

Original Research Article

Evaluation of the Residential Facades in Tehran from the Neuro-Aesthetics Approach

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Abstract | In recent years, the study of apartment buildings is important because of their growth in Iran. This issue has been neglected in contemporary architecture and landscape research. Previous studies show that one of the factors affecting the mood of apartment dwellers is aesthetic criteria. The purpose of this study is to redefine the aesthetic criteria in evaluating the residential facade of Tehran to improve the quality of experience of residents. To this end, in the first step, the aesthetics criteria of the facade were extracted from the literature on neuro-architectural research. In the second step, according to the mentioned criteria, the residents of the apartments were interviewed. This research is an applied study and its method is qualitative. Sixteen articles were content analyzed in a systematic review. Eleven physical criteria and 8 semantic criteria for the aesthetic of residential facades were extracted. Classification between criteria was done through open-ended interviews with 14 apartment residents in Tehran. Findings showed that among the physical and semantical criteria of the facade, "vegetation", "color and materials", and "surface of the openings" have a positive impact on the perception of the aesthetics of the facade. The results show that the residential facades of Tehran are at a low level in terms of semantic and symbolic aesthetic. At the same time, these facades are not acceptable in terms of emotional aesthetic and are only visually enhanced.

Keywords | Aesthetics, Facade, Apartment, Perception, Neuro-aesthetics.

Introduction | Studies show that the environment around humans affects how they live. The built environment can facilitate one's interaction with the environment by shaping the behavior of the inhabitants of space. As a strong stimulus for the human nervous system, the built environment can change the level of psychological experiences of the viewer and enhance it if possible (Golembiewski, 2012). Knowledge about the impact of the environment on humans has also existed intuitively in the architects

and builders of ancient buildings. The construction of Iranian gardens and pavilions that maintained the utmost connection with the natural environment and sensory stimuli is evidence of this claim (Shahcheraghi, 2009). However, recognizing the psychological characteristics of the environment has an older history. More than two thousand years ago, Vitruvius was the first to address three crucial architectural principles in his architectural books: "strength, utility, and beauty" (Pollio, 1914). From Vitruvius' point of view, beauty is achieved when the building has a pleasant facade and the proportions

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of its components are calculated accurately. Renaissance architect Alberti considers beauty in architecture in proportion and unity between components, and Palladio argues that beauty lacks a mental concept and is an objective experience about architecture (Grütter, 2019). The difference of opinion in the definition of beauty led to the duality of the concept of beauty, which has continued to this day. Contemporary research in aesthetics shows that the experience of beauty, by influencing people's decision-making, provides the ability to enhance the environmental experience (Chatterjee, 2011). Zeki (2019), as one of the most prominent researchers in the field of neuro-aesthetics claims, if we consider beauty as a kind of brain food, the experience of beauty increases the level of personal health and social well-being, so beauty is not only a luxury feature but also is a vital necessity for architecture. The beauty of the urban landscape has an impact on the neurological features of the environment. Among the components of a city, apartments with a significant frequency are visible in most urban areas. The apartments can be classified into two categories: the first of which includes buildings under 8 floors (medium-rise) and the second category of buildings above 8 floors (high-rise) (Chiara & Crosbie, 1995). Studies show that over the past 18 years, the number of floors built-in in Tehran has grown. In the '80s, the average number of floors related to each building permit was 5.5 and at the beginning of the '90s, this average was 7.1 floors and in 2020, it was 7 floors (Allami, 2020). The buildings studied in this research have been selected from the type of medium-rise because of their frequency. On the other hand, buildings under 4 floors are often built as villas and do not have the characteristics of an apartment. Therefore, 4 to 8 floors apartments are analyzed in this research. These buildings require their aesthetic requirements due to the maximum use of vertical density in office and residential uses. The main facades of residential apartments are the significant factors that are recognized in the face of this building and the beauty of the facades is not ineffective in the beauty of the urban environment (Pakzad, 2003). The lack of studies in this field and the new capabilities of neuroscience in the study of the environment, provide the opportunity to link these two factors in the scientific method. Tehran has been selected for study due to having a large level of construction and facing many environmental challenges. The study of facade design in Tehran with a neuro-scientific approach is a new field in aesthetic studies. Accordingly, the research seeks to analyze the aesthetic perceptual aspects of residential facades in Tehran with a neuro-architecture approach. The purpose of the study is to redefine the aesthetic criteria in evaluating the residential facades of Tehran to improve the quality of the residents' experience. This is possible by extracting criteria

from the research background and evaluating them by the residents. Research questions include the following:

- How is the facade effective in perceiving the apartment aesthetics?
- What are the most effective factors in enhancing the facade aesthetic perceptions from residents' point of view?
- How do semantic factors such as culture or knowledge affect the aesthetic perceptions of apartment dwellers?

