

# The Relationship between Visual Preferences of Passengers in Subway Stations and the Interior Design of Their Space; Case Study: Tabriz Subway Stations\*

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## ABSTRACT

Nowadays, public transportation system, especially subway, is of particular importance in the world while its construction in the developing countries and Iran has been new, and unfortunately, there are no specific criteria for their construction in terms of spatial structure and design. Recently, in the construction process of most subway stations, quantity has been more considered than the quality, and proper design has been of low importance in accordance with what people want. One of the interior architecture's final purposes is creating a unique man-made environment. The current study identifies people's visual preferences in the interior space of the subway station based on Kaplan's information processing theory, consisting of legibility, coherence, complexity, and mystery. Using a survey-quantitative research method, the visual and textual questionnaires were completed by the statistical samples, including 306 people in the six stations of Tabriz subway line 1. The relationship between the research variables and the influential factors in the visual preferences of subway passengers was analyzed using SPSS software. According to the obtained results regarding the interior space of the stations, the spatial structure of mystery obtained the maximum preference and the spatial structure of coherence gained the minimum preference among the four spatial configuration. Soft form, indirect and cold lighting, warm and neutral colors combination, the combination of brick, wood, and glass were identified as the influential physical features in the design of the subway stations. However, regular form, direct lighting, bright colors, and a combination of stone, ceramics, and glass were identified as less influential physical features in this design. The obtained criteria and patterns regarding subway design and spatial structures can be applied as a tool by managers, urban designers, and urban railway organization.

**Keywords:** Subway Stations, Information Processing Theory, Visual Preferences, Spatial Configuration, Physical Features.

\* The current paper is derived from the first author's Master's thesis of architecture entitled "Entrance and Interior Design of Metro Station with Application of Passengers' Visual Preferences (case study: Tabriz Saat Square Station)", which was conducted in The Architecture and Art Faculty of Islamic Azad University, Tabriz Branch under the supervision of the second author in 2016.

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## 1. INTRODUCTION

Achieving easy, safe, and fast transportation is one of the purposes of human communities over different eras (Edwards, 2013). Hence, the stations and terminals are of particular importance as one of the main areas of using railway transportation and due to the coherence and combination with the people's daily life (Mardomi & Ghamari, 2011). The diversity of the urban land uses, and their density leads to imposing the use of public transportation on urban residents, such as the subway (Ashmaei, Gharagozlu, & Vafaenejad, 2017). In recent years, most subway stations have become boring and passing spaces for the passengers while these spaces can become attractive, pleasing, and entertaining places so that passengers enjoy the moments they spend in these spaces instead of escaping from the station. They can also improve their mood during the day (Pace, Fischer, & Nichol, 2007). Thus, although a station seeks to provide a proper context for citizens' social life besides transferring passengers, they require attention to components to realize this purpose as any other urban space (Mardomi & Ghamari, 2011). Quality of the visual environment and people's preferences (Mousavi Samimi & Shahhosseini, 2017), natural space preferences (Kamal & Maulan, 2014), and built environment (Kuper, 2017) are among these components. Visual environment quality refers to a capability that can stimulate positive feelings (satisfaction, interest, etc.) or negative feelings (dissatisfaction, antipathy, distance, etc.) in the people in the environment, and has various evaluation methods (Lovett, Appelton, Waren Kretzchmar, & Von Haaren, 2015). Thus, a desirable visual environment is not an abstract, aesthetics, and independent phenomenon, and depends on the evaluation of the people who experience it (Nasar, 1990; Liu & Schroth, 2019; Rapaport, 1990). Providing a desirable feeling that eventually turns into the user's preference is necessary for interior architecture (Liu, 2014). The results of various studies show the difference between ordinary people's visual preferences and designers and architects (Giggord, Hine, MullerClemm, Reynolds, & Shaw, 2000). The aim is to evaluate the environmental quality and preferences, people's perceptual evaluation of the environment, and what people have in their mind (Abkar, Kamal, Maulan, & Davoodi, 2011). Considering the significance and people's preferences in using urban open spaces in comparison with the urban closed spaces (Shi, Gou, & Chen, 2014), the current study attempts to present the influential spatial structure and physical features in the passengers' visual preferences (Farboud & Shahhosseini, 2020) in the

interior design of the subway station. Addressing the interior space of a closed urban space such as a subway station can provide a way to increase social interaction, even though people want to get to the open urban space as quickly as possible. Therefore, this study aims to answer the following question:

What are the visual preferences of the subway station passengers regarding interior design?

