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The using of urban park as perceived by visually impaired

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Abstract

Visually impaired individuals deserve a comfortable outdoor experience. They need to perceive the space in the urban outdoors and act independently in the urban environment. These individuals have multi-sensory perceptual abilities in understanding the formal criteria in accessing and using urban spaces. Subsequently, it is essential to discuss these multiple sensory perceptions within the design and planning of the public spaces. This study aims to understand the sensory references of visually impaired individuals and their perception of landscape and space while they use urban parks. In this context, the focus is on how these individuals take their positions, develop orientations, coordinate movements, and behaviors based on the tactile, auditory, olfactory, and gustatory clues they receive from the environment. For this purpose, we conducted semi-structured one-onone interviews with 22 visually impaired individuals. As a result of in-depth interviews, we understood visually impaired individuals' sensory references and their independent mobility in the urban environment. While each individual's sensory references vary, sometimes different references are collected in one sense, and sometimes a reference was perceived by more than one sense. Developing sensory references in the urban landscape design is useful in providing comfortable space usage for the visually impaired and all other users.

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Universal design, Visually impaired, Sensory perception, Sensory references, Sensory perception of a landscape.

Visually impaired individuals are a significant reference group for universal design. The universal design promotes a sound design approach to meet potential user groups' needs, while taking into account all users with specific characteristics (Mace, 1988; Rocque et al., 2015). There are a lot of people in society who live partially or fully lacking vision. Even though some individuals have a congenital visual impairment, sometimes people might be visually impaired due to an illness or accident. Visually impaired people have the right to participate in social life in the urban environment as much as every human being.

The visually impaired individuals are limited in their ability to use, experience, and perceive the space. However, they cannot perform their movement independently in the urban environment and therefore cannot use the urban environment.

The problems faced by visually impaired individuals in urban life are related to the physical structure of the cities. It is inevitable that these individuals, who cannot act most of the time independently, lose their area of movement thoroughly due to unplanned construction and inadequate arrangements in the urban environment. Besides, spatial designs can restrict the mobility of these individuals. Improper implementation of relevant standards in the urban built environment prevents these individuals to move out of their homes and restrict participation in urban life and their access to health services provided by the government (Republic of Turkey, 2010; Gezer 2014; Akcalı, 2015).

A study conducted with visually impaired young people living in the UK shows that 20% of the young people who participated in the study could not go out of their houses. 34% of them could go to places close to the area they live in, and only 41% of them can walk alone in the neighborhood (Bruce et al., 1991). Thus, another study shows that 70% of the visually impaired individuals who participated in this survey can move independently outside their home and environment (Clark-Carter et al., 1986; Belir, 2012). In providing accessible urban living standards to visually impaired individuals, resolving physical barriers may help to overcome social constraints.

Studies on visually impaired individuals in the literature vary in architectural and urban design scales and contents, and try to reveal the event in the context of buildings, streets, and squares. Most of these studies focus on urban space's physical properties and not the sensory perception of the visually impaired. However, there are insufficient number of studies investigating visually impaired individuals in the city parks context and focusing on the use of multiple senses.

This study aims to understand visually impaired individuals' sensory references and their perception of the landscape space. In this context, the focus is on how these individuals direct their positions, develop descriptions, understand orientations, decide on movements and behaviors by using the tactile, auditory, olfactory, and gustatory clues in the urban park scale.

In this paper, we study the perception of landscape and understanding of landscape space with visually impaired people's auditory, tactile, olfactory, and gustatory senses, which reveals the importance of a different starting point in multi-sensory perceptible landscape design. In universal design context, this study has original value in terms of the perception of all senses to shape landscape design and providing sustainable solutions in promoting exclusive urban public space design.

2. Visually impaired individuals and their perception patterns

The visually impaired persons prefer a cane, guiding visionary, or guide dog more than electronic devices. The guiding visionary can facilitate a comfortable, fast, and safe stroll of the visually impaired; however, the guiding visionary may not be available all the time to give this service. The guide dogs can also lead the movement and become the best friends of the visually impaired towards developing emotional connection. However, the guide dogs may be costly, and not welcomed some places including café and such; therefore, their utility may diminish (Gürkan, 2012). The visually impaired persons mostly use a cane as a tool to move in different environments. Although they support the independent movement, these solutions are addictive for the visually impaired.