Literature Review

• Neuro-aesthetics

In the definition of beauty, various models have been proposed by philosophers. Some philosophers have considered beauty as the product of philosophical thinking and have defined it as a subject (Grütter, 2019). In this viewpoint, beauty cannot be experienced except by thought and knowledge. Accordingly, beauty is not necessarily related to the concept of being pleasant, and another type of experience called "sublime" is considered an aesthetic experience (Boskabadi, Afhami & Farboud, 2014). On the other hand, empiricists believe in the evolutionary roots of aesthetics based on their achievements in understanding human biological evolution throughout history. Evidence from the research of scientists indicates that beauty as a factor in the continuation of the generation has been a criterion. In other words, beauty is considered a sign of health and fertility, and over time has been effective in the formation of human beliefs (Thornhill, 2003). In the neuroscientific interpretation of beauty, both types of beauty are understood together. In his recent research, Zeki shows that environmental elements have both objective and subjective beauty (Fig. 1). Subjective beauty refers to man-made and is variable in people. It is influenced by education and culture. On the contrary, objective beauty often results from natural elements and geometric proportions. It is understood in the same way by different people (Zeki, 2019).

In aesthetic perception, no matter which emotion has been triggered or cognitive experiences have been perceived, the inner part of the brain's orbitofrontal cortex is activated (Fig. 2). The activity of the internal part of the orbitofrontal cortex in the brain is always associated with experiences of pleasure, reward, desire, and decision making. This relationship provides a common neural framework for the perception of beauty that participates as a factor in decision making (Chatterjee & Vartanian, 2014).

• Neuro-aesthetics model

Chatterjee and Vartanian (2016) have adopted a triad model for neuro-aesthetics. This model includes a process that shows a person's sensory-motor system, knowledge-meanings system, and cognition-valuation system are involved in the perception of beauty (Fig. 3). Architectural

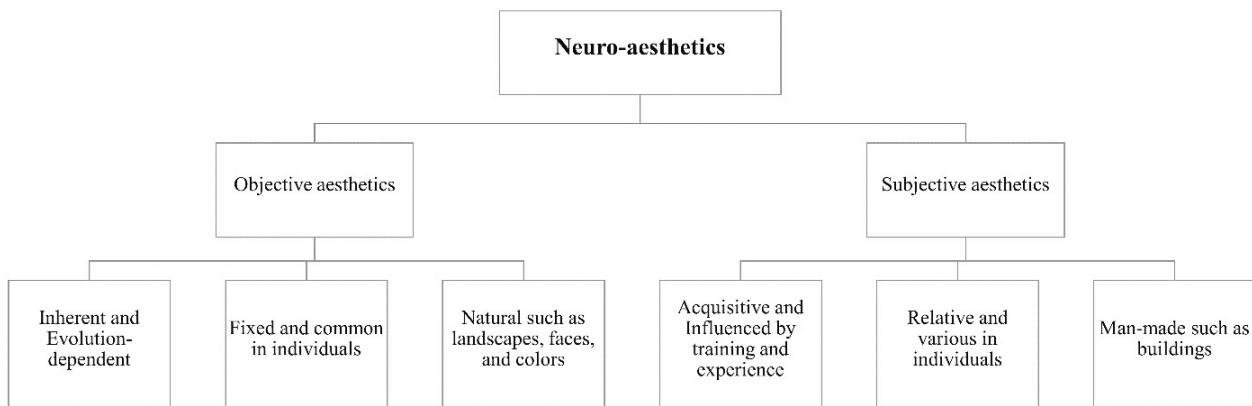


Fig. 1. Features of neuro-aesthetics. Source: Zeki, 2019.

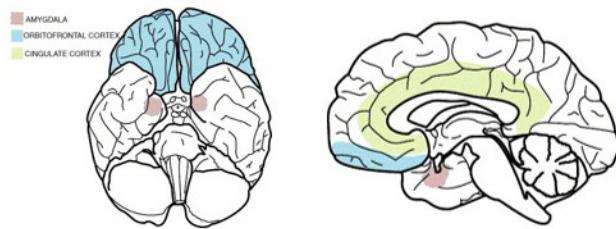


Fig. 2. Location of the orbitofrontal cortex of the brain in blue, from right to left, respectively: sagittal and horizontal sections of the brain. Source: Chatterjee & Vartanian, 2014; Richárd, 2019.

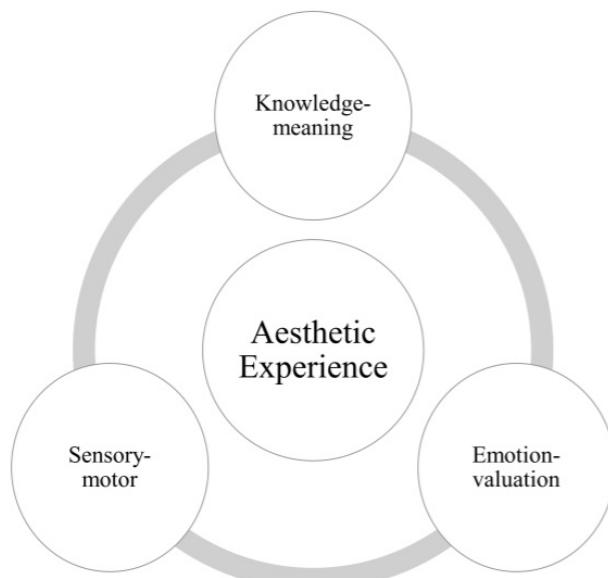


Fig. 3. The aesthetic triad. Adapted from Chatterjee and Vartanian. Source: Coburn, Vartanian & Chatterjee, 2017.

space influences the individual's response towards space by stimulating the human five senses. These responses can include avoiding a space or, conversely, interacting with it. A person's knowledge, which is influenced by his culture, education, and personal experiences, affects this

process. Finally, how an individual evaluates one's feelings and emotions in an architectural space is the last factor influencing the aesthetic experience (Coburn, Vartanian & Chatterjee, 2017).