## 2. THEORETICAL FOUNDATIONS

Due to the constant use by people, the design of the urban public spaces, such as subway stations, must be investigated accurately. If this design is conducted based on the users' preferences, it can increase the usage (Veitch et al., 2017). Then, after studying the public spaces and metro stations, the visual preferences approaches and the variables of the information processing theory are described.

### 2.1. Subway Stations and Public Space

The subway terminal station is considered an exchange space due to being in the vehicle exchange place. Terminal exchange space includes specific areas with exchange facilities in which two or different kinds of vehicles are exchanged. Therefore, it is considered a concentration and accumulation point and pause and stop point in the railway transportation system (Sherbaf, 2014). In terms of cultural-social perspective, public space is defined as a place to create and improve the external relations and events, changes, and social interactions in which various groups with different demands and interests gather (Rafieian & Sifaei, 2005). Due to using various terms by experts and definition of the social aspects for different public spaces, these terms are similar in terms of concept. The purpose of all these concepts is to achieve a place that belongs to all society members with the potential of forming collective activities in it. Also, some criteria, including attraction and vitality, safety and security, surveillance, participation, access and justice, health, education, and identity can be mentioned to define the social aspects and evaluate them (Sherbaf, 2014).

Tabriz subway includes the complex of the under-construction urban railways in Tabriz. The studies started in 2001, and its implementation began four years later. Tabriz subway consists of five lines (four main lines and one suburbs line). Its length is 75 km. Line 1 of this system connects the Elgoli region in the southeast of the city to the Laleh region in the southwest. Unfortunately, the environmental attractiveness and spatial body of the stations have been created as a raw space, regardless of the quality of the place and passengers' preferences.



Fig. 1. Tabriz Sahand Subway Station



Fig. 2. Tabriz Imam Reza Subway Station

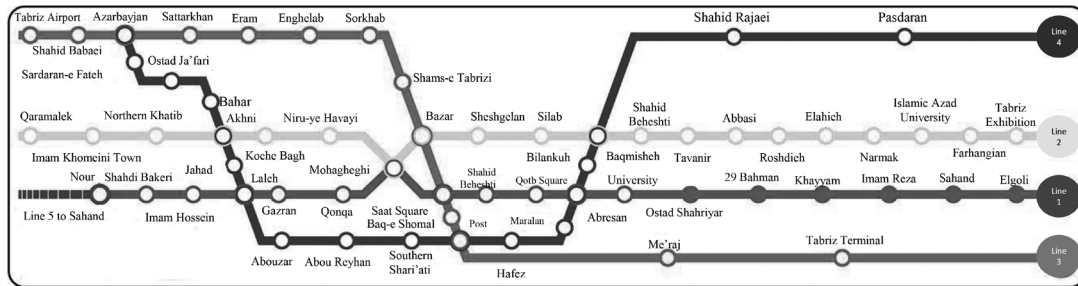


Fig. 3. Map of the Subway Stations Line of Tabriz

## 2.2. Visual Preferences

Cheng (2007) has classified various approaches of preferences, including mental approach, expert approach, experimental approach, psychological approach, and integrated approach. The mentioned approaches are considered measurable and executable approaches for the environmental indices to obtain information about understanding what environments are acceptable for people (Kaltenborn & Bjeke, 2002; Maulan, 2006). Also, the stated approaches are important to understand the environmental perception and to identify the most influential factors in preferences (Holahan, 1989). Considering environmental preferences and observing various scenes (Wang, Rodiek, Wu, Chen, & Li, 2016) are of particular significance for environmental quality evaluation, perceptual evaluation of people from the environment, and what people have in their mind (Abkar, Kamal, Maulan, & Davoodi, 2011). Environmental features, environmental signs, and personality differences are the influential factors in preferences (Cheng, 2007). The recent study indicates the strong adaptation between the perceptual sense and various symmetrical visual patterns. These patterns are used to find the relationship between visual preferences and perceptual sense. The degree of preferences is positively related to the overlay of the four assessment variables of the perceptual sense (Makin, Helmy, & Betamini, 2018). Also, it was recommended that these results reflect the public aspects of human priority. Most people prefer the symmetric proportions to the asymmetric (Eisenman, 1967; Makin, Helmy, & Betamini, 2012), blue color to the brown (Palmer & Schloss, 2012), and a soft curve to the angled (Betamini, Palumbo, Gheroghes, & Galatsidas, 2016; Cotter, Silvia, Betamini, Palumbo, & Vatanian, 2017).