Gaunet (2006), investigates the direction-finding performances of visually impaired pedestrians, where 7 of the observations in this study use a cane, and 3 use a guide dog. Her findings reveal that direction performance can change according to the technical assistance they use in their journeys. Similarly, her findings suggest that there should be guidance clues and design rules to help the visually impaired find direction in urban environments (Gaunet, 2006). Sound design is imperative to include visually impaired public spaces and essential for exclusively promoting quality of life in urban environments.

Quality of life in urban environments depends on spatial experiences and decisions in different situations and scales. Every individual living in the city has a spatial awareness formed by vision, auditory, tactile, olfactory, and gustatory senses. Sensory inputs from the surrounding environment enable people to perceive their environments (Stankiewicz & Kalia, 2007). People create their spatial knowledge by experiencing urban contexts; in this way, one knows the geography of the city and learns the locations of places. (Jacobson, 1998; Belir, 2012). Therefore, experience in urban space is essential in the perception of space (Porteous, 1996). The mental evaluation initiates the formation of behavior in space orientation. This formation is completed by the individuals choosing and perceiving the infinite signs in the space according to their importance (Giritlioglu, 1991; Pallasmaa, 2006).

Within the social life of the city, every individual perceives the environment, ultimately with visual stimuli (Turkoz Sarp, 2013). If the vision is impaired, individuals employ other sensory stimuli while conceiving their perception of the environment. Individuals who are born blind or blind after a limited period in childhood rely entirely on information from other stimuli hence utilizing their tactile, auditory, olfactory, and gustatory senses (Warren 1978; Heylighen & Herssens, 2014). Subsequently, blind in-

The using of urban park as perceived by visually impaired

dividuals' lifestyles, time management, and space understanding are different from other people. These individuals use icons, signs, and expressions in the external environment at different levels other than the sense of sight. With the help of these various clues, they take their places in urban life and participate in social life (Sürmen, 2004; Marston & Golledge, 2004; Jenkins, Yuen & Vogtle, 2015).

In crowded cities nowadays, urban parks provide physical exercise and relaxation areas for the citizens. In addition to these functions, these urban living areas also offer psychological, social, and cultural services (Lynch, 1990; Francis, 2003; Chiesura, 2004; Walker, 2004). Urban parks conveniently located and accessible to all types of users can promote and enrich social life (Celik, 2013; Siu, 2013). Urban park design is a process that adopts design principles such as accessibility, legibility of space, and its comfort and usability.

In the use of urban parks by visually impaired users, the location of the space in the city and the accessibility of the area are the first concerns. The spatial composition, the placement of the landscape elements, the physical and functional qualities are also important concerns. Sensory clues taken from both the physical environment and the perception of the space by visually impaired individuals are useful in visually impaired individuals' movement in the public space. Therefore, sensory clues in the physical environment is a critical element of open space design.

In urban design, there is need for comprehensive studies, which provide accessible, perceptible, cognizable, and usable implementation of landscape spaces, along with multidisciplinary and sustainable approaches. The urban spaces arranged with the visually impaired sensory space perception references will help to ensure accessibility and perceptibility for all users.

3. Method

The analytical approach of this study involves face to face interviews. The interviews include open-ended, unstructured, and semi-structured questions (Newton, 2010; Cokluk et al., 2011; Cetin, 2017; Creswell, 2014). The inquiries are related to the tactile, auditory, olfactory, and gustatory senses. We evaluate the sensory references for visually impaired individuals to understand their perception of landscape spaces.

3.1. Participants

In this research, we utilized a 'homogeneous sample' with a purposive sampling technique (Abbak, 2015). A total of twenty-two visually impaired individuals (10 females and 12 male) were involved in interviews. The participants' selection criteria are the following: 1-Lost all or almost all ability to see, 2- Use cane actively, 3- Active participation in urban life, and 4- Able to move independently. The participants were either work at or the member of the following enterprises: ITU Disabled Student Advisory Unit, Boğaziçi University Technology and Education Center for the Visually Impaired, Six Point Blind Association, Six Point Foundation for the Blind, Association of the Visually Impaired, Turkey Association of the Visually Impaired.