• Beauty and perception

One of the essential factors in the foundation of aesthetic experience is "perception". The pursuit of beauty in the human mind begins with the process of perception. Humans receive signals from environmental stimuli through the environment and using the senses. After transmitting neurological signals in code to the brain, analyzing them by humans leads to the formation of responses and behaviors. Aesthetic experience includes all the processes that deal with the beautiful object in our perceptual interaction (Pakzad & Saki, 2014). In this regard, Gibson argues that when individuals actively adapt to a highly dynamic environment, they rely on the fixed properties of objects that remain stable. Therefore, these fixed properties are made available to perceptual sensor mechanisms in the form of visual messages. A cursory glance at an object cannot give us enough information to get a clear meaning of the object. Accordingly, a fixed view of an object must be commensurate with the natural character of the object. In addition, it is based on cognitive feedback from the perceptual object to make a distinction (Gibson, 2014). According to these definitions, the aesthetic perception of a building is not a purely visual activity. The observer's knowledge about the qualities of the building with the previous remembrance plays an active role in shaping this experience. Nasar defines this process particularly in the individual's interaction with the environment. He considers the aesthetic perception of the building features as an intertwined process that includes perception, emotional reactions, cognition, and individual evaluations. This differs from person to person in terms of biology, personality, social and cultural experience, goals,

expectations, relationships, and environmental factors (Nasar & Hong, 1999).

• **Residential facade**

The facade of a residential building is considered a distinctive feature of that building. In his research, Harald Deilmann has identified four main features for the facade of a building: 1. protection, 2. communication, 3. presentation, and 4. part of the urban space. The basic function that the facade creates is to protect the occupants of the building from outer threats. However, the facade should play the role of a link between inside and outside, private and public, secluded and crowded, artificial and natural. Over time, a person's house is tied to his financial condition, and the facade represents the social class of the occupants. In urban space, we are not faced with a building and its facades as an independent entity, because the building is part of a larger whole, the urban space (Pakzad, 2003). Therefore, a facade with these three features as a part of the whole city is also effective in how the urban landscape is formed. Aesthetic research in the field of the residential facade shows that facade features such as materials, shape, roofline, and openings are elements that attract more attention than other factors such as how the building is placed in its context and the ratio of mass to space (Imamoglu, 2000). The facade forms a large part of the exterior surfaces of the building, which as the first source of sending a perceptual message from an environment, contains neurological information for the observers (Hollander et al., 2019). The facade is composed of various physical and semantic elements. Studies depending on their purpose, have analyzed the relation of these elements with the aesthetics. Mohammadi (2019) shows that the facade contains elements that lead to receiving emotional senses in observers. The perceived message contains a wide range of different emotions such as pleasantness, unpleasantness, stressfulness, and relaxation. This type of aesthetic perception is realized by objects and physical features. The physical characteristics of the facade are things that the observer evaluate and judge in the first encounter. Many researchers have studied the effect of objective features on the preference of individuals by asking people (Wahdattalab, Yaran & Mohammadi Khoshbin, 2020; Yaran Wahdattalab & Mohammadi Khoshbin, 2019; Mortazavi, Mehdizadeh Saradj & Faizi, 2021). In these studies, the perception of beauty is equivalent to the preference and taste of the individual. Semantic elements are subjects that are symbolically perceived by the observer. Culture and knowledge are effective in how understanding these elements (Zeki, 2019). For example, the meaning of turquoise facade tiles in the mind of an Iranian person evokes different concepts from a non-Iranian person. Because the systematic review covers the sources related to the neuro-aesthetics of the

facade, the repetition of these in the literature review has been avoided.

Research Methods

This is a qualitative study employing an analytical-interpretive approach. Qualitative research has multidisciplinary qualities that include an interpretive-naturalistic approach to the subject of discussion (Grout & Wang, 2017). The reason for choosing this method was its exploratory qualities in defining the unknowns of a scientific subject. The interview was chosen as the research tool. An interview is a tool that allows you to study complex topics, follow up on answers or find the causes and ensure the subject understands the question (Sarmad, Bazargan & Hejazi, 2019). Creswell (2020) introduces data collected by semi-structured interviews as the effective method we try to understand human beings. Interviews are conducted in a structured, semi-structured, and unstructured format. In this study, a semi-structured method was used. This research was conducted in two stages. The first stage was based on a systematic review in the field of the facade with a neuro-aesthetics approach. This led to the extraction of effective criteria in designing the questions of the second stage of the research. The second stage led to the extraction of key definitions related to the purpose of the research by conducting an open-ended and semi-structured interview. The following two steps are described:

• **Stage one (Systematic review)**

Research conducted in the last ten years and available in Persian citation databases including Noormags, Scientific Information Database, Magiran, and English citation databases including Scopus and Web of Science with the titles "Beauty" and "Facade" were searched. Out of 703 articles extracted, by removing sources with incomplete text, duplicate text, unrelated to the research approach, and with non-Persian and non-English language, 16 articles were selected for systematic review. The PRISMA checklist was used for systematic review (Moher, Liberati, Tetzlaff, Altman & Group, 2009). The extracted information from the systematic review was presented in Table 1.

