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Space perception among civil engineering students

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Abstract

Individual characteristics, alongside environmental features, significantly influence spatial perception and the environmental image formed by users. While previous research has emphasized environmental attributes, there remains a limited understanding of how non-designers interpret architectural space based on factors such as academic level and disciplinary training. Addressing this gap, the present study investigates the spatial perception of civil engineering students at different stages of their education. Specifically, it compares first- and third-year students' interpretations of architectural identity and legibility using photographic stimuli from urban street scenes. A structured questionnaire was administered to 90 participants to capture subjective evaluations of selected streetscapes. The findings reveal discernible differences in spatial interpretation between the two groups, suggesting that academic progression and increased exposure to technical knowledge influence perceptual tendencies. Notably, third-year students demonstrated a more analytical reading of spatial cues, while first-year students exhibited a more intuitive response to visual stimuli. These results underline the role of educational background in shaping environmental cognition and suggest the need for interdisciplinary pedagogical approaches that integrate spatial awareness in non-design disciplines. The study contributes to a deeper understanding of how architectural environments are perceived by future engineers, offering insights for the design of more inclusive and legible urban spaces.

Keywords: Architectural perception; civil engineering education; environmental cognition; identity; legibility.

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1. INTRODUCTION

Spatial perception is the ability to sense objects' size, shape, movement, and orientation. The primary sense used to perceive spatial relationships is the sense of sight, though other senses may also play a role in determining the spatial positions of objects. Like other forms of perception, spatial perception occurs in the sensory organs that collect data about the environment and in the brain (URL1). Psychology of space perception is basically about the process of gaining a short-term or a long-term experience in or around a space and recalling the space according to it (Mazancieux et al., 2023). This experience changes and evolves by the concept of movement. Perceptual space can be defined as the mental map we carry inside our heads, while conceptual space exists as a plan, stored in our memories (Ryu & Lee 2024; Son et al., 2024; Dragan et al., 2025). In this context, the physical space can be seen through images, sensed by its texture, smell, and taste, although it can be comprehended by our feelings and experiences that are filtered through time (Gezer, 2012).

Perception is a personal experience. As well as being related to the image of the space, it's also related to a large number of factors such as the age, gender, experience, educational level, socioeconomic status of the person, the time spent living in a place, urban living area, and occupation (Atac, 2006). In this respect, studies show that the individuals who had an architectural education or are known as a designer evaluate an environment primarily based on its physical features and the concepts architecturally theoretical/abstract, whereas the ones who don't have any formation in architecture seem to be more effected by the negativities caused by their spatial experiences and perceive the concepts in a more materialistic/concrete way and as primarily based on meaning and beneficial aspects, as part of the spatial perception (Elmali Sen, 2009; Yazici & Erdogan, 2011). The spatial perception relates to the ability to determine spatial relationships from visual information (Seabra and Santos, 2008; Choi & Kim, 2023).

1.1. Purpose of study

This study aims to determine how the individuals who are not designers perceive and interpret a space and how they read it. The main idea of the study is to find out if there are any differences in the way of perception of the 1st and 3rd grade civil engineering students. A discussion is made in order to sort out the relations between the concepts of identity and legibility, which form the backbone of the study. This study presents the opportunity to see the differences in the meaning that the spaces express for individuals.

2. METHOD AND MATERIALS

2.1. Research design

This study employed a case study approach to investigate the spatial perception of civil engineering students at different stages of their education. The objective was to compare how first- and third-year students interpret architectural identity and legibility in urban street scenes. The study utilized photographic stimuli from real-world urban environments to capture the subjective evaluations of the participants. The location for the study was Haskoy.

Hasköy is a historic neighborhood located along the Golden Horn in the Beyoğlu district of Istanbul. The area is marked by a rich, four-layered cultural and religious diversity, home to Jewish, Greek, Armenian, and Turkish communities. During the Byzantine Empire, the Karaite Jews first settled in Hasköy, followed by Sephardi and Ashkenazi Jews who relocated from Eminönü during the Ottoman period, particularly around the time the New Mosque was built. While Jewish heritage in Hasköy was once reflected in the street names, many of these names have been altered over time.

