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Article

Perceptual evaluation of street geometry by different groups based on pedestrian preferences

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ABSTRACT

Generally, there is a positive relationship between the walking routes' attractive physical features and pedestrians' preferences for walking. Individuals' preferences that emerge as a result of the perceptual evaluation and cognitive processes are affected by individual characteristics as well as the environment's physical features. In recent years, in cities formed by rational designers, functionality has been emphasised, and users' perceptions have been ignored. This study aimed to examine the differences between perceptions and preferences of different expertise and educational groups and emphasise that the user's perceptions should be considered besides the experts' opinions who define the formal qualities of the space in urban design projects. One of the most important walking route's physical features is its form and geometry, and it is effective on individuals' perceptual evaluations and preferences. In this study, keeping the other factors affecting perception constant, preferences regarding street forms – Straight or Curved – were investigated with two different groups, 72 participants who were educated in the urban design field and 87 participants who were not educated in this field. Five street views consisting of straight and curved street options were shown to the participants, and they were asked to determine their preferred option with reason. As a result of comparing the data obtained from the responses of two groups, while the participants who received urban design education mainly preferred streets with straight geometry, the other group preferred curved streets. In the study, two concepts were greatly emphasised for reasons of preferences: Order and Mystery. While the participants who were educated in the urban design field explained the reason for preferring the street with the Order descriptive mainly, other participants mostly used the Mystery descriptive as a reason for preference..

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INTRODUCTION

The primary purpose of urban design projects is to increase the satisfaction and quality of urban life. The content that forms the scope of these projects is the works on the shaping of the environment. Therefore, it is essential to know which urban form people prefer and what makes them feel more comfortable. The answers to these questions have always

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attracted the attention of researchers, and some studies have been carried out on these subjects (Bornstein & Berlyne, 1975; Gifford, 2007; Herzog, 1992; Herzog & Kropscott, 2004; R. Kaplan & S. Kaplan, 1989; Kaplan et al., 1998; Lozano, 1988; Nasar & Cubukcu, 2011). As a critical component of the urban space, the street is an area that people often use in their daily lives. In this context, knowing which street the pedestrians prefer for walking is essential to creating successful urban environments. The street design may have a metric dimension, but the shape and geometry of streets affect our perception and behaviour in space (D'Acci, 2019; Nasar & Cubukcu, 2011; Zacharias, 2001b). In recent years, especially design projects that develop within the framework of modernity projects are usually carried out by experts, and the perceptions and preferences of pedestrians and users are ignored. In this study, the following hypothesis has been developed: While the decisions of experts in the field of urban design are made on more rational and functional criteria, the users' preferences are more sensory. For this purpose, the individuals' preferences of street form – straight or curved – were examined over two groups. Group #1 consisted of 72 participants who received urban design education, and Group #2 consisted of 87 participants who did not receive urban design education. Five street views consisting of A (Straight Street) and B (Curved Street) options were shown to both groups, and they were requested to explain their preferred street form with the reasons. As a result, it has been determined that aesthetic perception is important in the preferences of the users regarding the street views, and the preference criteria of the two groups have changed.

PERCEPTIONS AND AESTHETIC RESPONSE

Three variables define space: the physical components, social activities, and perceptual qualities (Canter, 1977; Relph, 1976). At the same time, the perceptual quality of the space is affected by the physical, functional, and social parameters in the space (Manzo, 2005; Van der Klis & Karsten, 2009). Lefebvre (1991) classified space as perceived, lived, and conceived spaces: Perceived space can be understood using sense organs (Lefebvre, 1991). The first step in that we interact with the space is through perception. Humans consist of three basic systems: metabolic, perceptual, and musculoskeletal. Human static and dynamic anthropometric dimensions and perception systems are essential in interacting with the environment (Fitch & Bobenhausen, 1999: 185). During the perception process, signals received from the environment are evaluated through the senses and made meaningful throughout the cognitive process. Thus, there is a complex relationship between human perceptual structure and environmental variables. The perception emerges from the relationship between the environmental features and the mental patterns of individuals (Lynch, 1990), and they perceive the environment with their value judgments, beliefs, and cultures (Gieryn, 2000; Gustafson, 2001; Rapoport, 1990). According to Gibson's research (2014), perception occurs on two different levels: "Literal perception" and "Schematic perception". Objective factors dominate the literal perception level, and subjective factors dominate the schematic perception level (Gibson, 2014: 97). Thus, in the perception process, environmental stimulants of the space and personal characteristics of the individual play determining roles (Goldstein, 2009; S. Kaplan, 1987; Nasar, 2008). According to Rapoport's (1990) perception model, perception is first shaped within the framework of social values and then personal values. The perception created through external and environmental factors is fixed and universal, but perception can change and personalise depending on the individual's thoughts and characteristics (Rapoport, 1990). Figure 1 describes the perceptual process

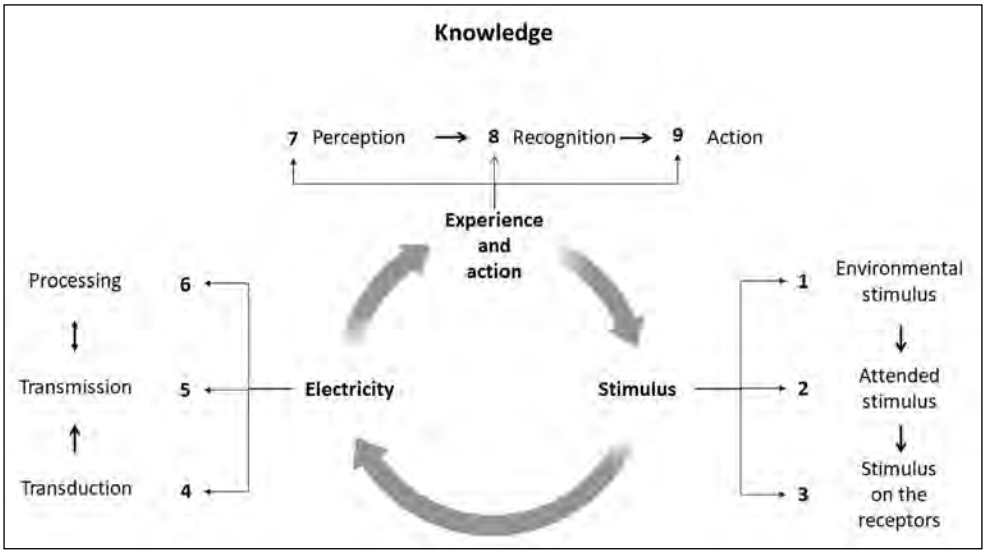


Figure 1. Goldstein's perceptual process (Goldstein, 2009: 6).

of Goldstein (2009). The steps in this process are arranged in a circle to emphasise that the process is dynamic and continually changing (Goldstein, 2009).