• **Stage two (Interview)**

The semi-structured interview was set according to a predetermined protocol (Baniasadi & Salehi, 2019). Each interview question was related to one or two of the research questions. Eight open-ended questions were asked in the interview. Their relationship with the research questions was explained in Table 2. The sampling was random. Eligibility for the interview included a minimum of 5 years of living in Tehran and living in a 4-story apartment or more. The age range of the participants was between 24 and 57 years (adult age

Table 1. Results of a systematic review of articles related to facade neuro-aesthetics. Source: Authors.

Reference	Facade Criteria	Aesthetics Criteria	Kind of Neuro-aesthetic
White & Gatersleben (2011)	Vegetation	Positive vibes	Objective
Ghomeshi & Jusan (2013)	The physical attributes (material, color, form, texture, opening, and decorations)	Preferences	Objective
Kholoosi, Behzadfar & Mohammadi (2014)	Formal and semantic criteria	Aesthetic perception	Objective & Subjective
Chamilothori et al. a uniform distribution of openings "Regular"(2019)	Daylighting and geometry of the opening	Emotional reactions: (pleasant, interesting, and exciting)	Objective & Subjective
Mohammadi (2019)	Typology	Semantic implications (pleasant)	Subjective
Naghibi Rad, Shahroudi, Shabani, Ajami, S. & Lashgari (2019)	Opening shape	Pleasant and unpleasant	Objective
Ruta, Mastandrea, Penacchio, Lamaddalena & Bove (2019)	Curvature and sharpness	Preferences	Objective
Yaran et al. (2019)	Porosity	Preferences	Objective
Yi (2019)	Complexity and Opening shape	Preferences	Objective & Subjective
Amanpour, Tahbaz & Karimi Fard (2020)	Proportion	Beautiful impression	Objective
Azemati et al. (2020)	Symmetry	Attention and visual attractiveness	Objective
Dietrich (2020)	Fractal geometry	Pleasant	Objective & Subjective
Jam, Azemati, Ghanbaran & Saleh Sedghpour (2019)	Color	Preferences	Objective
Joseph, Adeboye, Ezema & Opaluwa (2020)	The physical attributes (height, color, texture, shape, opening, columns, background, roof shape, entrance canopy, terrace, railing, decorations)	Pleasant	Objective
Wahdattalab et al. (2020)	Visual features	Preferences	Objective & Subjective
Ghomeishi (2021)	Perceptual features (meaningfulness, originality, clarity, and simplicity)	Preferences	Subjective

Table 2. Matrix of research questions and interview questions. Source: Authors.

Questions	Type of question	First question of the research	Second question of the research	Third question of the research	Contextual information
First question of the interview	Introductory question			*	*
Second question of the interview	Transitional question		*		*
Third question of the interview	Main question	*			
Fourth question of the interview	Main question	*			
Fifth question of the interview	Main question		*		
Sixth question of interview	Main question			*	
Seventh question of the interview	Probing question			*	
Eighth question of the interview	Final question				*

range). The interview was conducted with 14 participants. After 11 interviews, the results were saturated. The last 3 interviews were conducted to ensure the validity of the results. Data were extracted in textual form. Open and axial coding was performed using MAXQDA software. The categories were extracted by researchers. The number of participants in the test includes 14 people (10 women and 4 men) aged 24 to 57. The educational qualifications of the participants include two diplomas, one bachelor's degree, eight master's degrees, and three doctoral degrees. Six of these people have lived in Tehran for 5 to 15 years, four for 15 to 25 years, and four for 25 to 40 years. Eleven of the participants lived in a 4-story apartment and three of the participants lived in a 5-story apartment.

Findings

Content analysis of systematic review shows that the aesthetic elements of the facade in neuro-scientific studies can be divided into two groups: physical (shape and form, geometry, light and color, porosity, vegetation, design style, material, decoration, proportion, composition, and texture) and semantic (meaning, originality, clarity, simplicity, order, complexity, memorable, and artistic value). Among the mentioned elements, the shape and form of the building are studied more than others. Aesthetic evaluation in most studies is done by asking the dwellers about visual preference. Few studies use experimental tools such as Eye-tracker and Electroencephalography in evaluating aesthetic perception. Aesthetic experience in these studies is described by terms such as preference, pleasant, pleasure, attractiveness, attention, and beauty. The physical and semantic criteria obtained from this stage are the basis for designing interview questions in the second stage of