3.2. Data collection

The process of collecting data to determine the limits of research involve collecting information through unstructured, structured, or semi-struc-

Table 1. Demographic characteristics of participants.

tured interviews, observations, documents, and visual materials, as well as the creation of a protocol for recording the interviews (Cohen et al., 2007; Newton, 2010; Creswell, 2014). In this study, we used a semi-structured interview. There were four open-ended questions at two stages in the interviews. These questions are: (1) Do you go to the city parks in Istanbul? (2) Is there a city park where you go, why do you prefer this park? (3) Could you sort the senses according to the intensity of use during a park visit? (4) Could you explain how your senses provide a ref-

erence to you when you visit a park? The interviews were conducted through follow-up of the questions and without directing the individuals; each interview was 40 to 60 minutes. We took short notes during the interviews and recorded all interviews. Before each interview, we ask the permission of the participants. We follow the time and place preference of the interviewees. We first got permission from the "Istanbul Technical University Ethics Committee for the Social Sciences and Humanities. And then, we mailed the ethics committee's permission to individuals and obtained their consent for recording the interview before the interview.

Categories		Frequency	%
Age	21-30	6	27.3
	31-40	7	31.8
	41-50	3	13.6
	51-60	6	27.3
Gender	Female	10	45.5
	Male	12	54.5
Marital status	Single	8	36.4
	Married	14	63.6
Education level	Elementary	2	9.1
	High school	7	31.8
	University or above	13	59.1
Profession	Student	2	9.1
	Housewife	1	4.5
	Teacher	4	18.2
	Lawyer	1	4.5
	Sociologist	1	4.5
	Psychologist and		
	Psychological counselor	2	9.1
	Athlete	1	4.5
	Musician	2	9.1
	Civil servant	4	18.2
	Retired	4	18.2
Total		22	100

3.3. Data analysis

The best way to analyze the collected data is to identify the key themes in the data. Even the short notes received during the interview are beneficial in creating themes. It is not the numbers that are important in reporting the interview data, but what the participants report (Creswell, 1998).

We analyzed the interview voice recordings and transferred the records into text. We classified sensory references under four themes: auditory, touch, smell, and gustatory sensation. Each theme had its own categories; thus, we generated perception-comprehension-usage referrals to the space corresponding to each class. We then created a network map of sensory themes, sensory reference categories, and perception-comprehension-usage to elaborate on the corresponding relationships. We used Graph Commons software for this task. "Graph Commons is a collaborative platform for mapping, analyzing, and publishing data-networks. It empowers people and organizations to transform their data into interactive maps and untangle complex relations that impact them and their communities." (https:// graphcommons.com/about).

4. Results

4.1. Demographic characteristics of participants

Among the 22 participants of the study, the respondents' ages range from 23 to 59 years old (mean = 37.54; SD = 10.5). Twenty-one individuals in our sample are actively working in different professional disciplines, and one participant is a housewife. All of the individuals in our sample participate in urban life independently (Table 1).

Almost all respondents, except two, have at least a high school degree (90.9%). Moreover, four of the respondents are currently enrolled in college.

	4 participant	The visit frequency'
Visiting park or pot	I participant YES	
Visiting park of hot	participant NO	Reason for 'NO'
Responses to 'yes'	Responses to 'The visit frequency'	Responses to 'Reason for 'NO'
"I'm trying to go to green areas, especially." (9) "Not much, though. If I go, I usually prefer parks around the neighborhood where I live." (11)	"I often use a coastal park close to my house." (5) "I often go with my family, the grove in the neighborhood where I live." (7)	"There's no park around where I live that I can comfortably go." (3) "Our people are not very conscious about the disability; we can feel distressed." (19)
"I go to the park because of its proximity to get air at certain intervals." (13)	"There are several urban parks where I go often."(8)	"In the park, I cannot move safely; I do not know the transportation route; I do not have the safety of the obstacles on the route." (4)
"It is important to be close to my house and to be comfortable inaccessibility. When you leave, it's important not to have too many obstacles." (16)	"Mostly, I go to the grove. Because in these areas, there is a lot of green space and tranquility, and most importantly, the ground is different in the transitions of the wooded area through the walking path." (10)	"It is very difficult in our country for two visually impaired individuals to go to the park. You need to have a person who can see next to you, otherwise it is not suitable to use the area." (21)
"To be close, to be a pleasant area, and to be newly arranged." (18)		"I can't find my way, and there are lots of stairs, which prevent me from going to some parks." (8)
"Very close and accessible. I can go away in terms of having a large size, a lot of green space, where we can enjoy and play safely." (15)		"I don't think the parks are accessible. If I'm going, I compulsorily have to go with my friends who can see." (12)
"I go to the nearby parks to relax and do the walk." (14)		"I can't go alone and often, because space is not very large, there is no direction and controlled route." (6)
		"Since it is not close to where I live, it is difficult for us to go and return in terms of transportation, because you are visually impaired." (22)

