The flow of the experiment is shown in Fig. 2.

In the experiment, the Beck Depression Inventory scores of the participants were initially determined. The goal was to determine the participants' depression scores before they participated in the experiment. The Positive and Negative Affect Schedule (PANAS) test was performed immediately after the Beck Depression Inventory. In the second stage, the select-a-visual application prepared for the experiment was launched. At this stage, the participants were shown pictures on the computer screen and asked to rate them on a scale of 1 to 10. In the third stage, the participants were asked to navigate a virtual reality environment after attaching the GSR, EEG, and eye-tracking devices. The basic tests and the equipment used in the experiment were as follows:

Stage 1 — Beck Depression Inventory and PANAS Scale: The first stage of the experiment was to determine the participants' depression scores. The Beck Depression Inventory (BDI), developed by Beck (1963), measures somatic, motivational, emotional, and cognitive symptoms associated with depression. The purpose of the scale is to objectively determine the extent of depression symptoms, rather than to diagnose depression. Each item is scored between 0 and 3 points. The depression score is obtained by summing up these scores. The highest possible score is 63. A high score indicates a high level of depression. The cutoff point of the scale was determined to be 17. This score and higher scores indicate clinical depression, and an increase in the score indicates increased depression severity.

Fig. 1. Images from the areas visited by the participants in the modern, historical, and modern + historical environments

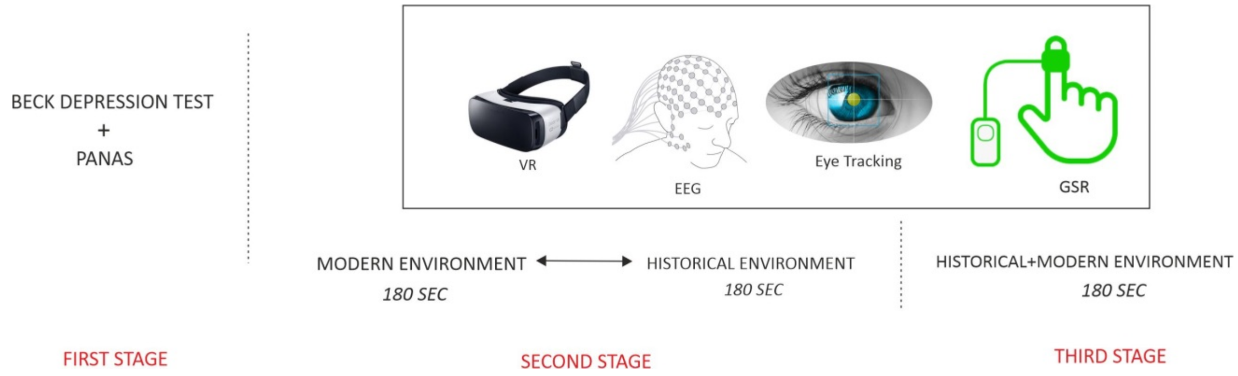

Fig. 2. Simple flowchart of the experiment

In the research, based on the conducted studies (Lasa et al., 2000; Steer et al., 1999), 30–63 points indicate severe depression, 17–29 points indicate moderate depression, 10–16 points indicate mild depression, and 0–9 points indicate no depression. Cronbach's Alpha analysis was used to determine the reliability of the responses given in the Beck Depression Inventory. Cronbach's Alpha of the Beck Depression Inventory was 0.945 (if $0.80 \leq \alpha < 1.00$, the scale is highly reliable).

After completing the Beck Depression Inventory, the participants took the PANAS test. On a scale of 10 positive and 10 negative feelings, Watson et al. (1988) determined the reliability of the positive emotion scale as 0.88 and the negative emotion scale as 0.87. The researchers used the PANAS test across various disciplines to determine the current moods of the participants. The participants responded to these feelings using a 7-point Likert-type scale based on the frequency of their general encounters (1 = Never, 2 = Very rarely, 3 = Rarely, 4 = Sometimes, 5 = Frequently, 6 = Mostly, 7 = Always). The scores that can be obtained on the scale range from 10 to 70 for both sub-scales. In this study, Cronbach's Alpha calculated for positive affectivity was 0.81, and Cronbach's Alpha calculated for negative affectivity was 0.76. The Cronbach's alpha method was used to assess the reliability of the responses to the PANAS test. PANAS total mood Cronbach's Alpha was found to be 0.79 (the scale is quite reliable if $0.60 \leq \alpha < 0.80$). The main goal of the PANAS test was to determine the moods of the participants before they embarked on their trips in a virtual reality environment.

Stage 2 — Select-a-Visual: The participants were asked to sit in front of the computer screen immediately after completing the Beck Depression Inventory and PANAS test. They were then instructed to give a score (1 being the lowest and 10 being the highest) to 30 different images shown to them. The software used in this study was developed with the assistance of the Visual Basic program, and the scores given by the participants were recorded. A screenshot of the software prepared for the study is shown in Fig. 3.

All the images shown to the participants are presented in Appendix 1. To help the participants distinguish between modern and historical images, the images were shown at 5-second intervals. The main purpose of the select-a-visual software is to enable participants to express their modern or historical preferences through visual arts. Therefore, an attempt was made to determine historical and modern tendencies. In the study, individuals with a high classical visual score were defined as inclined towards historical, while those with a high modern score were defined as inclined towards modern.