As seen in Figure 1, the "Environmental stimulus" is all of the events for which we notice or do not when perception occurs. The "Attended stimulus" is what we notice in the perception process. The "Stimulus on the receptors" is the transmission of the image – we create in our minds – to the brain through a series of neural processes and takes it to the perception process that begins in the brain. "Transduction" occurs in the nervous system when the environment's energy, such as light energy, mechanical pressure, or chemical energy, is transformed into electrical energy. Eventually, in the "Transmission" step, these signals are transmitted to the brain. Perception occurs as a result of the phase called "Neural processing". "Neural processing" transforms stimulus into things that we are aware of perceiving, recognising, and acting on objects in the environment. Finally, the perceptual process is completed. The "Recognition", "Knowledge", and "Action" sections of the process vary personally. In this relationship, we either use our past experiences or rebuild them. Perception varies in the context of the individual's own life and experiences. Sensory data of the environment and preliminary information stored in the mind combine, so the perception process begins (Goldstein, 2009). Weiten (2007) defines the process of perception as a two-way process: Bottom-Up process and Top-Down process (Weiten, 2007). Figure 2 explains this process.

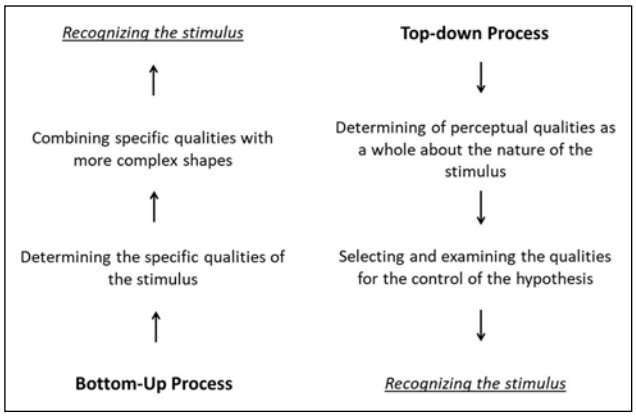


Figure 2. Weiten's bidirectional perceptual process (Weiten, 2007).

According to Weiten's bidirectional perceptual process, in the Bottom-Up process, the specific qualities of the stimulus are evaluated. However, the individual's thoughts about the stimulus are included in the Top-Down process. Like Weiten's bidirectional perceptual process, according to Goldstein's Moth image theory, the moth imagery that the person sees first starts in the Bottom-Up process (Figure 3).

At first view, various unique qualities of the moth, such as colour and size, begin to be determined in mind. Then, the Top-Down process starts with the previous information in the person's mind about the moth. Thus, as a result of these relationships, the process of perceiving and recognising the moth occurs. In this example, (a) the image of the moth on the person's retina initiates bottom-up processing, and (b) her prior knowledge of moths contributes to top-down processing (Goldstein, 2009). So, everyone interprets the environment according to his/her background (Pallasmaa, 2012). Personal characteristics such as age, gender, experience, education, culture, and familiarity affect the cognitive process (Evans, 1980; Nasar, 2011; Russell, 1992). Considering the environmental perception scheme of Nasar (2011), "Aesthetic response" occurs as a result of the

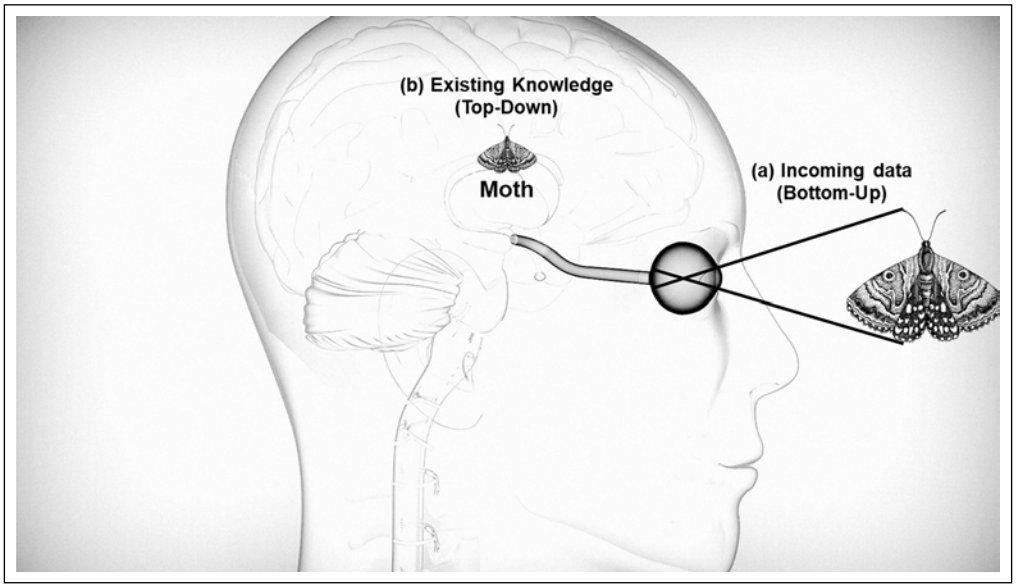


Figure 3. Goldstein's Moth image (Goldstein, 2009: 10).

perception and cognitive evaluation that happens under the environmental features and personal characteristics. Figure 4 illustrates Nasar's environmental perception scheme.