Figure 1. Responses of participants to questions about their park experiences.

In our sample, twelve of the participants of different ages are congenitally blind; 5 of them lost their sight when they were young, and 4 of them gradually lost their sight when they were adults (e.g., with only 10% visual activity).

4.2. Responses of participants to questions about park experiences

The main obstacle encountered for a visually impaired person in experiencing the urban environment is the danger of safety. The following table (Figure 1) provides some quotations from two open-ended question-answers about participants' urban park experiences.

The results show that 54.5% of the respondents go to a city park frequently or occasionally, and 18.2% of the participants visit city parks very rarely, while 27.3% of them never go to a park. 5% of the frequent visitors emphasize that they prefer these parks because they are near their houses. This finding shows that the accessibility of the urban parks by visually impaired users are affected by the neighborhood where s/he lives. Besides, the location of the participant's residence, transportation route, type of transportation, and the availability of different modes of public transport (such as pedestrian use and various public transport: bus, subway and such) is critical. Participants prefer the areas frequently experienced more because they know well.

Seventy-five percent of participants (6/8) who don't visit a city park state the following issues: The transportation network of the place is not readable, the presence of multi-step stairs, the disappearance of the direction to go in some areas, and the safety concerns in the incident of accident. For these reasons, respondents declared that they prefer using a sighted guide instead of visiting city parks alone. Additionally, they have accessibility concerns within the parks.

4.3. Senses used for conceiving the urban park

The weakness or absence of sight requires the use of alternative senses other than vision. The individual's character and his/her social and cultural values are highly influential in the perception of a place (Morval, 1985; Gezer, 2014; Fuda, et al., 2015). As in every individual, these different physiological and socio-cultural characteristics affect visually impaired people's orientation to the senses of auditory, touch, olfactory, and gustatory (Table 2).

Ten participants state that they first use their sense of auditory when they enter a city park, and they determine the sensory reference mostly in a space with the help of this sense. Ten participants state that they mainly focus on the olfactory sense in the same experience process.

	The sequence of using the senses			
Participant	1.	2.	3.	4.
1	Olfactory	Tactile	Auditory	-
2	Auditory	Olfactory	Gustatory	Tactile
3	Auditory	Olfactory	Tactile	Gustatory
4	Auditory	Tactile	Olfactory	Gustatory
5	Auditory	Tactile	Olfactory	Gustatory
6	Olfactory	Auditory	Gustatory	-
7	Olfactory	Auditory	Tactile	Gustatory
8	Auditory	Olfactory	Tactile	Gustatory
9	Auditory	Olfactory-Gustatory	Tactile	-
10	Olfactory	Auditory	Tactile	Gustatory
11	Auditory	Tactile	Olfactory	-
12	Olfactory	Auditory	Tactile	Gustatory
13	Auditory	Tactile	Olfactory	-
14	Olfactory	Auditory	Tactile	Gustatory
15	Olfactory	Auditory	Tactile	Gustatory
16	Olfactory	Auditory	Tactile	Gustatory/meditative
17	Auditory	Olfactory	Tactile	Gustatory/pleasure
18	Olfactory	Auditory	Tactile	-
19	Tactile	Auditory-Olfactory	-	-
20	Olfactory	Auditory	Tactile	Gustatory
21	Auditory	Olfactory	Tactile	Gustatory
22	Tactile	Olfactory	Auditory	Gustatory
	%45.5 Auditory	%43.2 Auditory	% 62 Tactile	%93.3 Gustatory
	%45.5 Olfactory	%31.8 Olfactory	%19 Olfactory	% 6.7 Tactile
	% 9 Tactile	%22.7 Tactile	% 9.5 Gustatory	
		% 2.3 Gustatory	% 9.5 Auditory	

Table 2. The ranking of the senses used by the participants in park visit.