Stage 3 — VR-1: At this stage, GSR, EEG, eye tracking, and VR goggles were used for the participants. Thanks to virtual reality, participants can take trips as if they were in a real environment. Researchers working in different disciplines have noted that VR systems have several advantages. At this stage, the participants were able to navigate two different settings designed using VR technology. Some of the participants first navigated through the modern environment, while others first explored the historical fabric of the city. In other words, it was randomly determined which participants would start from the modern urban fabric and which would start from the historical urban fabric. All the participants were allowed to navigate for 180 seconds, which means that the experiment took 360 seconds at this stage.

Stage 4 — VR-2: At this stage, the virtual environment was designed in an urban setting with both modern and historical structures, and was referred to as a historical + modern urban environment. Additionally, the VR-2 stage was intended to provide a different experience for the subjects, and, therefore, this stage took place 1 hour after the standard experimental procedure. In other words, the volunteers who participated at the VR-1 stage of the study were also invited to VR-2. At this stage, EEG, VR, GSR, and eye tracking stages were also applied in the same manner. Unlike the VR-1 environment, the VR-2 environment can be

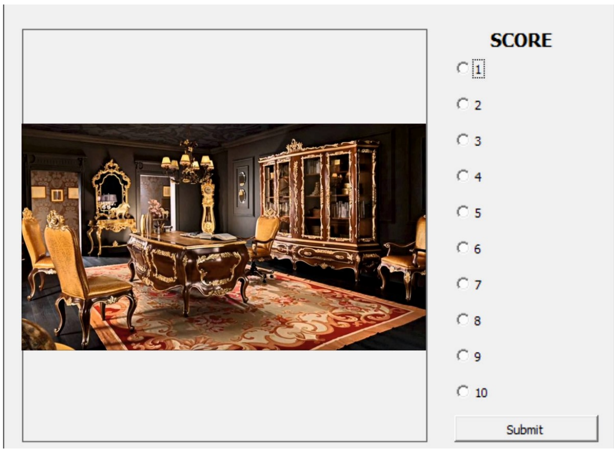

Fig. 3. Interface of the select-a-visual program as seen by the participants

described as historical + modern, designed in 3D. The environment, both with modern fabric and historical fabric, was tested with the same participants.

In the experiment, data were recorded from the participants using physiological measurement methods. The details of these measurement methods are as follows.

Galvanic Skin Response: Galvanic Skin Response is a type of data used to measure the response to stimuli in individuals. The GSR device was attached to the participants to measure a type of response caused by changes in the electrical conductivity of the skin. Minor changes in the electrical properties of the skin are measured using electrodes attached to the fingers. These physiological changes are caused by changes in the person's psychological state, such as stress and relaxation. Galvanic skin response (GSR), also known as skin conductivity or electrodermal activity response, is a reliable indicator of stress (Healey and Picard, 2005; Labbé et al., 2007). It is the measurement of electric current flow in an individual's skin. Skin conductivity increases due to the increased moisture on the surface of the skin when an individual is under stress (Sharma and Gedeon, 2012). The GSR values tend to decrease as time passes during a period of rest. This change can indicate that the person is experiencing a sense of relief at that moment. In the study, a statistically significant difference was found in the average skin conductivities during the rest and navigation states ($p = 0.005 < 0.05$). Over time, the conductivity values increase from their minimum to their maximum. The difference between the maximum and minimum values refers to the amplitude.

Electroencephalography (EEG): EEG is measured by recording the electrical activity in the brain, specifically the cerebral cortex, with the help of electrodes on the scalp. In other words, the change in electrical potential defines the signal of electroencephalography. EEG electrodes are placed according to the 10/20 electrode layout, standardized by the International Federation of Electroencephalography and Clinical Neurophysiology (Jasper, 1958). The frequency range of electroencephalography signals varies between 0.1 and 100 Hz, depending on the dominant regions. In order to regularly examine these changes, electroencephalography signals are divided into five main classes based on their frequency. These are called alpha, beta, theta, delta, and gamma. The study focused on the FP1, FP2, F3, F4, FZ, C3, C4, CZ, P3, P4, and PZ channels. Moreover, this study focused on alpha, beta, and gamma. EEG was used to measure changes in the neurophysiological states of the participants' emotions.

Eye Tracking (ET): The basic principle of the eye tracking technique is based on recording infrared light projected onto the retina and corneal layer of the eye. Although it depends on the specifications of the device used, light is typically reflected to the pupil at a frequency ranging from 120 to 1000 Hz on average. As a result of this process, the recorded data are processed using special computer programs. The eye-tracking system is integrated into the virtual reality goggles to measure where and for how long participants are looking.

Results

In the study, the reactions of people to historical and modern environments were analyzed using quantitative data and various analysis methods. The hypotheses put forward were investigated in detail.

• H1: There is a relationship between gender and preferences for navigating modern or historic urban areas.

Based on the hypothesis, the navigation preferences of the participants were determined. First, the participants were shown 15 modern and 15 classic images in the select-a-visual software developed for this study. They were asked to rank the images shown on a scale of 1 to 10 (with 10 being the highest). Statistical analysis was then performed on the participants' scores. The main goal was to determine people's preferences for visual art (modern/historical). The responses of the participants were recorded. The statistical values of the recorded responses are shown in Table 1.

As shown in Table 1, the select-a-visual test found that women prefer classical visuals, while men prefer modern visuals. After the select-a-visual test, the Beck Depression Inventory and PANAS test were used (Table 2).