According to Figure 4, sense organs are the means of perception. However, choosing the senses that come in, neglecting or strengthening some of them, and interpreting and judging occur in the cognition evaluation process. A person interprets the stimuli coming from the environment with the information available in his mind and turns the reactions into behaviour such as aesthetic response. Thus, attitudes and behaviours such as liking, preferring, and belonging are shaped (Nasar, 2011). Our pleasures and preferences for space are perceptual. These pleasures and preferences are related to how the eye and consciousness interpret visual data in space. Consciousness tries to place the information given to it in a meaningful template. When the incoming data is meaningless, consciousness cannot recognise it. Therefore, what we perceive is based on what we already know (Leland & Clark, 2014). As a result, people's scientific backgrounds affect their preferences.

Aesthetic Perception

Environmental aesthetic, defined as the perceived quality of the environment, is an essential component of environmental quality. Aesthetic evaluation of the environment affects the individual's preferences and behaviours; also, it has an inclusive characteristic since it is examined at different scales (Nasar, 2008). Some studies have been conducted to determine the factors affecting aesthetic perception. Berlyne (1970) defined the model of aesthetic perception in terms of components such as complexity, novelty, surprise, and so on (Berlyne, 1970: 284). Kaplan & Kaplan (1989) explained the preference matrix over four components: coherence, legibility, complexity, and mystery (R. Kaplan & S. Kaplan, 1989). This theory is based on the hypothesis that humans have two basic needs about the environment: perception and cognition. Coherence and legibility occur at the perceptual level, while complexity and mystery appear at the cognitive level. The sense of exploring the space greatly affects the preferences of individuals at the cognitive level. Another researcher investigating the importance of mystery in the preference of space was Kent. According to Kent's (1989) research, it was determined that there is a positive relationship between mystery and preference in the built environment in shopping centres (Kent, 1989). Another study revealing the positive relationship between mystery and preference in space was carried out by Herzog and Kropsvott (Herzog & Kropscott, 2004). Also, in the study by Gifford (2007), it was claimed that people are more likely to prefer mysterious environments (Gifford, 2007). In the aesthetic evaluation of the space, while a sense of certainty and predictability is dominant at the perceptual level, there is a desire to explore and uncertainty at the cognitive level.

Form and Geometric Perception

All visual and physical features have the potential to be perceived and evaluated aesthetically, and therefore, they affect preferences (Jennatha & Nidhish, 2016). In naturalistic environments, the experience of objects is not separate from the formation of the base "Gestalt" of perception geometry. According to Gestalt psychology theory, perceptual organisation principles help the process of comprehending and understanding the space, and in this context, shape and form are important factors in perceptual and cognitive evaluation (Bower & Hilgard, 1981). Form, an effective design element in recognising and separating objects, has an important role in the perceptual process. According to the perceptual process, recognising objects is critical for our survival and functionality. We learn the

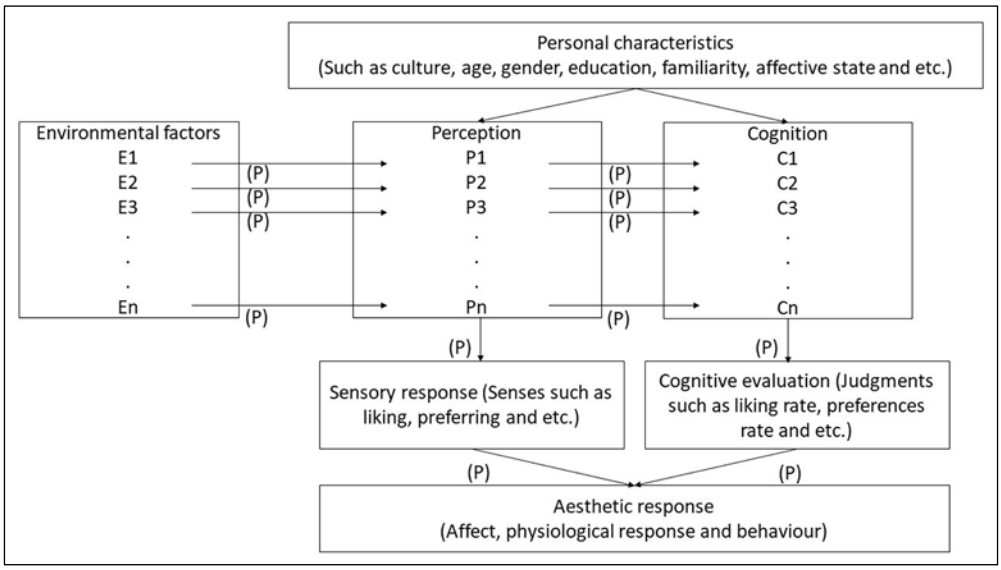


Figure 4. Environmental perception scheme (Nasar, 2011).

qualities of objects, predict their position, and distinguish them from one another through our interactions and experiences. We know, for example, that solid objects have a fixed volume and that the "surfaces" that separate them keep their apparent shape and form. Using a combination of senses, we can learn about the qualities of objects. As a result, our ability to distinguish various surface components is crucial to our visual perception of our environment (Assadi, 2001). The relationship between geometry and visual perception is crucial and fundamental. The basic objects of both are forms, surfaces, and lines. Both are concerned with the characterisation and measurement of these elements as well as their relationships. Therefore, geometry appears to be important in understanding how information is processed and represented in the visual system (Öğmen & Herzog, 2010). According to Salingaros (2005), geometric forms and combinations are effective in the perception process and three actions occur during spatial perception: "Combining space's elements to create a novel configuration", "Experimenting with every feasible geometric configuration", "Selecting the most reasonable and comprehensible configuration" Salingaros (2005). Salingaros (2005) evaluates spatial forms in two different titles as geometric (Figure 5).