## 2.3. Information Processing Theory

In the preferences studies, information processing theory is the most prominent and relevant theory, which can be applied to determine people's landscape preferences (Bourassa, 1991; Cheng, 2007; Stamps III, 2004; Mumcu Duzenli & Ozbilen, 2010). One of the theories in the evolutionary approach is the proposed model by Rachel and Stephen Kaplan. It is formed based on the human's needs for information and his/her ability to process information. This model addressed the issues by considering the variables of complexity, mystery, coherence, and legibility (Liu, 2014). Kaplan believes that people's reaction to the objects and spaces depends on their purposes, dividing into two main aspects of "trying to understand" and "tendency to discoveries" (Kaplan & Kaplan, 1989). Each of these needs points out two levels of information, i.e., "what is rapidly understandable" and "what is understandable by people's movement in the environment" (Stamps, 2006). According to this theory, the received information from the environment includes a classification in two levels of immediate and inferential (Shahhosseini, Bin, & Bin Maulan, 2015). According to Kaplans, people prefer responsive environments to these basic needs. Therefore, environmental preferences are a process leading to the perceptual interaction between objects and spaces and resulting in people's reactions due to their ability to realize the purposes (Kaplan & Kaplan, 1989). First, four variables describe the frameworks of human perception and recognition of the environment as predicting the landscape aesthetics (Bell, 1999; Gifford, 2007; Ryan, 1998; Stamps III, 2004). Information processing theory calls these variables informative variables (Mazandarani, 2015). Mystery and complexity variables are necessary to collect the information, and coherence and legibility address the need to acquire information.

Table 1. Kaplan's Framework

Human Needs		Access to the Information in the Environment
Exploration	Perception	
Coherence	Complexity	What Can be Perceived in a Moment.
Legibility	Mystery	What Can be Perceived by People's Movement in the Environment.

(Kaplan & Kaplan, 1989)

In this model, the coherence variable (immediate perception) indicates a degree of order and environmental organization (Rappaport, 1990). Legibility (inferential perception) shows the facility of navigation in the environment and being aware of the environment's situation. They also predict environmental preferences (Gifford et al., 2000). Complexity (immediate or fast reaction) addresses the diversity of the various environmental elements and the multiplicity of the visual elements (Strumse, 1996), and mystery variable (inferential exploration) studies the

presentation of more information in the environment. The predictive factors of the environmental preferences are identified to discover the environment (Stamps, 1996; Kaplan & Kaplan, 1989). In general, mystery stimulates a sense of curiosity in the people. Also, according to the conducted studies to investigate and evaluate people's environmental preferences, the impact of the coherence and mystery variables has been frequently proven (Herzog, Kaplan, & Kaplan, 1976; Ikemi, 2005).

**Table 2. Definitions of the Variables of the Information Processing Theory**

Variables	Definitions
Legibility	<ul style="list-style-type: none"> <li>- When I Enter the Space, Everything is Obvious.</li> <li>- Access to Various Parts of the Space is Easy.</li> <li>- Understanding how to Go to Different Parts, Does Not Take Long.</li> <li>- I always Know Where I am.</li> </ul>
Coherence	<ul style="list-style-type: none"> <li>- Every Part is Well Related to other Parts.</li> <li>- The Components Work together Well.</li> <li>- All the Elements are Corresponding to Each other.</li> <li>- The Components Help Each other to Achieve a better Understanding of the Environment.</li> </ul>
Complexity	<ul style="list-style-type: none"> <li>- The Scene has Many Complexities that are Distracting.</li> <li>- The Scene Does not have Adequate Elements to Attract my Attention.</li> <li>- The Scene has Diverse Elements that Occupies Me.</li> <li>- I Feel Overwhelmed by the Variety of Components and Information that the Scene Provides.</li> </ul>
Mystery	<ul style="list-style-type: none"> <li>- The Scene Makes me Feel that There is Something Interesting to Discover in the Environment.</li> <li>- The More I Move on the Scene, the More My Curiosity is Stimulated.</li> <li>- I Expect to Find Things in The Scene to Meet My Curiosity When I Walk in.</li> <li>- I Feel that I Will Find More Interesting Things by Walking More in the Scene.</li> </ul>