Based on Table 2, it was found that the Beck Depression Inventory score differed significantly by gender and that the scores of the females were higher than those of the males ($p < 0.05$). Positive and negative mood levels were also found to differ significantly depending on gender, and the positive mood score of the males was higher ($p < 0.05$). As a result, the depression scores and PANAS

Table 1. **Data on the participants' responses to the select-a-visual test**

	Modern Picture Scores	Historical Picture Scores
Male (Avg)	6.78	3.58
Female (Avg)	4.54	7.12
SD	2.54	2.78

negative mood scores of the females participating in the study were higher than those of the males.

Modern and classical preferences of the females (N = 61) with higher depression scores and PANAS negative mood scores were examined. The results showed that these females preferred classical works in the select-a-visual test, indicating that their scores for classical visuals were higher than their scores for modern visuals. In the eye-tracking recordings of the same 61 female participants in modern city navigation, the heat maps analyzed were found to have fewer highlighted areas compared to the historical urban fabric (Fig. 4).

This may indicate that they don't really look at the details in the modern city. For an overview of the information obtained in the two tasks, some general eye-tracking measures were calculated (Table 3).

The number of dwells, total time, and the number of options attended to were all pieces of information acquired from the two urban settings. The mean dwell time and the total dwell time were collected from each city setting. GSR signals for 61 tested female participants are shown in Fig. 5.

61 female participants first navigated the historical city and then the modern urban fabric, as shown in their GSR records in Fig. 5. As shown in the figure, the GSR signals are above a certain level when navigating the historical urban fabric, but tend to decrease as soon as they move to the modern urban fabric (from the 180th second onward). In addition, the GSR value graphs of the participants with high scores for modern and classic pictures were overlapped, as shown in Fig. 6.

The data shown in Fig. 6 confirm data in Fig. 5. It was observed that the GSR records of the participants with a modern tendency increased during their navigation in the modern urban fabric, while the GSR records of the participants with a classical tendency increased during their navigation in the historical urban fabric. Furthermore, this finding confirms the findings of Erkan (2021), which state that increased GSR signals indicate people's excitement in that environment. In the study, EEG bands were examined with a focus on beta and gamma waves. The beta bands of EEG signals are known to be associated with stimulation, stress, active thinking, and active attention (Sanei and Chambers, 2013). In addition, Güntekin and Başar (2010) stated that people exhibit excessive responses to stimuli that trigger negative emotions. Erkan (2021) reported that the EEG amplitude of higher beta bands (21–30 Hz) was relatively high in participants with negative mood. When examining the EEG plots of 56 out of the 61 females mentioned earlier, it is evident that there are significant differences in beta EEG amplitudes during the navigation of modern urban environments. In this case, it can be assumed that people with a historical inclination may experience a heightened state of anxiety, as evidenced by the increase in beta bands during a modern urban trip. The amplitudes of electroencephalography in historical and non-historical (modern) environments were determined using the measured beta bands, as shown in Fig. 7.

Moreover, the gamma power spectrum of the participants was also found to be different. The EEG activity of gamma bands can be easily observed along with beta band activity in sensory analysis and negative emotional analysis (Luijcks et al., 2015; Newson and Thiagarajan, 2019). Furthermore, the EEG activity in the gamma band is related to higher-level cognitive processing in the sensory system, including auditory and visual systems (Bhattacharya et al., 2001; Müller et al., 2000). In this study, there was a significant difference in the EEG power spectrum of gamma bands during the navigation in modern and historical environments among the participants who selected modern visuals in the select-a-visual section and had a high modernity score. A higher EEG power spectrum in the gamma bands was observed during historical environment trips of the participants with a high modernity score, and vice versa. In other words, the participants with high classical scores were also found to have high EEG

Table 2. **Relationship between the Beck Depression Inventory score, the PANAS test score, and gender**

Score	Gender	N	X	S.S	t	S.D	**p**
Beck Depression Score	M	88	0.148	0.324	–8.789	157.147	0.000
	F	76	0.389	0.329	–	–	–
Positive Emotional State Score	M	88	2.789	0.287	7.778	189.879	0.000
	F	76	2.147	0.301	–	–	–
Negative Emotional State Score	M	88	2.145	0.678	–7.457	201.145	0.000
	F	76	3.147	0.699	–	–	–

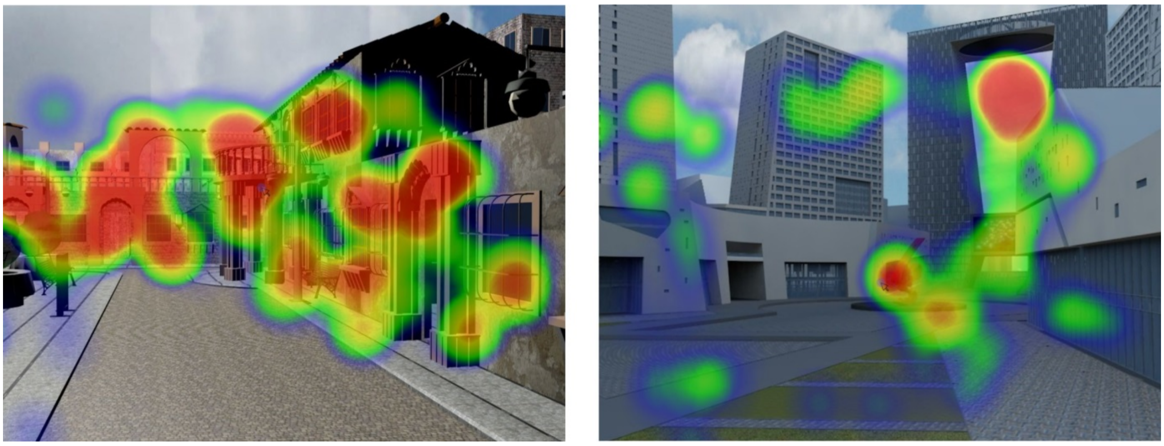

Fig. 4. Heat maps revealed in the eye-tracking analysis in the modern and historical urban fabric as viewed by the female participants with high depression scores and high classical scores in the select-a-visual test