The interaction of curved forms with their surroundings is at maximum level, and the visual connections of the elements designed with curved lines with other spatial elements are strong. In today's modern designs, the use of simple, straight, and regular lines weakens the relationship between humans and space and reduces the perceptibility of the space (Salingaros, 2005). While curved forms in designs make it easier to perceive (Krier, 1984), straight and sharp forms are more difficult to perceive (Devaney & Gleick, 1989). Instead of straight and sharp lines, natural forms and organic shapes with curves are more appropriate forms for individuals' perceptual and cognitive actions.

Aesthetic Perception of Street Shape

Roads, streets, and paths are essential representation spaces, movement channels, and socialisation centres in our environment. In this context, people should be able to use these walkways as pedestrians with comfort, peace, and pleasure. The existence of safety, linkage, well-designed, and comfortable pedestrian routes that all individuals in urban spaces can use increases the quality of urban life and provides the opportunity to benefit from public spaces equally. Today, walking in urban spaces

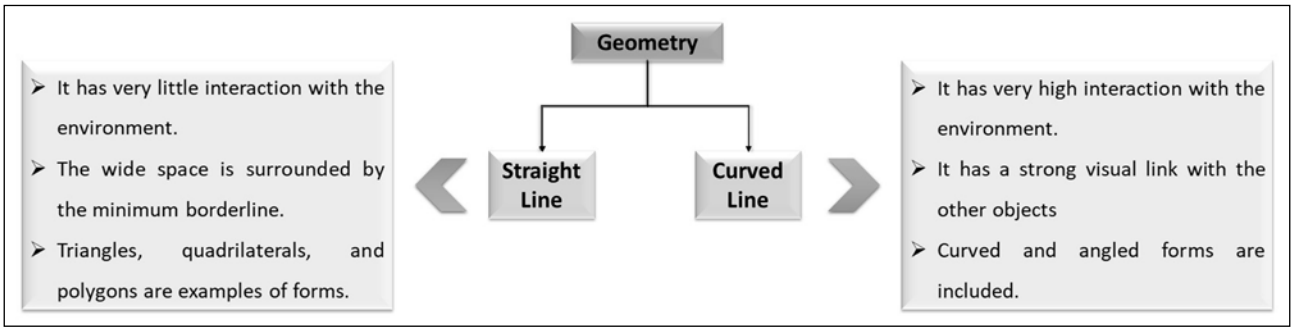


Figure 5. Geometry (Salingaros, 2005).

Table 1. Earlier studies

The result of the study	Researcher
Studies that prove the positive effect of the environment's visual characteristics on pedestrians' preferences for walking	(Agrawal et al., 2008; Ball et al., 2001; Ferrer et al., 2015; Giles-Corti et al., 2005; Giles-Corti & Donovan, 2002; Heesch et al., 2014; Hodgson et al., 2004; Hoehner et al., 2005; Inoue et al., 2010; King et al., 2000; Li et al., 2009; McCormack et al., 2004; Owen et al., 2004; Shigematsu et al., 2009; Van Dyck et al., 2013)
Studies that prove the positive effect of the street's curved geometry and the sense of mystery on pedestrians' preferences for walking	(D'Acci, 2019; Nasar & Cubukcu, 2011; Zacharias, 2001a)
Studies revealing the views of individuals who prefer straight streets for walking due to the perception of continuity and visibility	(Dalton, 2003)
Studies that prove there isn't a significant relationship between environmental factors and pedestrians' preferences for walking	(Owen et al., 2007; Van Cauwenberg et al., 2012)
Studies that prove the negative effect of straight streets' long lines of sight on pedestrians' preferences for walking	(Ewing & Handy, 2009)

developing due to rapid population growth has become a vital component of the pedestrian transportation system. Also, it has been an action that meets daily recreational and physical activity needs (Unal Cilek, 2020). According to Southworth (2005), walkways should provide easy access to their surroundings, be safe and comfortable, appeal to everyone, be exciting and aesthetic with their designs, offer strong visual connections, contain diversity and mystery, and have qualities that support walking (Southworth, 2005). According to some studies, there is a relationship between the environmental characteristics of streets and walkability. People generally prefer to walk along the paths they find aesthetically attractive. Table 1 gives the results of some studies examining the relationship between the physical characteristics of urban recreation areas and users' perceptual evaluation and preferences.

According to several studies, it was claimed that there is a positive relationship between the physical qualities of the walkways and the pedestrians' preferences for walking. The visual features of the environment significantly affect the aesthetic judgment of the space, and an important factor among these features is form and geometry undoubtedly (D'Acci, 2019; Nasar & Cubukcu, 2011; Zacharias, 2001a). According to Salingaros (1997), boundaries of space are abstracted by geometric shapes. Curved lines visually connect with their surroundings at the maximum level compared to straight lines, and also, spaces designed with curved lines establish a strong connection with the user (Salingaros, 1997). Figure 6 shows examples of straight and curved streets.

METHODOLOGY

This study examines the perceptibility and preference level of straight and curved streets with different geometries and forms by different educational groups. Thus, an experimental study was conducted with two groups, those educated and not educated in the urban design field, and their preferred street form – straight or curved – was questioned. In the study, five hypothetical street views that are different in physical features were used, and the participants were asked to indicate the street (Straight or Curved) they preferred with reason. The reason for using street views with different physical features was to examine the consistency of the results obtained and whether the same result was obtained in all street views.

Participants

Table 2 shows the characteristics of the two groups. Since some personal characteristics influence perceptual

Figure 6. Examples of straight and curved streets.

Table 2. Characteristics of two groups

	N	Gender	Age	Education	Cultural Status
Group #1	72	Male: 44.44% Female: 55.56%	Min.: 20 Max.: 25 Ave.: 23.17	Urban design	Students who are similar in characteristics such as religion, language, ethnicity, and culture
Group #2	87	Male: 52.87% Female: 47.13%	Min.: 20 Max.: 25 Ave.: 22.92	Non-fields related to urban design	

N: Subject number; %: Percentage.

evaluation and preferences, other characteristics of groups were kept the same except for the education field.