Table 3. Participant categories of auditory cues.

uditory	gories of sensory references	Tapping the cane onto the ground (8 participants) The sound of the cane crashing into urban furniture (4 participants) Applause (2 participants) Sound of water (8 participants) The acoustics of space/distribution of sound (10 participants) The sound of the bird (13 participants)	ence in the use of landscape space
	egorie	Human voice (12 participants)	of refe
	Cat	The sound of children's sound and play equipment (6 participants)	sentation
		Rustling of trees (6 participants)	Repre
		Traffic sound (5 participants)	
		The sound of the teaspoon (2 participant)	
		Activity sound (7 participants)	

A

Defining different ground material
Grip the width of the walking path
To be able to determine the separation of road
Locating and identifying urban furniture
Defining the materials of urban furniture
Define objects in the environment
The presence and location of the water element
Orientation and positioning
Understanding the size of space
Feeling the ambiance of the surroundings
Plant presence, location, and density
Plant diversity
Different and more plant species
Understanding the likelihood of insects
Presence of the water element
Definition of human existence, intensity, and activity
Areas where plants are common
The presence of children
Determination of children's playground and its location
Understanding the presence and location of trees in
the area; direction determination
Directing and locating the location of the entrance gate
Understanding the park's distance to the street
Detection of the drinking facility and its location

Defining the place and activity

Road tracking and direction

As the second input, ten participants (43.2%) use the sense of auditory, eight of them (31.8%) use the sense of olfactory, five of them (22.7%) employ the sense of tactile, and finally (2.3%) use the sense of gustatory. Overall, the participants use auditory sense followed by olfactory, tactile, and gustatory senses (Table 2).

Some factors play a significant role in the perception, comprehension, and use, and cognitive mapping of the space for our research participants; these include the location (e.g., distance to motorway and buildings) and the basic sounds of the climatic features (e.g., sounds from plants under the influence of the wind). Besides the temporary sounds that have a surprising or sudden effect (e.g., birds singing) and the typical sounds (e.g., the sound of water, equipment, human or child, activity) shape their auditory references, hence affecting the preference of the space, activity, usage frequency and length.

4.4. Sensory reference points of participants using parks

Visually impaired individuals identify specific sensory cues for their independent mobility in urban parks. These sensory references have a particular purpose and meaning. The participants indicate the sensory references of each sense that they detected during the use of a city park. Tables show the spatial references collected under each sensory reference category.

4.4.1. Auditory sense

The audible references provide many clues about the space to the visually impaired user. Human voices, external voices coming from the surroundings (such as traffic), the sound of the cane hitting the object, and the echoes of these sounds are very helpful to these individuals. With these references' help, the participants can define/ comprehend the city park, determine the direction of movement, and confirm their location within the space (Table 3).

Auditory references, both external sounds coming from the surroundings of the space and the sounds within the space, are useful in defining the space. For example: "I'm listening, I wonder if there are different bird sounds, is it too crowded, whether people are scattered or together, wherein the park where the *human voices are more intense, and I try* to understand more or less whether the park is small or large." (2nd participant). The majority of the participants (13/22; 59.1% of participants) identify the user sounds, space acoustics, and bird sounds as relevant auditory references for a city park. A human voice heard in the area is the second basic auditory reference (12/22; 54.5% of the participants).

Visually impaired persons try to define the fiction of the space, determine the activity areas, understand their position, and determine the direction of movement in the space with the references perceived with the sense of hearing. For example; "The sound produced by the cane touching the material used on the floor is different. The choice of flooring has importance." (14th and 18th participant). They also recognize the spatial diversity and distribution of different parks by following the sound of the activities'. Some of the auditory references give clues about the turning points in the park. For instance, a water feature located at the juxtaposition of the walking paths can tell a person that he/ she is at an intersection. In conclusion, auditory references usually support impaired person orientation and independent movement in the space.

4.4.2. Olfactory sense

The results showed that the most critical olfactory reference is the smell of the plants for visually impaired users in a city park (Table 4).