Table 3. **Measures of information acquired in the different tasks (SD in parentheses; all times are in ms)**

	Modern City Environment	Historical City Environment
Total Duration	17,589.4 (16,788.7)	29,086.4 (20,559.2)
No. of dwells	34.64 (30.73)	39.48 (33.78)
No. of options attended to	21.14 (15.89)	27.78 (78.99)
Mean dwell time on each option	400.45 (124.67)	700.78 (211.88)
Total dwell time on each option	641.78 (245.47)	997.78 (456.45)

gamma bands compared to the other groups in the modern environment (Fig. 8).

Environmental psychologists have proposed the concept of attention restoration in contrast to the concepts of stress and mental fatigue. They have noted that the relaxing benefits of natural landscapes can stimulate brain activity associated with positive moods (Tilley, 2017; Ulrich, 1981). Based on this, the alpha bands of the same participants were also studied by adding FP1 and FP2 channels. The alpha value of the participants with a positive mood was found to be significantly higher in both the historical city trip and the modern city trip compared to other

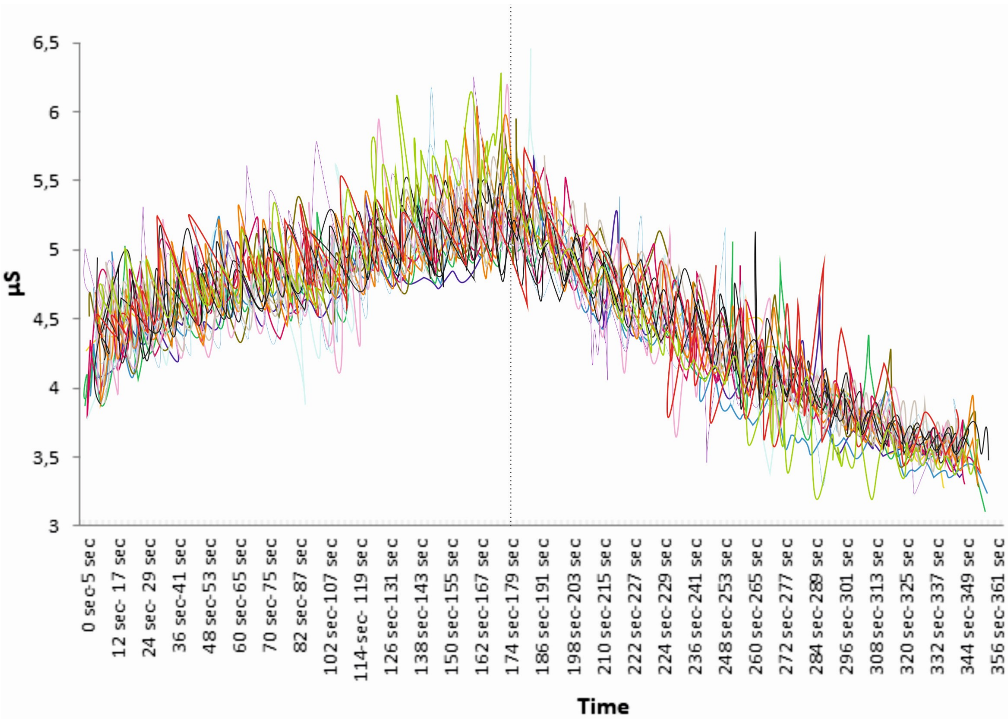

Fig. 5. GSR responses of 61 female participants as they navigated the modern urban environment following the historical city