As seen in Table 2, Group #1 consists of 72, and Group #2 consists of 87 participants. The ages of the participants in both groups ranged from 20 to 25. Age is one of the most important factors affecting the cognitive process. That's why the age range was limited. The average age of Group #1 is 23.17 and gender distribution is 44.44% male (n=32) and 55.56% female (n=40). The average age of Group #2 is 22.92 and gender distribution is 52.87% male (n=46) and 47.13% female (n=41).

Perceptual Assessment

At this stage, the street preferences of the two groups were examined through street views with an experimental evaluation. Hypothetical street images with greatly varying physical features were used. Street views vary in enclosure ratio, visual diversity, landscape density, and architectural style. It is assumed that evaluating different street views will result in more consistent data. Street views were edited based on hypothetical street images. Street images were straight streets and then curved with the help of the Adobe Photoshop CS5.1 program. Thus, street views consisting of A (Straight) and B (Curved) options that are similar in other features apart from geometry were obtained. Street views are shown in Figures 7–11.

Five street views were shown to both groups via the computer, and the street option they preferred for walking

Figure 7. First street view.

Figure 8. Second street view.

Figure 9. Third street view.

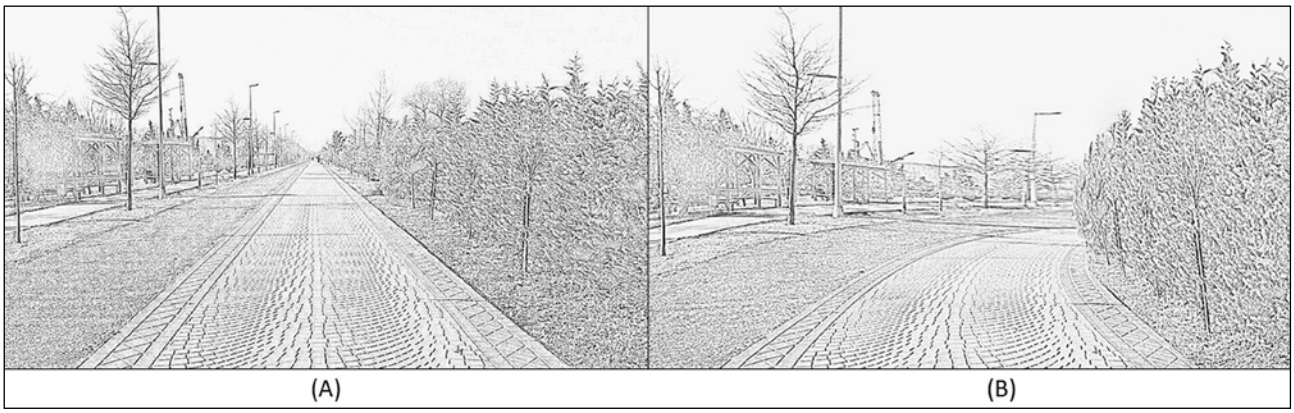


Figure 10. Fourth street view.

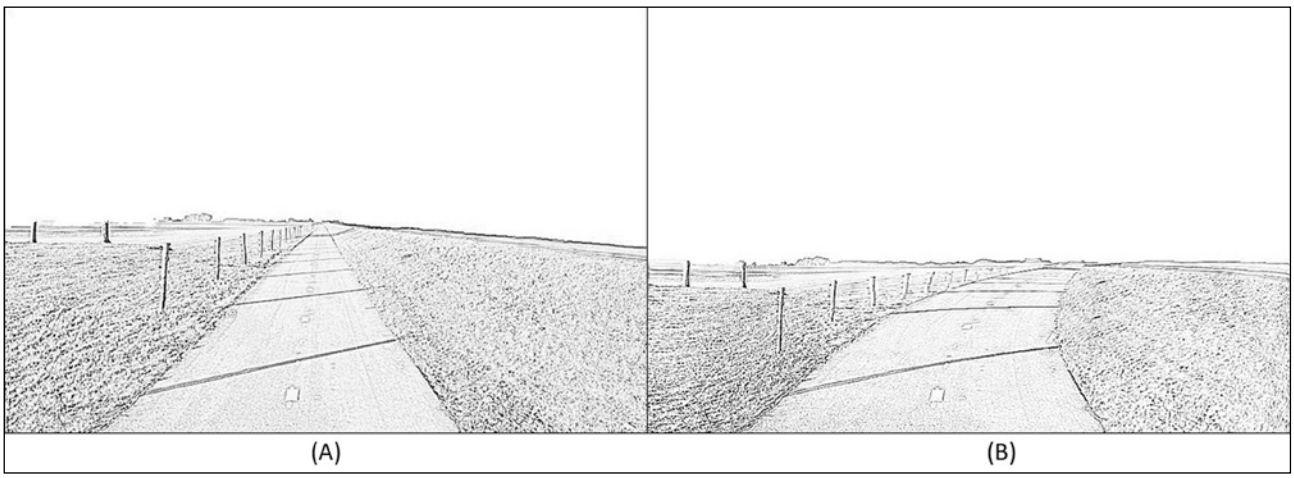


Figure 11. Fifth street view.

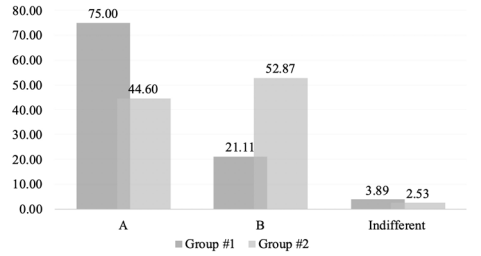
was questioned over three options (A, B, Indifferent). Also, participants were asked to explain why they preferred the selected street option with a single word. They were asked to choose among the descriptive words given in a list or write their descriptive words for explaining why they preferred the street. The given descriptive words were; Diversity, Legibility, Linkage, Enclosure, Coherence, Transparency, Human Scale, Openness, Identifiability, Continuity, Imageability, Visibility, Rhythm, Order, Symmetry, Vividness, Intimacy, Pleasurable, Shortness, Safety, Exciting, Mystery, Naturality, Comfort, Clarity. These words are in the scope of street design principles defined by various researchers with different priorities, which emerged as a result of the literature research in this study (Refer to Table 1).