Participants emphasize that especially the plant scent is an essential factor in their choice of the city park. For example; "I understand where I am if there is a plant that gives an intense fragrance, such as spindle tree. We can benefit a lot from plants." (19th participant). The plant scent provides references, such as the size of the area allocated to the green, the location of this area in the overall space, the identification of the plant species, and the perception of its diversity. For instance; "You can perceive how much green space there is by scent. You can perceive if there are too many people." (16th participant).

With the sense of smell, the most important reference that visually impaired individuals (21/22; 95.5% of participants) perceive in a city park is the plant smell. The perceived plant smell is useful in defining the plant location, density and size, user density in the



place, the location of the site in the city, and the plant species found in the area. The participants have emphasized that especially the smell of plants is an important factor in choosing a city park to visit. This result shows the importance of quality, quantity, and plant species used in urban park for visually impaired users' perception of space.

Table 4. Participant categories of olfactory cues.



Determine the route with the help of border stone/direction determination Understanding the material and width of the walkway Touch of the cane Understanding the fiction of the park and finding the seating area (13 participants) Identifying and accessing urban furniture Getting general information about the field the use of landscape space Determination of concepts such as size and depth Identification of the tissue (softness, hardness, thickness, fineness, roughness, slope, etc.) The difference of ground material references Defining the type of walking path Touch with foot base Perceived of the slope in the walkway (12 participants) Determining the type of area / green area Saving the cognitive map of the place Categories of sensory Don't memorize distances .⊆ Discovering the turns Tactile Defining and understanding urban furniture Representation of reference Hand touch Identification and understanding of plant species (10 participants) Controlling the use and defining the sports equipment Defining children's play equipment and game space Defining soil area and feeling the soil Touch with body Understanding the shadow, width, and depth of the tree (6 participants) Hitting obstacles encountered in the area Identifying seating material Heat and light of the sun/ Distinguishing shadow and sunny area Drop shadow Identify the place (5 participants) To be able to think of the plant species that can be grown The location of the smell it brings The touch of the wind Feeling in the body (3 participants) Learning about climate Touching the water Feeling in the body (2 participants)

ITU A Z • Vol 18 No 3 • November 2021 • D. Özgür, H. Eşbah Tunçay

Seasonal evaluation of the edited vegetative landscape and even thinking of the vegetation area on the wind tunnel of the space will be effective in the individual's easy perception. Apart from the smell of plants, some other scents (e.g., food, toilet odors) help locate the facilities and services in the park. Such as; "*If we are passing by a cafe, we say there is a place to eat here in the park, but if we do not know the place, we can find it by smelling it.*" (7th participant).

4.4.3. Tactile sense

Participants stated that tactile references were the use of a cane (touching the cane), feeling with the soles of the feet, and touching the hand (Table 5). In tactile perception, touching with a cane (13/22; 59.1% of the participants), feeling with the sole of the foot (12/22; 54.5% of the participants) and touching with hands (10/22; 45.5% of the participants) are references that come in the front row.

The most effective tactile reference perceived are elements that function as boundary elements. The boundary element on the roadside in large areas such as city parks enables visually impaired individuals to walk straight without leaving the walking axis. Such as; "Am I on the main road or a footpath or at the entrance of a place, or am I climbing downhill? I feel it all with my feet." (9th participant). The roadside boundary element can be a curbstone,

vegetative fence element, or railing element applied at the edge of the walking axis. With this application, individuals have emphasized that they can be more independent and comfortable in their accessibility in urban space. References have been perceived by touch make a different contribution than definition. For instance; "I am trying to guess, according to the shadows of the trees falling on me, where is the forested part and where it is suitable for sunbathing." (5th participant) or "I entered the park, went 30-40 meters, and for example, I came across a slightly hollow area or a sloping area, so when I notice this place on my return, I can say I am at the right point." (12th participant). On the other hand, tactile references provide spatial references such as locating/identifying urban furniture, specifying materials, and using activity equipment in the park area. For example; "I'm touching, is it a slide, a swing or a seesaw, I say okay, this is a children's playground." (15th participant).

4.4.4. Gustatory sense

Gustatory information reminds the places and makes the spaces perceivable (Gezer, 2012;2014). Most of the participants stated that the gustatory and the other senses play a significant role in the space perception-comprehension process while experiencing the place (Table 6).

Table 6. Participant categories of gustatory cues.