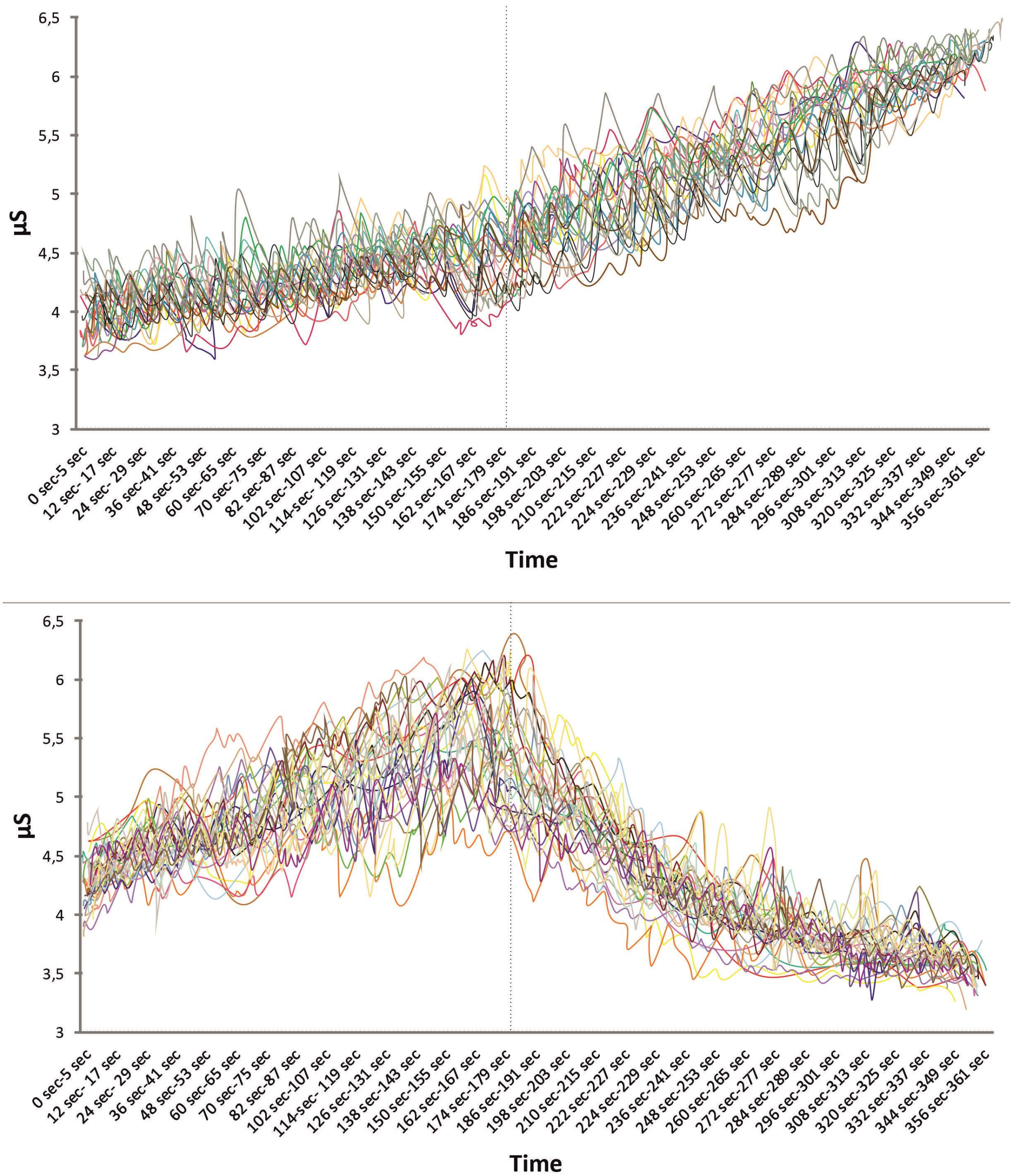

Fig. 6. (1) Schematic view of the GSR plots for the participants with a high modern score, navigating from the historical city to the modern city; (2) Schematic view of the GSR plots for the participants with a high modern score navigating from the modern city to the historical city

participants (who had a higher Beck Depression score and a higher PANAS negative score) (Fig. 9). This result confirms the findings of Shaw (2003) and Hugdahl and Davidson (2004).

In the first 60 seconds, the higher alpha power spectrum is remarkable in the right frontal lobes of the participants with higher classical or modern visual scores, navigating respective historical or modern environments. This is consistent with Tilley's (2017) study, which indicates that participants are relieved in these environments, albeit for a while.

In contrast to the activities of beta and gamma bands, in stressful situations, the EEG power spectrum of alpha bands is known to increase in a steady state, such as meditation or relaxation (Erkan, 2017a; Erkan, 2017b Lagopoulos et al., 2009). Given the positive relationship between alpha power and comfort (Sammler et al., 2007), it can be concluded that the participants were comfortable in both environments. However, when examining the modern-classical visual tendencies of the same participants, it is noteworthy that the modernity score was higher. This is in line with the results of the 61 participants mentioned above.

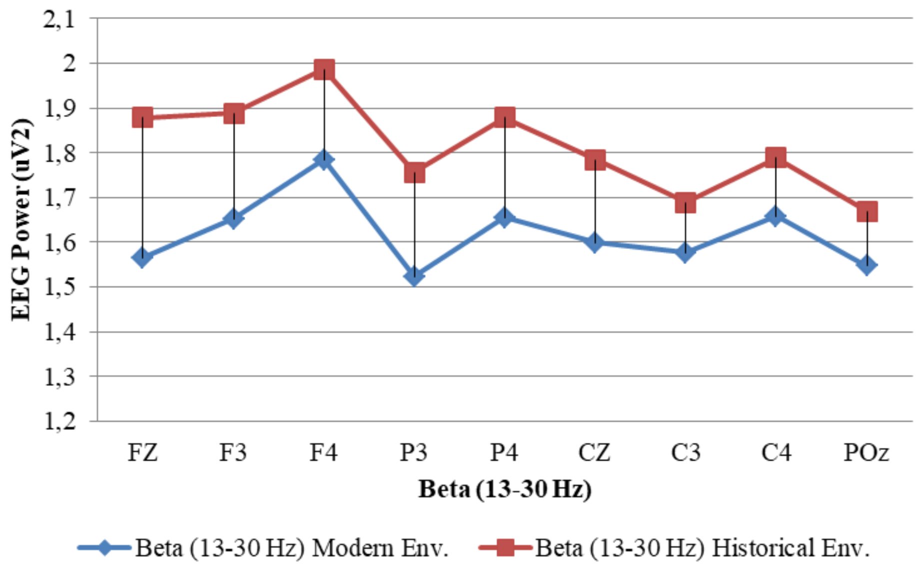

Fig. 7. Distribution of the electroencephalography (EEG) power spectrum beta waves measured in different architectural environments