RESULTS

After the necessary statistical analyses were made, the data obtained were summarised and described. Firstly, the responses given by Group #1 and Group #2 were examined

Table 3. The preferences made by Group #1 and Group #2

	A		B		Indifferent		Total		Graph
	N	%	N	%	N	%	N	%	
Group #1	270	75.00	76	21.11	14	3.89	360	100	
Group #2	194	44.60	230	52.87	11	2.53	435	100	



N: Subject number; %: Percentage.

collectively, and then a detailed analysis was made of each street view. Table 3 illustrates the preferences made by both groups.

As seen in Table 3, Group #1 preferred the A option with a 75.00% ratio for all street views and the B option with a 21.11% rate. Also, the responses given by Group #1 as the indifferent option were a 3.89% ratio. In Group #2, the A option was preferred with a 44.60% ratio and the B option with a 52.87% ratio for all street views. The responses given as the indifferent option were a 2.53% ratio. Figure 12 shows the responses to the question 'Why did you prefer?'

As seen in Figure 12, in the top three, Group #1 explained their preferred street views with Order, Continuity, and Visibility description with a 47.69% ratio. Whereas the top three rankings of Group #2 were Mystery, Exciting, and Pleasurable, with a 43.16% ratio. Table 4 shows the preferences of both groups for each street view.

First street view: While the straight street option was preferred by Group #1 with a 91.7% ratio, it was preferred by Group #2 with a 58.6% ratio. Group #1 preferred the curved street option with an 8.3% ratio, and Group #2 preferred that with a 37.9% ratio.

Second street view: Group #1 preferred the straight street option with a 90.3% ratio, and Group #2 preferred that with a 52.9% ratio. While the curved street option was preferred by Group #1 with a 9.7% ratio, it was preferred by Group #2 with a 44.8% ratio.

Third street view: While the straight street option was preferred by Group #1 with a 66.7% ratio, it was preferred by Group #2 with a 40.2% ratio. Group #1 preferred the curved street option with a 22.2% ratio, and Group #2 preferred that with a 57.5% ratio.

Fourth street view: While the straight street option was preferred by Group #1 with a 79.2% ratio, it was preferred by Group #2 with a 50.6% ratio. Group #1 preferred the curved street option with a 16.7% ratio, and Group #2 preferred that with a 49.4% ratio.

Fifth street view: Group #1 preferred the straight street option with a 47.2% ratio, and Group #2 preferred that with a 20.7% ratio. While the curved street option was preferred by Group #1 with a 48.6% ratio, it was preferred by Group #2 with a 74.7% ratio.

Generally, in all street views, the A option was preferred more by Group #1 than Group #2. Whereas the B Option was chosen more by Group #2 than Group #1. However, another result obtained is that as the spatial elements

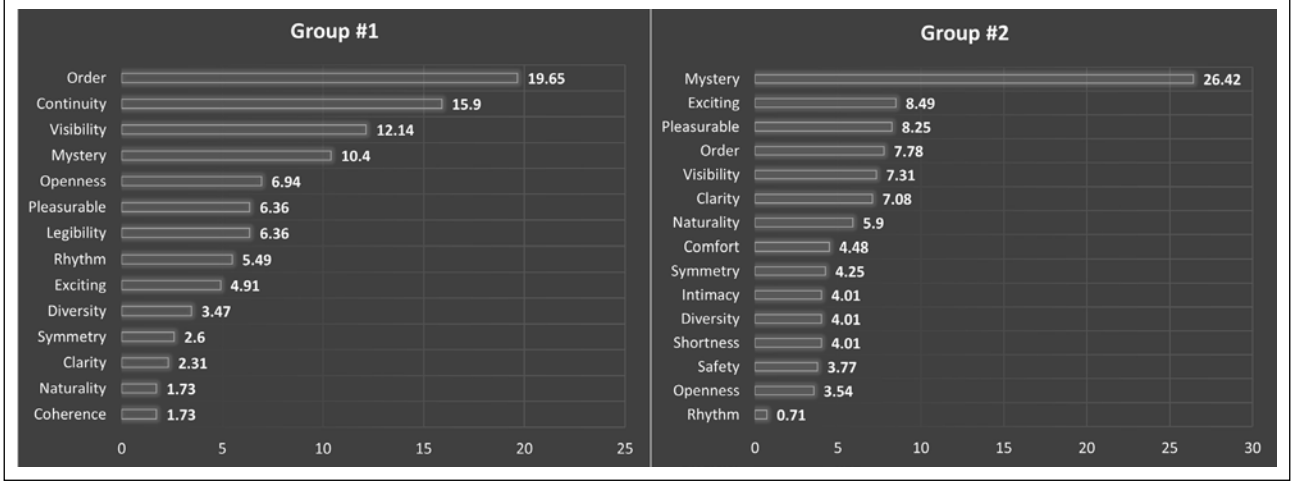
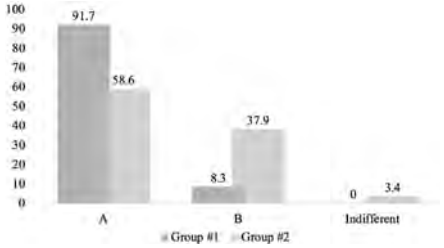


Figure 12. Distribution of descriptive words.