the research. After the interviews, the coding was done in two stages open and axial coding. Open coding is an analytical process through which the main concepts of identification, their characteristics, and their dimensions are discovered (Strauss & Corbin, 2014). According to Karimi and Nasr (2014), the method of analyzing the data extracted from the research is effective in how to encode the results. Therefore, a structural-interpretive approach was used in the analysis. The codes were extracted as related semantic expressions. The coding steps were initially performed by researchers. Then, to validate the results, the collaborative researcher was asked to re-codify the interviews. The similarity of 83% of the results indicated that the interviews were coded correctly. Table 3 shows the results of open coding. The relationship between the categories extracted through axial coding was designed in MAXQDA software (Fig. 4). In axial coding, by examining the place of words in the text, the frequency of the word, the degree of compliance with the research problem, the links and relationships between words and concepts are shown (Karimi & Nasr, 2014). At this stage, the relationships between 19 categories were extracted from open coding and Tehran apartment facades were examined in terms of neuro-aesthetics. 13 categories were related to physical features and 6 categories were related to semantic features. These categories have 60 sub-categories, which are mentioned in the third column of Table 3. To avoid the visual complexity of axial coding, the sub-categories are not mentioned and it is enough to mention them in Table 3. The frequency of each category was calculated based on the number of codes related to them and was plotted in Excel software as a bar chart in descending order (Fig. 5). The results showed that "physical features of the facade"

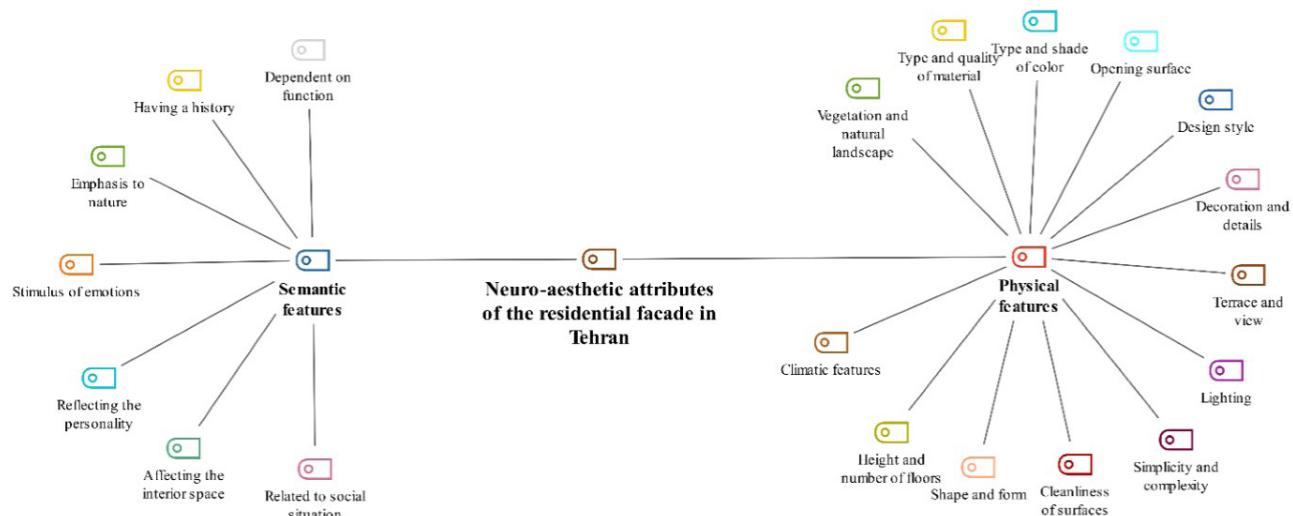


Fig. 4. Axial coding of the interview in MAXQDA. Source: Authors.

Table 3. Open coding of interview. Source: Aothurs.