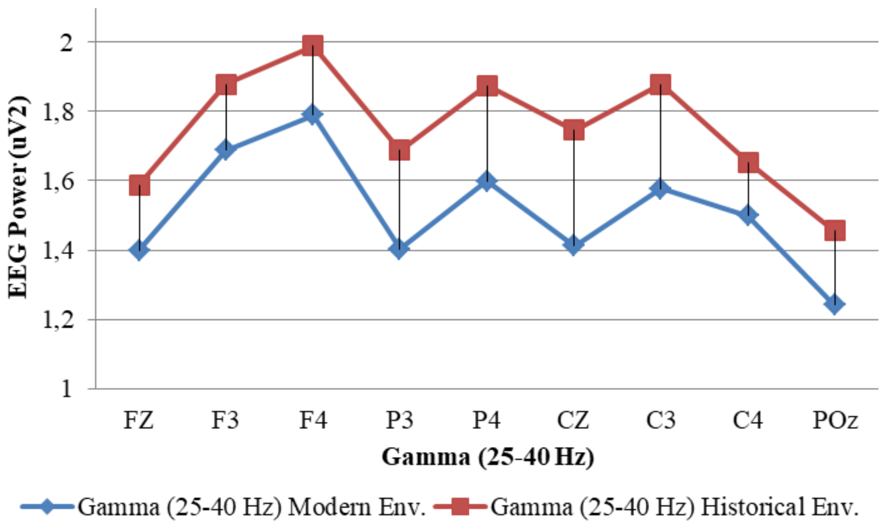

Fig. 8. Gamma bands of the participants with higher modernity scores in modern and historical environments

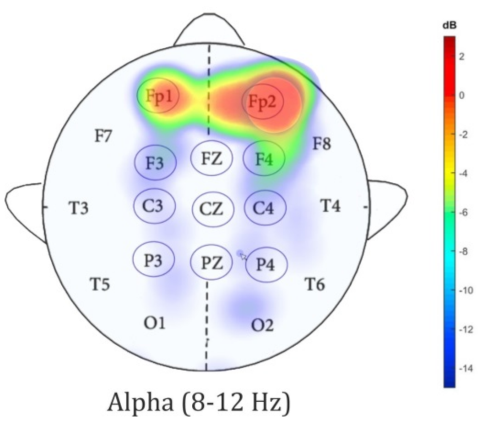

Fig. 9. Brain map of the alpha value of the participants with positive/negative moods during both the historical city trip and the modern city trip

Discussion

When all of these findings are carefully examined, it is neurocognitively confirmed that there is a relationship between gender and preferences for navigating modern or historical urban fabric, as mentioned in Hypothesis 1.

• H2: In a modern + historical city, the navigation behavior exhibited by the same participants will not change.

Stage-VR-2 was used to test this hypothesis. This stage was tested unlike any other stages.

First, eye tracking data from the participants with a historical-modern tendency in Stage-VR-2 were analyzed in a historical-modern environment, and compared with Stage-VR-1 data. The fixation duration data are shown in Fig. 10.

Fig. 10 shows the participants' fixation duration on modern or historical environmental fabric. The total fixation scores of the participants who navigated both the modern and historical environments seem to be close to each other. Interestingly, the total fixation scores in the historical + modern environments were quite high. GSR analyses were performed on the same participants, and instant rises and falls in the GSR records were observed during the modern + historical urban trip. A logarithmic increase/decrease was observed in the GSR signals obtained from both modern and historical settings.

The right temporal lobe of the brain, among other functions, is responsible for visual attention, interpreting visual information, pictorial memory, and processing visual scenes (Milner, 1968). As expected, more beta signals were recorded in the right temporal lobe (Fig. 11).

In this experiment, it was observed that brain activity (greater right temporal beta activity) induced by stimuli in both historical and modern fabric may be associated with the mechanism of involuntary attention. However, this effect was more intensively recorded in the modern + historical urban fabric. This was significantly more powerful in the modern + historical environment compared to both modern and historical environments. This may indicate that participants perceive the holistic aspect of the setting more intensively while navigating the environments, recognizing and processing the general spatial relationships between the elements. This is because, during the modern + historical urban trip, the participants were found to be more focused, as evidenced by the activity in the right temporal lobe of the brain (Fig. 11).

Upon careful examination of all these findings, the hypothesis positing that "in a modern + historical city, the navigation behavior exhibited by the same participants will not change" was neurocognitively rejected, and behavioral changes were observed compared to the case of the modern + historical environment.

Given the unique nature of human behavior, it is quite difficult to identify the causes of any behavior. This study focused on identifying people's preferences for historical and modern urban fabric and investigating the reasons behind these preferences.

At the first stage of the study, the select-a-visual test was conducted, revealing that the males scored higher in modern pictures while the females scored higher in classic pictures. In other words, the modern/classical preferences of the participants were determined at this stage of the study.

At the second stage of the study, PANAS and psychological tests were conducted to assess the participants' depression scores. It was found that the females had higher depression scores and PANAS negative mood scores compared to the males. When the Beck Depression Inventory and PANAS scale results were evaluated together, it was found that the average score of 61 out of the 76 female participants indicated a depressive level. The select-a-visual test results of these 61 female participants were analyzed, and all of them were found to prefer classical works. When examining the GSR records of the same participants, it is observed that the GSR signals above a certain level during navigation in the historical urban fabric tend to decrease in the modern urban fabric. This decrease can be interpreted as a reduction in excitement when transitioning to the modern fabric, aligning with other results.