Table 4. Preferences for each street view

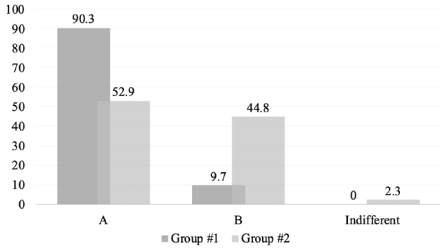
First Street View

	Group #1		Group #2		Graph
	N	%	N	%	
A	66	91.7	51	58.6	
B	6	8.3	33	37.9	
Indifferent	0	0.00	3	3.4	
Total	72	100.00	87	100.00	



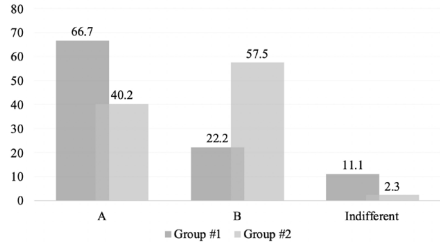
Second Street View

	Group #1		Group #2		Graph
	N	%	N	%	
A	65	90.3	46	52.9	
B	7	9.7	39	44.8	
Indifferent	0	0.00	2	2.3	
Total	72	100.00	87	100	



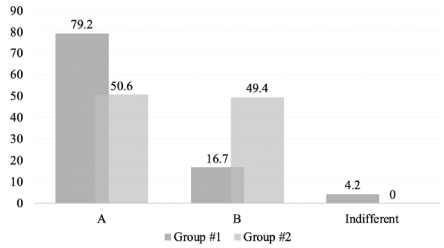
Third Street View

	Group #1		Group #2		Graph
	N	%	N	%	
A	48	66.7	35	40.2	
B	16	22.2	50	57.5	
Indifferent	8	11.1	2	2.3	
Total	72	100	87	100	



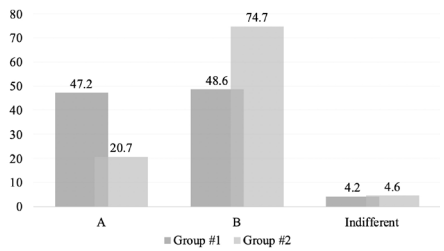
Fourth Street View

	Group #1		Group #2		Graph
	N	%	N	%	
A	57	79.2	44	50.6	
B	12	16.7	43	49.4	
Indifferent	3	4.2	0	0	
Total	72	100	87	100	



Fifth Street View

	Group #1		Group #2		Graph
	N	%	N	%	
A	34	47.2	18	20.7	
B	35	48.6	65	74.7	
Indifferent	3	4.2	4	4.6	
Total	72	100	87	100	



N: Subject number; %: Percentage.

Table 5. Descriptive words for each street view

First Street View											
	Group #1						Group #2				
	A			B			A			B	
Description	N	%	Description	N	%	Description	N	%	Description	N	%
Order	24	36.36	Mystery	4	66.7	Order	14	27.5	Mystery	17	51.5
Continuity	12	18.18	Exciting	2	33.3	Diversity	9	17.6	Exciting	7	21.2
Visibility	10	15.15	Total	6	100.0	Comfort	8	15.7	Intimacy	3	9.1
Diversity	9	13.64				Visibility	8	15.7	Pleasurable	3	9.1
Legibility	8	12.12				Clarity	7	13.7	Safety	3	9.1
Coherence	3	4.55				Symmetry	3	5.9	Total	33	100.0
Total	66	100.00				Pleasurable	2	3.9			
						Total	51	100.0			
Second Street View											
	Group #1						Group #2				
	A			B			A			B	
Description	N	%	Description	N	%	Description	N	%	Description	N	%
Order	22	33.8	Mystery	3	42.9	Order	11	23.9	Mystery	20	51.3
Continuity	11	16.9	Exciting	2	28.6	Diversity	8	17.4	Exciting	5	12.8
Legibility	10	15.4	Diversity	1	14.3	Comfort	7	15.2	Intimacy	5	12.8
Visibility	10	15.4	Pleasurable	1	14.3	Visibility	6	13.0	Pleasurable	4	10.3
Rhythm	7	10.8	Total	7	100.0	Clarity	5	10.9	Safety	3	7.7
Coherence	3	4.6				Pleasurable	3	6.5	Clarity	1	2.6
Diversity	2	3.1				Rhythm	3	6.5	Exciting	1	2.6
Total	65	100.0				Symmetry	3	6.5	Total	39	100.0
						Total	46	100.0			
Third Street View											
	Group #1						Group #2				
	A			B			A			B	
Description	N	%	Description	N	%	Description	N	%	Description	N	%
Openness	19	39.6	Mystery	8	50.0	Openness	11	31.4	Mystery	18	36.0
Order	11	22.9	Pleasurable	5	31.3	Naturality	8	22.9	Exciting	8	16.0
Symmetry	9	18.8	Exciting	3	18.8	Symmetry	6	17.1	Pleasurable	7	14.0
Visibility	5	10.4	Total	16	100.0	Clarity	5	14.3	Safety	6	12.0
Legibility	4	8.3				Visibility	5	14.3	Intimacy	5	10.0
Total	48	100.0				Total	35	100.0	Shortness	4	8.0
									Naturality	2	4.0
									Total	50	100.0
Fourth Street View											
	Group #1						Group #2				
	A			B			A			B	
Description	N	%	Description	N	%	Description	N	%	Description	N	%
Continuity	21	36.8	Mystery	6	50.0	Naturality	11	25.0	Mystery	22	51.2
Order	11	19.3	Exciting	3	25.0	Clarity	10	22.7	Pleasurable	9	20.9
Visibility	11	19.3	Pleasurable	3	25.0	Order	8	18.2	Exciting	8	18.6
Clarity	8	14.0	Total	12	100.0	Symmetry	6	13.6	Shortness	4	9.3
Naturality	6	10.5				Visibility	5	11.4	Total	43	100.0
Total	57	100.0				Comfort	4	9.1			
						Total	44	100.0			
Fifth Street View											
	Group #1						Group #2				
	A			B			A			B	
Description	N	%	Definition	N	%	Description	N	%	Definition	N	%
Rhythm	12	35.3	Mystery	15	42.9	Visibility	7	38.9	Mystery	34	52.3
Continuity	11	32.4	Pleasurable	13	37.1	Naturality	4	22.2	Shortness	9	13.8
Visibility	6	17.6	Exciting	7	20.0	Openness	4	22.2	Exciting	7	10.8
Openness	5	14.7	Total	35	100.0	Clarity	3	16.7	Pleasurable	7	10.8
Total	34	100.0				Total	18	100.0	Intimacy	4	6.2
									Safety	4	6.2
									Total	65	100.0

N: Subject number; %: Percentage.

and diversity in the streets decrease, the probability of preference, which is described by the sense of mystery, increases. Table 5 shows the responses to the question 'Why did you prefer?' for each street view.