Today, the Karaite Synagogue and the Maleem Synagogue, both situated on Aziz Street near the Hasköy Seaport, stand as reminders of the area's historical Jewish presence. The Ottoman-era buildings of the Osmanlı Lengerhanesi and the Sirket-i Hayriye Tersanesi (Ottoman Anchor Casting Building and Shipyard of Sirket-i

Hayriye), which played a significant role in the Ottoman Navy, are also located along the Hasköy coastline. In 1991, these buildings were acquired and restored by the Koç Group and now house the Museum of Industrial History.

Directly across from the Museum, on Kırmızı Minare Street, lies the Kiremitçi Ahmet Mosque, built in 1591, known for its minaret made of red bricks. Further up the street, the Hacı Saban Mosque, constructed at an unknown date on Kalaycı Bahçe Road, is another prominent landmark. At the end of the green park stretching along the coast, near the shipyard wall, stands the Handan Aga Mosque, believed to date back to the 15th century.

Known for its tilework and wooden structure, this mosque is yet another example of the architectural beauty that Hasköy has to offer (Wikimedia Foundation, 2025). Figure 1 is a graphical map of Haskoy.

Figure 1
Haskoy

In the scope of the study, Haskoy district with its cosmopolitan structure as a result of the cultural accumulation is chosen to sort out the relations between the concepts of "identity and legibility," which form the backbone of the search for differences that affect the perception. From two different streets chosen in Haskoy, images from 4 different angles are obtained. For these images to bring out the liking preferences of the users, survey research is conducted using the Semantic Differential Scale, with the help of some bipolar adjectives. The data obtained from the surveys is analyzed with SPSS statistics software.

2.2. Participants

The participants of the survey are civil engineering students. A questionnaire was conducted with 90 students. Of those who participated, 46 were first-grade students, while 46 of them are third-grade students.

2.3. Material

For subjective evaluation, four different scenes from two different streets in the Haskoy area are selected. The streets are Tursucu Cesmesi Street for Scene 1 and Scene 2, Kalayci Bahce Street for Scene 3 and Scene 4 (Figure 3). Kalayci Bahce Street is located in the middle of the Haskoy area, and Tursucu Cesmesi Street is located on the

west side of the Haskoy area. The locations of the scenes and streets are shown in Figure 2. Figure 3 shows scenes and streets in the case study.

Figure 2

Locations of scenes and streets in the case study

Figure 3

Scenes and streets in the case study

2.4. Data collection instrument

The study used a questionnaire. Eight semantic variables representing several dimensions of architectural space are chosen to constitute a semantic differential scale. The operationalized versions of spatial dimensions are Unfamiliar-Familiar, Usual-Perplexing, Insincere-Sincere, and Ordinary-Impressive for identity dimensions; Complex-Simple, Distractor-Focuser, Irregular-Regular, and High-Low for legibility (Table 1). The participants are asked to rate their agreement with each couple of adjectives on a 5-point scale from -2 to +2. -2 represents the most negative opinion, and +2 represents the most positive one.

Table 1

Classification of the variables in the case study

Identity	Unfamiliar-Familiar, Usual-Perplexing Insincere-Sincere, Ordinary-Impressive
Legibility	Complex-Simple, Irregular-Regular Distractor-Focuser, High-Low

3. RESULTS

As a result of the descriptive statistical tests, Table 2 reveals mean values for the answers of eight adjective couples for each of the four street scenes. While 3rd grade students found the first image more complicated, 1st grade students found it more insincere and irregular. While 1st graders found the second image more insincere and complicated, 3rd graders found it sincere. While 1st graders found the third image more insincere and complicated, 3rd graders found it more unfamiliar and organized. 1st graders found the fourth image more ordinary.