When all participants' GSR records were examined, it was observed that those with a high

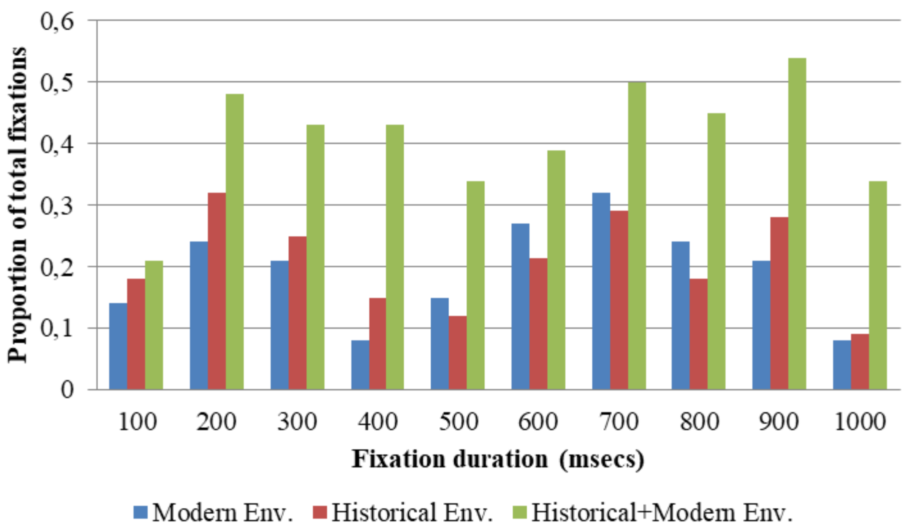

Fig. 10. Heat map analysis of participants with high modern and historical scores in a historical + modern urban environment

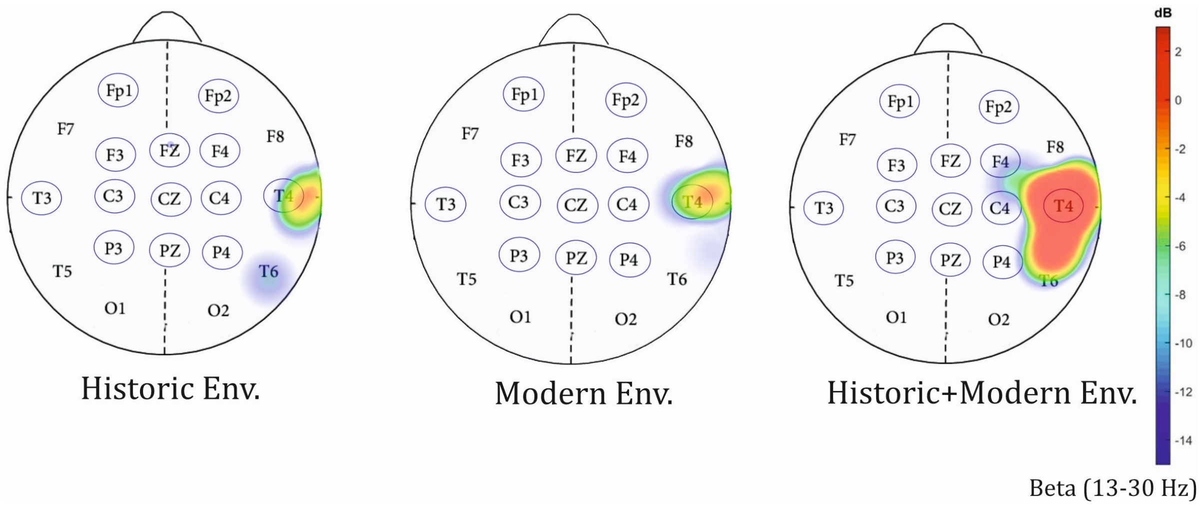

Fig. 11. Activation of beta signals observed in brain mapping

modern tendency in the select-a-visual test had higher GSR levels during their navigation in the modern urban fabric. Similarly, the participants with a high classical tendency had higher GSR levels when navigating the historical urban fabric. It is believed that this indicates that people tend to become more excited when they navigate in their preferred historical or modern urban fabric.

At the third stage of the study, the alpha, beta, and gamma bands of the participants with high modernity scores during their navigation in modern and historical environments were examined, and a significant difference in EEG levels was observed.

It was found that the alpha value of the participants who had positive emotions was significantly higher than that of other participants (with high Beck Depression scores and high PANAS negative scores) in both the historical and modern city navigations.

Nohl (2001) proposed a conceptual framework for a better understanding of future landscapes as aesthetic objects, investigated various aesthetic aspects of development, and outlined the most important aesthetic prototypes of tomorrow's landscape. This study supports the study by Noh (2001) from a different perspective and concludes that the aesthetic data is better understood within a modern + historical environmental framework.

Based on the techniques used in the study (eye tracking + EEG + GSR) and the characteristics of the participants (gender, PANAS + Beck Depression Inventory), it appears that historical + modern environmental design is superior in all aspects. In the analysis of all the test results, it was found that all the participants, whether they preferred a modern or historical environment, spent a longer period of time exploring the historical + modern environment. This was determined through eye-tracking analysis, which also showed higher cognitive awareness as detected by EEG, and elevated skin conductivity according to the GSR results. Considering the reflection of all these findings on the design, it can be stated that designs in the construction of future cities should be shaped by the trips and behavioral decisions of people who live in the city or will visit this habitat.

The study is believed to inspire future space and environmental designs. The study plays an important role in shaping environmental design, utilizing various methods. EEG was used in the study. An fMRI device can also be used to perform more precise and detailed measurements, allowing for the study of changes occurring in the inner regions of the brain in greater detail. The study was conducted in a VR environment. Even though VR environments are considered ideal for such experiments, it may be advisable to use real experimental environments in future studies. Additionally, the factors/stimulants that affect decision-making mechanisms are a separate issue projected for future study.