According to Table 5, in the first street view, both groups explained the reason for preferring the A option as "Order" and the B option as "Mystery" in the first rank. In the second street view, the descriptions of both groups in the first rank were the same as in the first street view. In the third street view, both groups described the reason for preferring the A option as "Openness" and the B option as "Mystery" in the first rank. In the fourth street view, while Group #1's preference for the A option was "Continuity" in the first rank, the description of preference made by Group #2 for this option was "Naturality" in the first rank. However, both groups preferred the B option by the description of "Mystery" in the first rank. In the fifth street view, while Group #1 explained the reason for choosing the A option mainly as "Rhythm" and "Continuity", Group #2 explained why they preferred this option mainly as "Visibility". However, the reason for preferring the B option in both groups was mainly defined as "Mystery".

DISCUSSION

The perception is based on receiving, transforming, storing, and using sensory data. Biologically, perception includes the same processes for all people, but individual characteristics and the physical characteristics of the environment create diversity in the perception formed in the mind (Downs & Stea, 2005; Rapoport, 1977). As an individual feature, the differentiation of the educational field causes a change in perception and, as a result, the diversification of preferences among individuals. In recent years, the physical features of the urban spaces have been shaped by experts on functionality, and the aesthetic perceptions and preferences of the users have been ignored. Especially in the design of streets, which are an important urban public space, some objective criteria are determined, and the perceptual and subjective evaluations of individuals are ignored by not taking into account the walkability principle (Nasir et al., 2014). In this context, understanding pedestrian preferences in street forms is beneficial for urban design projects to provide perceptually more pleasant walking opportunities. The Babylonians and Egyptians built straight roads that intersected at right angles to form regular and repeating blocks of land in the planning of cities. According to the belief of Hippodamos, known as the first city planner, the grid form represents the logic of civilisation as a cultural symbol (Fainstein & Campbell, 2016:85). Today, grid designs have become a modernisation tool, and rational city planners and designers have generally ignored the concept of aesthetics (Porteous, 1996). According to the results of some studies done in recent years, individuals consider curved streets to be more mysterious than straight ones (D'Acci, 2019), and the sense of mystery positively affects the preferences of individuals (R. Kaplan & S. Kaplan, 1989; Nasar & Cubukcu, 2011). In this study, street geometry was evaluated within the scope of participants' educational field, based on their preferences (straight or curved). In the study, all other variables except the geometry of the street were kept constant. Thus, the factors affecting the preferences were eliminated, and the results' consistency was validated. Undoubtedly, the preferences made by the two groups were entirely influenced by the geometry of the street. According to the results obtained, the participants educated in the urban design field mostly preferred the straight street (75.00%). In contrast, the participants not educated in this field mostly preferred the curved street (52.87%). Also, Group #1 used more rational adjectives such as Order, Continuity, and Visibility as a reason for preferring streets. Whereas the reasons why Group #2 preferred streets have been mainly sensory adjectives such as Mystery, Exciting and Pleasurable. In this study, it has been proven that the educational field of individuals significantly affects their preferences and perceptual evaluations. However, in a similar study conducted by Nasar and Çubukçu (2011), the importance of the mystery's perception regarding the preferences of curved and straight streets was examined with City and Regional Planning students in Turkey and the United States. Despite the possible differences between the environmental experiences and cultures of the two groups, their preferences for the curved street were positively associated with the perception of mystery. Obtaining similar results was interpreted as due to the similarities in educational experiences (Nasar & Cubukcu, 2011). As a result, it should be noted that since many environmental and individual factors are effective in the perceptual and cognitive process, it is impossible to generalise the results obtained and requires deeper investigations.

CONCLUSIONS

In this study, it was questioned how experts and non-experts perceived the street form and geometry. It was examined which street form – straight or curved – these two groups preferred. According to the results obtained, while the urban designers preferred the straight streets with a rate of 75%, the participants from different disciplines mainly preferred the curved streets with 52.87%. Also, two important concepts were emphasised in street preferences: Order and Mystery. While Order was mainly stated as the reason for preference by the designers, Mystery was mainly stated as the reason for preference by individuals from different disciplines. These are two important dimensions that make the environment desirable: Order is related to "whether an individual can make sense of the environment" and Mystery is related to "whether an individual can engage

in the environment through exploration." Order is about the certainty and easy perceptuality of the space, while Mystery is about the uncertainty and variability of the space. Both dimensions should be sufficiently considered in urban design projects. Since the aim of the study is only to investigate the effect of street geometry on preference, the effect of parameters such as street enclosure ratio, degree of obstruction, limiting surface features (building types, façade qualities, permeable/impermeable surfaces, etc.) that affect the perception of form were out of the scope of the study. One of the other most important limitations of this study is that it was not examined in a real environment but in a virtual environment through imaginary street views. In cases where the subjective assessment will occur in real environments, it can be assumed that different and more accurate results will be obtained. In addition, individuals' different psychological states and travel purposes affect their perceptual and cognitive processes differently. In order to obtain a more comprehensive result, it is recommended to consider these factors in future studies. When the results obtained in this study and the results of other studies are examined, it is thought that it is difficult to generalise about the straight or curved street perception. However, as a final result, it can be said that geometric and form perception is very important in urban design education, and it can be suggested to develop an educational framework that includes deeper information on the geometric perception of design during the education period.

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