Generic categories	Sub-categories	Concepts or codes	Sample data
Physical features	Vegetation and natural landscape	Green walls, vegetation in entrance and around the facade, green terrace, vegetation in the yard, indoor greenhouse in front of the window	"It has an interesting and beautiful surface of a plant texture." "There are trees and a garden in front of the building." "I feel pleased with a building that has a large terrace and was full of colorful vases." "Inside their yard, there are trees that have grown and penetrated outside the building." "It has a greenhouse in front of its windows."
	Type and quality of material	High quality and durable materials, the attractiveness of stone, brick, metal, and wood, a combination of materials, elegance, and proportions, insecurity of glass facade, the effect of materials in color, texture, and reflection	"Use fine and durable materials." "One of them had a white marble facade." "I think that bricks and their combination with stone are not disproportionate." "Facade materials do not have delicate dimensions." "The glass facade is not safe and an earthquake breaks them." "Facade materials determine the color, texture, transparency, and gloss of the facade."
	Opening surface	Opening surface and daylight, opening shape, the color of glass, details of the window, and transparency	"A beautiful facade, in my opinion, should have many windows and skylights." "Their windows are arched." "The colorful glass of windows on the balcony." "The details of the window are also important." "Windows have a positive impact on the facade."
	Type and shade of color	The attractiveness of light and warm colors, the preference of color in the facade over other factors, the attractiveness of white, black, and brown colors, and the Unattractiveness of gray and jade colors	"It was better to have a lighter color of the facade stone." "I do not like the color of the brick; I would probably change it." "Use white color on the facade." "The beautiful building has a brown facade." "I changed the color of the gray stones on the walls." "The facade is old because its stone is the color of jade."
	Design style	Preference of design style over other factors, the attractiveness of traditional design and its combination with modern design in some cases, the attractiveness of using creative and modern design, the unattractiveness of fashion design	"The facade must have a proper design." "I like the design style of traditional architecture more than modern." "A beautiful building, in addition to being modern, must maintain originality." "It also has new designs and is creative." "One year there will be a fashionable style and the next year that style will be out of fashion. After several years, the fashionable buildings will be seen as strange and ugly."
	Decoration and details	Unattractiveness decorations, non-functional details, the pleasant effect of entrance and railing details, visible mechanical equipment	"I do not like the facades that have a lot of decorations and make them messy." "Another is the door of the facade, which I think is important." "The concealment of wires, antennas, etc. can also differentiate the facade of the building from other buildings." "The traditional style of balcony railings is attractive to us."
	Terrace and view	Having pleasant views and attractive landscapes, attention to the visual privacy in the neighborhood, uniformity of the facade with the urban landscape	"The windows facing the alley are attractive to me." "With an excellent view of the whole city of Tehran at night." "I do not like those low-rise buildings that do not have privacy." "The facades develop with an irregular structure and this makes the streets not uniform."
	Lighting	Preference of lighting at night	"Recently, the lighting that is used at night is becoming beautiful, and lights that are used on the walls are effective."
	Complexity and simplicity	Preference for simplicity, attention to the complexity of design, the attractiveness of order in the composition	"The facade should be simple; the simplicity has a kind of charm." "It would be more attractive if complex designs were used." "Ugly facades are messy."
	Cleanliness of surfaces	The unfavorable condition of the old facade, the attractiveness of the clean facade	"Buildings that are worn out and their bricks are exposed or some of them have been demolished are ugly." "Disproportionate and dirty visual elements are seen in the facade."
	Shape and form	Preference of artistic and curved form, gable roof, and visual symmetry of facade, unpleasant of sharp-angled form	"The artistic form used in the facade is attractive." "Their windows are arched. I like them more." "I get upset every time I see this pyramid." "Facades that have visual symmetry are beautiful." "I have always been interested in houses with gables, but they are few in Tehran."
	Height and number of floors	Preference of low building height and proportional floors height	"The fewer number of floors is better and it feels pleasant." "The beautiful facade has a higher ceiling height."
	Climatic features	The proportion of facade with the climatic conditions of an area	"The facade can be beautiful with a design that fits the climate of a city."

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Rest of Table 3.

Generic categories	Sub-categories	Concepts or codes	Sample data
Semantic features	Related to the social situation	The facade reflects the psychological characteristics of individuals and their wealth level.	"People who are tidy and orderly usually have a building with a more attractive facade." "A pleasant facade is due to more prosperous dwellers."
	Affecting the interior space	Priority of facade in creating the pleasant experience of building, the relation of the facade with the decision to enter the building	"The beautiful facade when entering the building creates a good feeling in the residents, which can be the beginning of other good feelings." "The facade of the building influences its choice for entry."
	Stimulus of emotions	Feeling fear and insecurity with high-rise facade, feeling suffocation with facade without opening, feeling monotonous by the Roman style in the facade, feeling dull with the conventional facade, feeling calm with a light color surface	My feeling is that the high-rise leads to a feeling of" insecurity and fear in humans." "I do not like windowless facades, it looks like a cage." "Roman facades are not attractive." "The usual shape of buildings with conventional windows has a monotonous appearance." "If the facade is white marble, I would like it to give a sense of calm
	Emphasis on nature	Feel the vitality of the green facade	The facade with vegetation makes it closer to nature" ".and makes the residents feel livelier and happier
	Having a history	Feeling nostalgic with old houses, feeling of belonging to the original and stable facade over time	Seeing houses that are not more than three or four floors, I remember my grandmother's house." "In my opinion, buildings should be built in such a way that ".they retain originality over time
	Related to function	Use of elements and materials related to the internal function and use of the building	Transparent facades in buildings that are office and" have a good view of the city from the inside, or buildings that have a shared workspace can be attractive