(Lee & Kozar, 2009; Mumcu, Duzenli, & Ozbilen, 2010; Ramanujam, 2007)

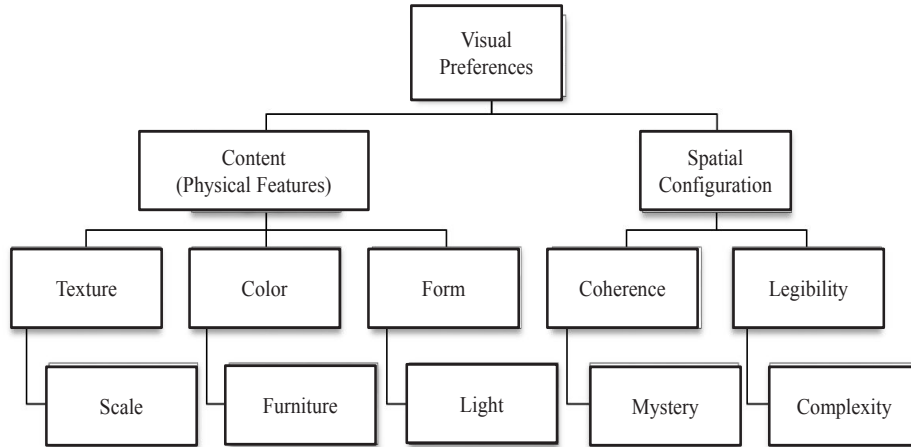
The conducted studies (Shahhosseini, 2014; Mei & Olaf, 2019; Stamps III, 2014) indicate that the stated theory included the broadest experiments among the psychological theories (Theory of Habitat (Darwin & Beer, 1909), Prospect-refuge theory (Appleton, 1996), and environmental landscape (Sell, Taylor, & Zube, 1984). It was recommended to test the theory in other environments. In this regard, in 1989, Kaplan & Kaplan state that their model is incomplete and must be evaluated more in different contexts due to the cultural diversity and human's recognition of the environment.

#### 2.4. Physical Features (Content)

As a part of our perception of the environment, all the senses are constantly affecting memories, feelings, activities, choices, preferences, and perception (Krishna, 2012). Eyesight is considered the most prominent sense regarding the environment. It greatly helps people in photographing the environment and records external information. Eyesight is the most dominant sense in all regards, and it can be claimed that it is the central part of human perception. Also, along

with other senses, eyesight helps the human perceive the world, and collects the information that turns into memories later (Yoon & Park, 2012). Certainly, visual perception plays the main role in the sensory-mental process (Soliva & Hunziker, 2009).

One of the design purposes is to materialize the human needs and ideas in creating an adaptable environment to his/her needs (Alahdadi & Honarbakhsh, 2013). Design can have a significant impact on users' preferences (Nikander, Liikkanen, & Laakso, 2014). Various researchers consider numerous physical features and factors that determine each of the people's preferences in different spaces and conditions affecting parameters in visual preferences (Fakhimi, 2011, p. 98; Alahdadi & Honarbakhsh, 2013). Texture (Wong, 1993, p. 87), color (Cheshmeh, Rahim Salmani, & Rahim Salmani, 2011; Dagget, Cobble, & Gerfel, 2008), light (Sharifian & Langrodi, 2009), furniture (Fakhimi, 2011), and scale (Alahdadi & Honarbakhsh) are among the most significant environmental factors affecting the visual preferences and design of the subway station interior space.