	1	0 70	/	
Gustatory	Categories of sensory references	The smell of plants and oxygenated fresh air (6 participants)	esentation of reference in the use of landscape space	Being a place that makes you feel hungry Feeling the presence of the wind
		A case of tea-bagel (5 participants)		Being a case-specific to the park
		The gustatory of the plant (2 participants)		Discovering the gustatory of plants
		Memory of gustatory (3 participants)		Becoming a well-known place with the park The park is in a high position in the city
		Eating-drinking activity (4 participants)		Purpose of visiting the place The purpose of having a picnic The association of flavors that come with its scent
		Planting of fruit trees (3 participants)		Fruit-eating desire and enjoyment
		Metaphorical gustatory of space (8 participants)		The emotional connection between space and user The intensity of use of space Being a peaceful place Meditative / mental rest The energy of plants and colors Providing socialization opportunities Decrease in traffic noise
				The smell / sound / pleasure of the place
		The unpleasantness of space (1 participant)	Repr	Failure to use space and having experienced an accident

For some of the participants, the gustatory references are related to eating and drinking activity. Gustatory senses become active in the fresh air and trigger the feeling of hunger. For instance; "In fact, the taste is something that goes with odor because our senses of smell and taste work together, so often it's very likely to be what it evokes. I eat when I go to the park because the smell of plants and getting plenty of oxygen while walking makes me hungry. " (2nd and 9th participants). The behavior is attributable to cultural habits. In Turkey, it is common to drink tea accompanied by Simit (a traditional Turkish bagel) while enjoying a sunny day outdoors. For example; "Turkish bagel is sold in the park where I frequently go. When we go there, we eat it, we won't go back without eating it. " (6th participant). Besides, gustatory references create opportunities for social interaction. For others, gustatory references construct intangible qualities such as tranquility, peacefulness, and positive energy from the plants. For instance, one of the participants declare; "It is meaningful to me when the crowd and taste come together. Park means chatting / feeling of the crowd." (3rd participant) or another respondent state: "The sense of taste is that the park is human, it is crowded, it has animals, that is, there is such joyful laughter, there are children, people walking their dogs, or children who are under the supervision of their parents at that time. Taste is like that for me." (11th participant).

4.5. Relationship sensory themes, between sensory reference categories and spatial references of participants

The relationships of sensory themes, sensory reference categories, and space perception-comprehension-usage references present a network map (Figure 2).

The network map reveals that a sensory reference help in identifying different attributes of the outdoor space. For instance, a tactile reference provides different spatial references, such as identifying the objects encountered on the walkway (the tactile reference with the cane), recognizing its function and material, and discovering its use (the tactile reference with hands). The network map also shows that the visually impaired uses multiple sensory to detect a spatial reference. For instance, the scent from the plants (olfactory reference) helps determine the presence, location, and frequency of the plant, while the sound of birds (auditory reference) gives information about the direction and the va-



Figure 2. Network map of the relationship between sensory themes, sensory reference categories, and spatial references of participants.

riety of plant groups. All of these inputs affect the user's position and orientation because it signals a turning point for a particular zone in the park.

5. Discussion

Examining and understanding the dynamic interaction of visually impaired users with the city's urban open spaces is essential to ensure their participation of this user group in recreational activities and social life, hence supporting their well-being. The sensory cues that individuals receive from the physical environment support the perception, comprehension, and independent use of space in the urban environment (Sürmen, 2004; Marston and Golledge, 2004; Jenkins, et al., 2015). The visually impaired individuals use their senses other than a vision at a personal and unique level for independent and comfortable use of the urban physical environment. In the light of the references they perceive with these senses, they shape their independent movements in public spaces. If sensory references are perceived easily and effectively, visually impaired individuals will be able to move independently in the space.

Defining the sensory interaction of visually impaired users with the public space will be effective in creating senso-

ry cues in urban landscape design. Individual characteristics and social and cultural values are influential in perceiving a place (Morval, 1985; Gezer, 2014; Fuda, et al., 2015). Different physiological and socio-cultural characteristics of visually impaired affect their tendency to utilize auditory, tactile, olfactory, and gustatory senses. If visually impaired users with different characteristics are taken into account in the design process, it would provide a deep clarity to the sensory references. Moreover, providing the input of multi-layered sensory cues into design would provide design solutions in the 'universal design' role of the urban environment.