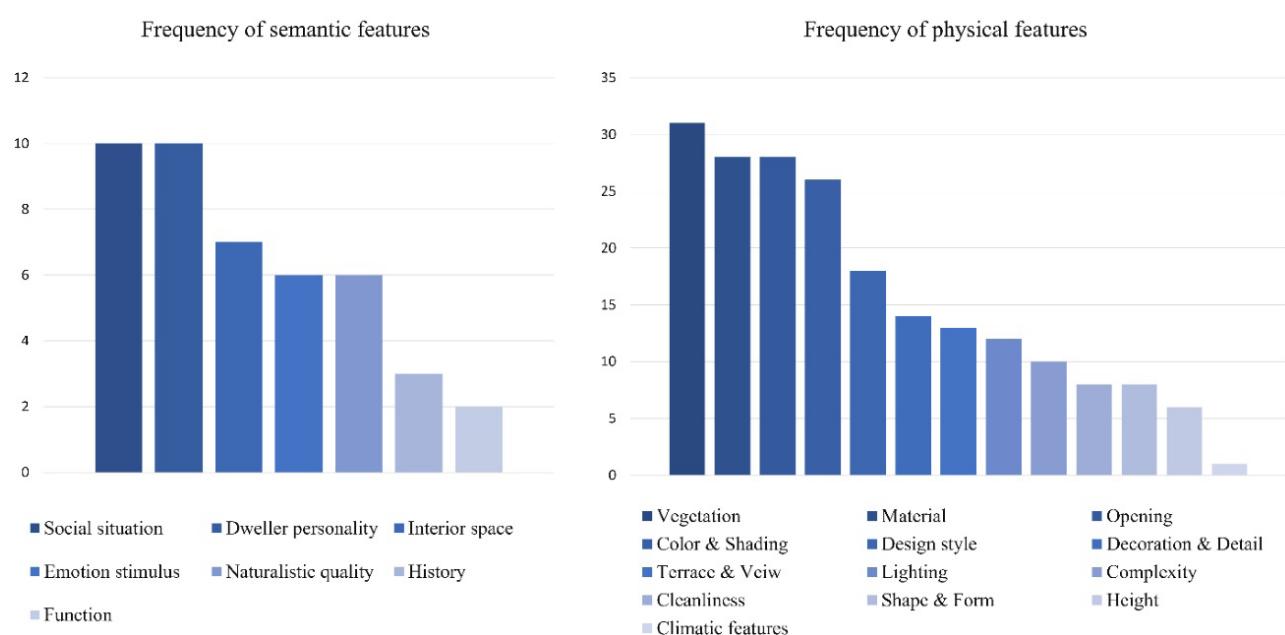


Fig. 5. Frequency of physical and semantic features of the facade resulting from the interview. Source: Authors.

with 203 codes have the highest frequency compared to "semantic features of the facade" with 44 codes. Among the physical features of the facade, "vegetation and natural landscape" with 31 codes had the highest repetition, and "climatic features" with 1 code had the lowest repetition. Among the semantic features of the facade, "dwellers social situation" with 10 codes had the highest repetition, and "building function" with 1 code had the least repetition among the answers.

Results

Evaluation of the findings shows that people consider the physical features of the facade to be more effective in its beauty than the semantic features. 68% of participants' answers refer to the physical features of the facade and its role in the facade's beauty. These features often include visual characteristics such as color, shape, height, etc. In other words, observers perceive the beauty of the facade primarily through visual experience. Beauty judgment of facade, sometimes considered in general and as part of the "urban landscape" and sometimes it is considered with detail, such as "window or balcony railings design". Participants value the visual attractiveness of the facade to such an importance that they intuitively consider the "decision-making" to enter the building, dependent on it. Another type of aesthetic judgment is made by perception based on the observers' feelings. Phrases such as "green facade evoke a sense of vitality," "Bright facades evoke a sense of calm," and "Roman facades evoke a sense of despair" are some of the factors that prioritize the role of emotions in aesthetics evaluations. Of course, identifying people's sensory experiences is not always so clear. These emotional encounters are multifaceted and mixed with conflicting concepts in some cases. For example, participants' feelings about the height of the building are as follows: "Looking at very tall buildings, I feel fear ... I am interested to know how someone who lives on the top floor sees the city." These expressions show that the attractiveness of the high-rise facade depends on a functional concept in the interior space and creates a contradictory feeling in the viewer from the outside. However, in valuing between the beautiful and ugly facades, features based on visual attraction are diminished. Features of the facade become significant that are related to the way of living in the interior. For example, in describing a beautiful facade, participants referred to the definition as "a beautiful facade has large windows because it allows more light into the space", or "an ugly facade does not have terrace and view to outside". The same is true about the semantic features of the facade. From people's point of view, the beauty of a building has a conceptual connection with the beauty of the interior. For example, the phrase "a beautiful

facade when entering a building creates a pleasing feeling in the occupants, which can be the beginning of other excellent feelings" is evidence of this claim. Priority of facade is crucial in creating the semantic and sensory experience from a building. The fourth kind of valuation between the features of the facade is formed by the symbolic perception of them. For example, "a beautiful facade should be made of durable stone such as marble" or "a simple facade is more attractive than facades with many decorations." In these phrases, it can be seen that marble is considered beautiful because it is defined in the viewer's mind as a symbol of durable materials. The same is true about the simplicity of the facade. An attractive facade is defined as the symbol of simplicity in people's minds. Symbolic perception is most noticeable in identifying the semantic features of the facade. Phrases such as "Relation of the luxurious facade with a high level of residents welfare", "Relation of the clean and orderly facade with the positive personality of residents", and "Relation of brick and wood materials with memories and the feeling of nostalgia" is due to the symbolic perception.

Conclusion

The facade beauty of a residential building, as an effective factor in deciding to enter the building, plays a vital role and requires study. This study aimed to investigate the neuro-aesthetics of Tehran's residential facade. The research was conducted using a qualitative method and interviews with individuals, based on criteria extracted from the systematic review. The interpretation of the findings shows that the perception of the aesthetics of a building's facade takes place in several successive stages. First, the objective features of the building facade such as shape, form, color, and materials are transmitted to the observer in the form of visual messages. The mind experiences pleasure through the neurological function of the brain and by discovering connections between facade properties, such as proportions, geometric symmetry, and pleasing colors. The next is the effect that the facade directly has on the person's emotions and feelings. Factors such as opacity and brightness of surfaces, natural elements, scale, and proportions play an essential role in the aesthetic experience. The type of aesthetic experience at this stage is based on pleasant emotions. In the third stage, the individual's mental meanings of life in the building are attached to the aesthetic judgment of the facade. Criteria such as accessibility to attractive views and daylight are considered. In this stage, the type of aesthetic experience is based on judgment and preference. The last stage is related to the symbolic perception of the facade. Based on knowledge and culture, the observer interprets some