**Fig. 4. Classification of the Key Bases of the Visual Preferences in Subway Space**

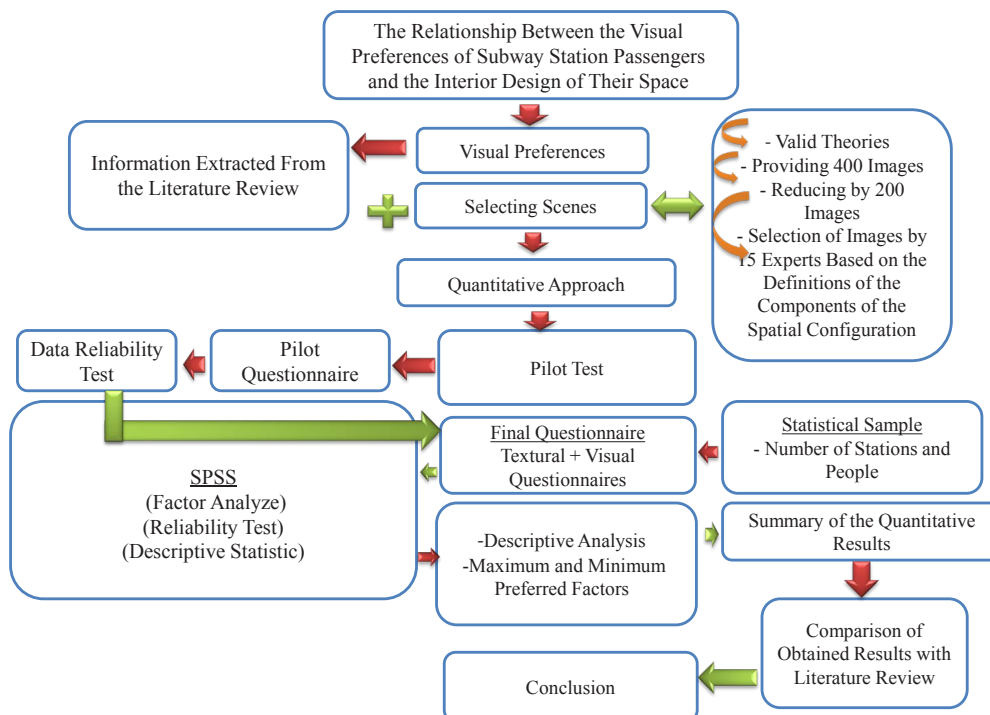
### 3. RESEARCH METHOD

The current method is a resultant of the conducted studies in this regard (Shahhosseini et al., 2015; Masoud, Ghalenoei, & Shokohi, 2016). Also, a quantitative research method was considered to determine the cause and effect. This approach states the systematic empirical studies of the social phenomena through statistical calculations (Bryman, 2016). The current research aims to apply the theory and introduced factors by implementing the non-empirical design, such as a general survey (Creswell, 2002). Information

processing theory, as the most significant theory in the landscape, indicates the inferential perception of the environment. Many studies that have applied this theory have been conducted in forests, large urban and rural parks, and urban regions. However, this theory was less used in the internal environments. Although this theory was applied in many studies, there is not any comprehensive description of the environmental preferences based on the variables. Therefore, using this theory with its variables can be considered a solution to find a new description for the public visual preferences in the interior spaces of the subway stations.

**Table 3. Research Plan**

1. Using Quantitative Approach for Research Process (Questionnaire)
2. Directing Statistical Calculations by SPSS Software to Propose a Structural Model
3. Presenting Information to Reconstruct the Interior Design Approach of the Subway Station
4. Identifying the Influential Variables in the People's Visual Preferences in Subway Stations



**Fig. 5. Research Procedure in a Glance**

Taking into account (95% confidence level, 5% error, and standard deviation from the average of 50%) the number of people using the six metro stations of Tabriz line 1 (1500 people based on statistics on the first and last days of the week, in October 2017) and the statistical population using the Cochran's formula, 306 questionnaires were distributed during metro working hours (from 10 am to 4 pm). Questionnaires were given only to subway passengers over the age of 18 who were not artists or architects. The reason was that the artistic perspective of these people on their opinion while filling out the questionnaire was effective, and there was a possibility of making errors in the analysis of information. To conduct the research process, after randomly identifying the sample members, two series of questionnaires, which included a visual

questionnaire and a questionnaire containing questions (two parts), were provided to the sample members. The first part of the questionnaire included questions about gender, age, occupation, level of education, marital status, income, time of using the subway, location, distance from the first station, and who to accompany when visiting the subway. The second part includes a visual questionnaire. These images and questions can determine the selective range of preferred images by individuals. The third part consists of questions related to the principles and criteria of individuals' visual preferences in the interior design of a subway station.

#### 4. RESEARCH RESULTS

The statistical information of the respondents is presented in Figure 6.