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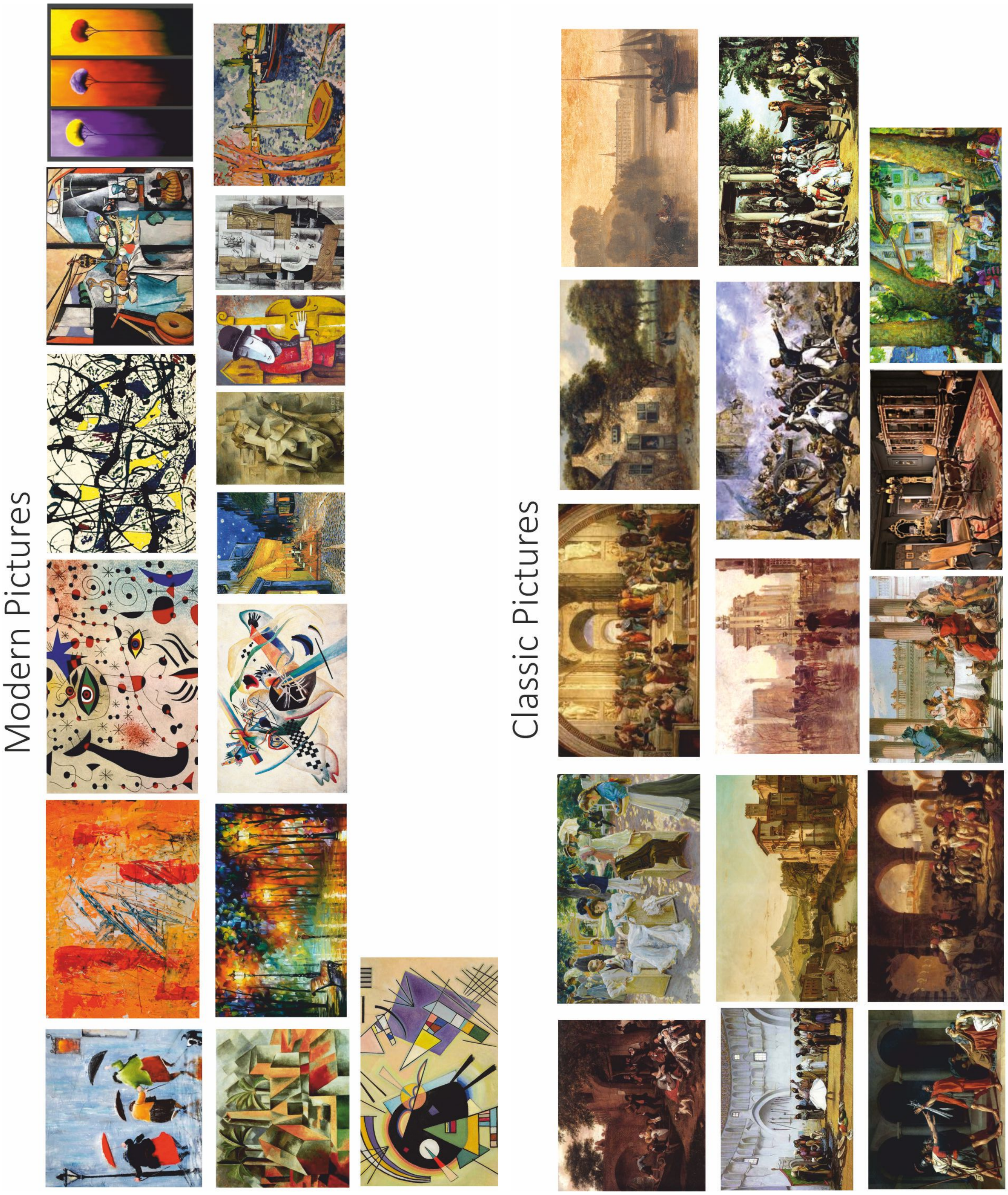
Appendix 1



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ОЩУЩЕНИЕ ГОРОДСКОЙ И АРХИТЕКТУРНОЙ СРЕДЫ

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Аннотация
Введение: В рамках данного исследовании изучено, как различные пространства влияют на людей и на их эмоции с точки зрения нейроархитектуры. **Цель исследования**: изучить, как перемещение в исторической и современной архитектурной среде влияет на людей как когнитивно, так и физиологически.. **Методы**: изучены реакции на историческую и современную среду, которые затем были проанализированы с помощью количественных данных и различных методов анализа. Разработаны три различные архитектурные среды. Участникам эксперимента было предложено перемещаться по ним в виртуальной реальности. Участникам было также предложено выбрать изображения в современном или историческом стиле, после чего они проходили тесты по шкале депрессии Бека и по шкале позитивного и негативного аффекта. Кроме того, с помощью приборов для электроэнцефалографии, отслеживания движений глаз и кожно-гальванического рефлекса были собраны физиологические данные 164 участников эксперимента. В **результате**, когда участников эксперимента оценивали по их предпочтениям в отношении современной или исторической среды, оказалось, что они предпочитают сочетание исторической и современной среды. Установлено, что в разных архитектурных средах люди демонстрируют различные когнитивные реакции. Это важный вывод для перепланировки окружающей среды.

Ключевые слова: нейроархитектура; архитектурная среда; поведение людей; застройка.