elements in the facade as signs of concepts. Factors such as the originality and history of the facade are understood at this stage. At this stage, the type of aesthetic experience is based on cognition and exploration. These four steps seem to correspond to the model introduced by Chatterjee and Vartanian (2016). As shown in Fig. 6, the first stage of perception is related to sensory-motor factors, the second stage is related to emotion-evaluation factors and the third and fourth stages are related to knowledge-meaning factors. The results obtained from the interviews show that the characteristics affecting the semantic and symbolic perception in the residential

facade of Tehran are often neglected by designers. At the same time, the factors affecting emotional perception, although most of the participants emphasized it, are limited and non-targeted. The use of elements such as vegetation, brightly colored materials, and wide openings in the facade are things that create pleasant feelings in people. The use of vernacular materials and reducing the height of the building are features that create desirable meanings and concepts in people's minds. In future research, it is possible to address each of these perceptual aspects using visual tests and develop our knowledge in the field of neuroscientific facade design.

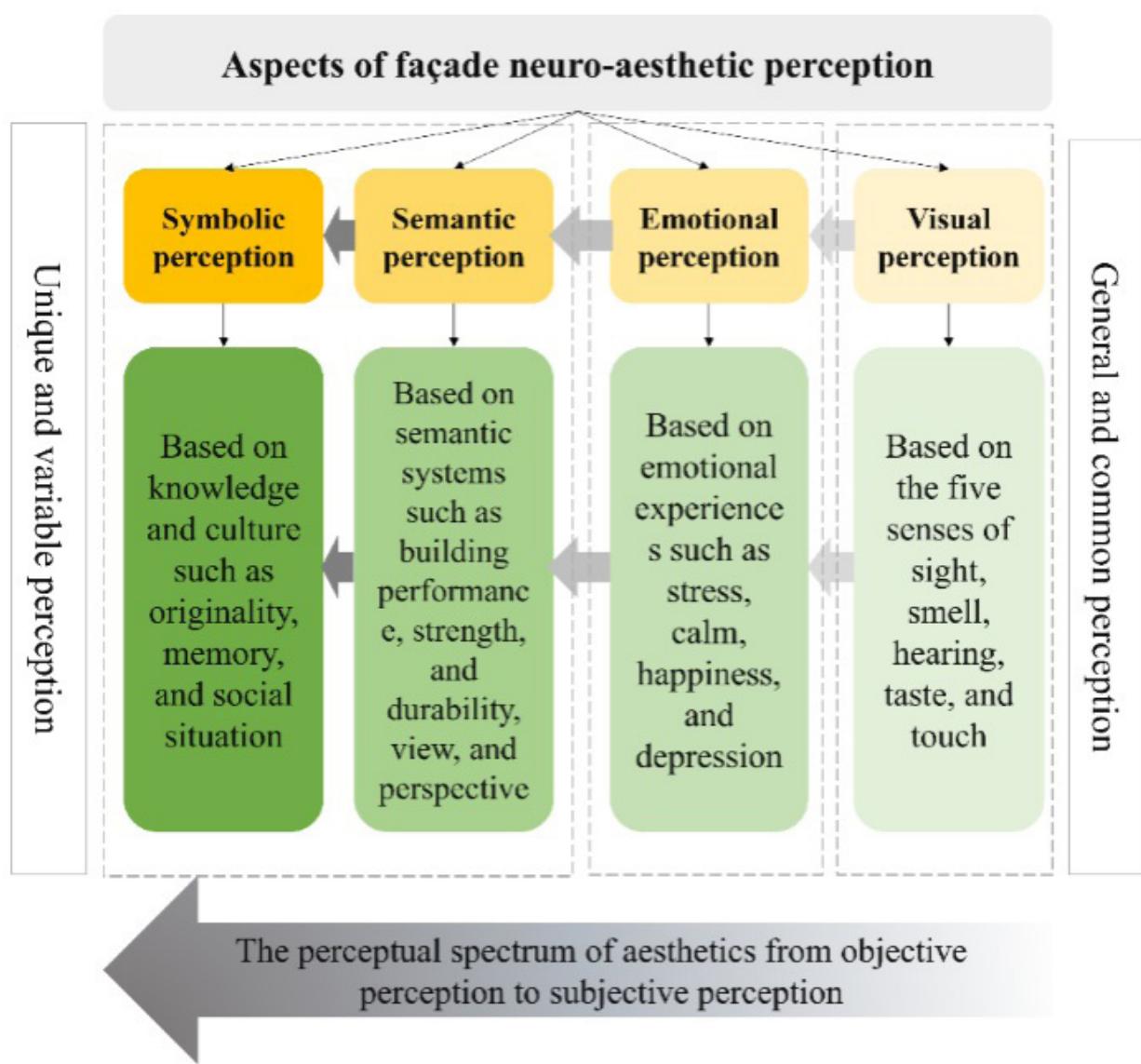


Fig. 6. Aspects of façade neuro-aesthetic perception. Source: Authors.

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