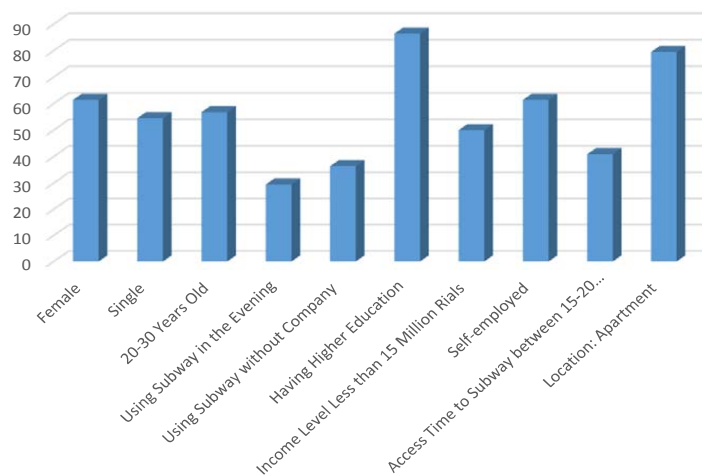


Fig. 6. Demographic Information of the Sample Population in the Subway Station

Regarding the visual questionnaire (the second part of the questionnaire), first, the maximum and minimum preferred spatial configuration were determined for each image based on the experts' opinions (15). 28 best images (selected images from the Internet) regarding the interior design of the subway stations space (Seven images for each one of the legibility, complexity, coherence, and mystery variables) were selected and presented to the passengers in a visual questionnaire (indicating the studied spatial configuration). According to the definition of the four variables of Kaplan's theory, the images related to each structure were evaluated considering the mean of the scores. Then, the data were classified into four groups proposed by SPSS software (legibility, complexity, coherence, and mystery) to identify the correlation between the set of data by

factor analysis. Also, reliability and validity tests using Cronbach's alpha were used to study the internal consistency of each structure. Eventually, the results related to each scene turn into a unit value to identify the scores for each structure. Finally, the maximum and minimum preferred structure were recorded based on the audiences' score. The classification of the mean scores was in the high and middle ranks using the Likert Scale for most of the presented images. According to the results obtained from the visual questionnaire, the scores of the total mean for each of the pre-determined spatial images were determined. According to Table 4, the data reliability test was confirmed for each structure for people's visual preferences using Cronbach's alpha ( $0.6 \geq \alpha$ ) without removing any data (Nunnally, 1978).

Table 4. The Final Defined Results for the Variables of the Visual Preferences of the Interior Spaces of the Subway Stations with the Considered Scoring (1= I Like It, 2= I Like It a Little, 3= No Comment, 4= I Don't Like It, 5= I Don't Like It at All).

	Mean	Standard Deviation	Cronbach's Alpha
Legibility	2.58	0.683	0.714
Coherence	2.59	0.799	0.700
Complexity	2.28	0.718	0.610
Mystery	2.21	0.788	0.850

The more preferred images in each group of images of four spatial configurations have been presented in the following. The mean value of the best image of the mystery variable is less than others (it is close to the

value of the “I like it” item). Therefore, the mystery variable had the maximum preference, and coherence and legibility had the minimum degree of preference.



Fig. 7. Mystery (Mean: 1.83, Standard Deviation: 1.12)



Fig. 8. Legibility (Mean: 2.33, Standard Deviation: 1.113)



Fig. 9. Coherence (Mean: 2.45, Standard Deviation: 1.02)



Fig. 10. Complexity (Mean: 2.08, Standard Deviation: 0.93)

Considering 15 expert opinions in architecture and urbanism and the results of the visual questionnaire, the dominant concepts, and attributes of each variable

(physical features) were identified, investigated, and presented in Table 5.

Table 5. The Dominant Attributes of the Spatial Configuration in the Interior Spaces of the Subway Station

Spatial Configuration in the Interior Spaces of the Subway Station	Concepts
Legibility	Open Spaces, Rhythm and Frequency, Plaster, Bright Flooring, Bright Colors, and Direct Lighting
Coherence	Transparent Spaces, Rhythm, and Regular Frequency, Stone, Ceramics, Glass, Bright Flooring, Bright and Appropriate Color, Direct Lighting
Complexity	Irregular Frequency and Rhythm, Diverse Material (Stone, Glass, Ceramics, Concrete, and Plaster), Bright and Dark Flooring, Dark, Bright, and Diverse Colors, Direct and Indirect, and Cold and Warm Lighting
Mystery	Multipath, Ambiguous Rhythm and Frequency, Stone, Wood, Plaster, and Combination with Brick, Dark and Bright Flooring, Dark Bright and Warm Colors, Cold and Indirect Lighting

The results of the people’s preferences to each one of the related questions to the physical features used in the

questionnaire were studied in Figure 11.