Table 2

Mean values

Mean Values																
	1st Grade								3st Grade							
	Unfamiliar-Familiar	Usual-Perplexing	Insincere-Sincere	Ordinary-Impressive	Complex-Simple	Irregular-Regular	Distractor-Focuser	High-Low	Unfamiliar-Familiar	Usual-Perplexing	Insincere-Sincere	Ordinary-Impressive	Complex-Simple	Irregular-Regular	Distractor-Focuser	High-Low
Scene 1	-0,15	-0,93	-0,78	-0,97	-0,39	-1,02	-0,76	-0,67	-0,28	-0,69	-0,04	-0,54	-1,13	-0,23	-0,17	-0,02
Secene 2	0,43	-0,84	-0,15	-0,47	-0,23	-0,54	-0,41	-0,6	0,39	-0,6	0,84	-0,15	0,3	-0,39	-0,21	-0,19
Secene 3	0,04	-0,15	-0,1	-0,23	-0,06	-0,32	-0,26	0,39	-0,06	-0,02	0,06	-0,17	0,36	0,19	-0,08	0,45
Scene 4	-0,41	-0,45	-0,8	-1	-0,69	-0,73	-0,6	0,13	-0,28	-0,23	-0,19	-0,39	-0,45	-0,71	-0,56	0,1
														min. mean		
														max. mean		

4. DISCUSSION

The findings of this study provide valuable insights into how civil engineering students at different stages of their education perceive architectural identity and legibility in urban street scenes. By comparing first-year and third-year students, this research highlights the impact of academic progression on spatial perception. The results

suggest that the increased exposure to technical knowledge in later stages of study influences students' ability to analyze and interpret architectural environments more analytically.

First-year students, who are relatively new to the subject matter, exhibited a more intuitive and emotional response to the street scenes, often associating them with adjectives such as "insincere," "complicated," and "irregular." These students seemed to interpret the spaces in a more visceral and personal manner, which could be influenced by their limited exposure to architectural theories and concepts. In contrast, third-year students, with a more developed understanding of architectural design and its complexities, demonstrated a more systematic and structured response. They found certain aspects of the scenes to be more "organized," "sincere," and "familiar," reflecting a deeper engagement with spatial cues and an ability to process them in a more structured way.

The study's use of Hasköy, a culturally rich and historically layered neighborhood, as the case study area adds a layer of complexity to these findings. The area's diverse architectural heritage, with its mix of Ottoman, Jewish, and other cultural influences, offers a compelling context for examining how students from different educational backgrounds perceive space. It is clear from the data that students' educational progression shapes their ability to decode the cultural and architectural identity of a space, highlighting the importance of incorporating spatial awareness and architectural perception into civil engineering curricula.

Ultimately, these findings underscore the importance of integrating architectural and urban design principles into non-design disciplines like civil engineering. As future engineers, students' ability to understand and interpret the environments they will help shape is crucial for creating more inclusive and legible urban spaces. Further research could expand on these findings by exploring the effects of interdisciplinary pedagogical approaches that foster spatial awareness across different fields of study.

Spatial perception of first-year and third-year engineering students has been studied in this paper. Their perceptions were tested by SPSS tests. Many different factors cause the spatial perception to differ from individual to individual. Among these come gender, age, educational level, and it's proven by a wide range of research that different life experiences cause individuals to react in different ways. Accordingly, the findings of our study conducted with the 1st and 3rd grade students of civil engineering show that while 1st grade students approach the environment more abstractly and positively, the 3rd grade students' approach to the environment appears to be more concrete. These differences show us that the critical point of view, in other words, the abstraction in the environmental perspectives disappears, and the concrete approach becomes more visible as the level of education rises. It shows that the environmental perception evolves and differentiates with the experience that comes out of the relation established with time and texture; in other words, as the experience towards the environment increases, a time-dependent change in the perception of the individuals occurs.

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Ethical Approval: The study adheres to the ethical guidelines for conducting research.

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