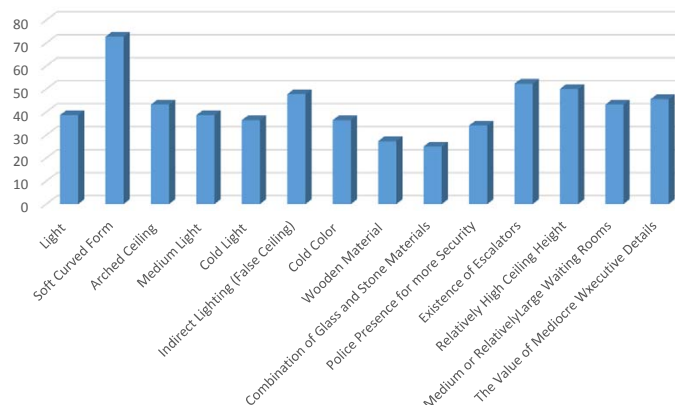


Fig. 11. Percentage of Dominant Response Selection by the Sample Population at the Subway Station

The obtained results indicate that the lighting and its degree in the interior spaces of the station are more considered by the passengers. It is one of the significant factors that make the human feel happiness by being in some of the places and spaces and enjoys the most by being in that environment, or it can lead to feelings of sadness, dejection, depression, and uneasiness (Naebi, Kateb, Mazaheri, & Birashk, 2008). According to the data analysis of the questionnaire, the use of cold and indirect lighting in the interior design of the subway station has been more preferred by passengers. Different forms create a different feeling of space in the person, which in the interior design of the subway station, passengers preferred to use soft and curved forms and arched ceilings. Some have considered color to be the visual property of form, and form finds meaning through color. Most respondents preferred to use cold colors in the interior design of the subway station. The choice of materials in architecture can affect the diversity and visual appeal of the environment that most passengers preferred the use of wood, along with a combination of brick, stone, and glass in the interior design of the subway station. Designing spaces with appropriate dimensions is very significant and influential in the interior design of the station. Most travelers prefer relatively large halls with relatively high height for the interior design of the station. The presence of executive details in the station design is relatively significant for most passengers. Also, the use of escalators and furniture (facilities) with a sufficient number to facilitate access to the floors of the station has been preferred more. In all public spaces, security is very vital and necessary for space users. Most passengers prefer the presence of the police and the use of appropriate lighting to ensure security at the station. The obtained results regarding the configuration of the interior space can be consistent with many other studies, such as natural landscape preferences in forests or agricultural lands (Hegerhall, 2000; Herzog, 1984), urban regions such as buildings of old factories (Herzog, 1989; Herzog, Kaplan, & Kaplan, 1976; Ikemi, 2005), and a combination of urban and natural

elements (Herzog & Miller, 1998). The main concept of preference is whether a landscape is interesting enough to be looked into or not. It supports the results of other studies. It must be noted that mystery can be the most significant predictive of the preferences (Woodcock, 1982), indicating the importance of considering the influential components in the visual preferences in design.

## 5. CONCLUSION

Based on the results obtained from the theoretical foundations and analysis of the information regarding the people's visual preferences (results obtained from the visual and textural questionnaires), the relationship between the visual preferences of the subway stations' passengers and the interior design of their spaces is obtained considering the influential spatial configuration components and the features of the textural components. Given the conducted studies, the combination of these two components can provide a context for an efficient design.

In the current research, analysis of the maximum and minimum preferences regarding visual factors (spatial configuration and physical features) in the interior spaces of the subway station is presented. It was indicated that regarding the spatial structure of the interior space of the subway stations, the indefinite information in an environment called mystery was more preferred than other factors. It includes the spaces with multipath, ambiguous frequency and rhythm stone, wood, plaster, and a combination of brick, dark-bright flooring, dark-bright and warm colors, indirect and cold lighting. In contrast, coherence and legibility with regular frequency open and transparent spaces, and direct lighting have the minimum preference.

Among other factors considered by the subway stations' users are the soft forms, paying attention to the details, and the height of the ceiling. Also, natural materials were more considered in the application of the materials. The conducted studies can provide useful solutions for the urban managers and the designers of the urban closed spaces.



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