This study provides concrete ideas for the inclusion of functional sensory references in the urban park design process. All participants in this study express the significant impact of sensory references on independent access to transportation, navigation, access to different activities, and services in the space in their participation in the urban environment. Subsequently, adding these references to design would support natural perception of the area, independent and safe mobility, correct orientation, and easy access to the activities and services in urban public green spaces (Table 7).

Table 7. Summary of sensory references in a park experience.

Independent transportation and finding direction	Edge tracking lines /the cane path /the sound of the cane on the ground (<i>tactile or auditory</i>) Voice guidance plates (<i>auditory</i>) Finding parking gates (<i>tactile, auditory, olfactory or gustatory</i>) Providing a reference to the location (<i>tactile, auditory or olfactory</i>) Stimulating references /road turns and intersection (<i>tactile, auditory, olfactory or gustatory</i>) Information and guidance /using braille (<i>tactile</i>)	
Landscaping setting	Specifying strategic points (<i>tactile, auditory, olfactory or gustatory</i>) Perception of space fiction (<i>tactile, auditory, olfactory or gustatory</i>) Using the moving water (<i>auditory</i>) Location /number /frequency of urban furniture (<i>tactile or auditory</i>) Increasing audible references (<i>auditory</i>) Providing ground material difference (<i>tactile or auditory</i>) Determination of the difference of transportation axles /main- intermediate road (<i>tactile or auditory</i>) Ensuring perceptible slope on the road (<i>tactile</i>) Planting design layout and care Greenfield size and plant diversity (<i>auditory or olfactory</i>)	
Access to different activities and facilities	Access to urban furniture (<i>tactile, auditory, olfactory or gustatory</i>) Access to various activity areas /Sound of ground or little sounds that won't disturb nature (<i>tactile or auditory</i>) Finding different equipment and using it (<i>tactile or auditory</i>) Finding the introduction of different places (<i>tactile or auditory</i>) Finding entries of different areas (<i>tactile, auditory, olfactory or gustatory</i>) Finding facilities and utilizing them (<i>tactile, auditory, olfactory or gustatory</i>)	

The using of urban park as perceived by visually impaired

With this approach, important suggestions emerge when the urban landscape design criteria are evaluated together with the sensory references.

- In order to provide comfortable and safe transportation to city parks, a design should be made in such a way that public transportation stops, sidewalk arrangements, parking areas and entrance entrances are interconnected. The perception of the doors with different sensory references in large green areas such as city parks will facilitate access to the city from inside the park and within the city. An auditory reference that could be distinguished from other sounds (water sound, a melody, or a bell sound) or an olfactory reference such as a plant would be perceived by its scent can lead entering and exiting into space.
- Considering the usage integrity of the area, the user should be able to easily access all the landscaping services they need. In this direction, the circulation of the space should be in perceptible accessibility. For example, the central circulation axis material could have a different texture than the rest of the paths, hence facilitating the wayfinding in case of being lost. It would also be a good reference if the sound of the cane's hitting changes in different flooring materials. Having a channel or a path where the cane can be attached will also support independent walking.
- In urban parks, there should be a boundary element at the edges of the pedestrian paths to ensure the walking rhythm of the user and support the correct route walking. Also, the design should eliminate any obstacles that endanger safety. For independent access to space, the boundary element should be in proper dimensions, material, and position, appropriate to the sensory feedback in the form of the auditory (sound of touch of the cane) or tactile (feeling of contact with the soles or an obstacle that blocks the cane). Considering this design element in the whole transport network and diversifying it on different walking routes (primary and secondary road axes) might support various uses.

- It is necessary to consider the characteristics of the transportation network and the change points together. In this case, it is essential to employ appropriate sensory warning references when approaching potentially dangerous transitions such as slope change, road junctions, a shift from the walkway to the green area. These cautionary references should utilize different textures and appropriate slope gradients. These references should capture the perception of the users walking on both sides of the road. Besides, extra auditory references could be useful. Incorporating some sensor technologies and new sound systems that do not interfere with the other sounds in the landscape would help. Different water sounds can be used as an auditory reference. For example, a sound of water can be placed at each crossroads; there may be different water sounds: the sound of water coming from the fountain is different from the waterfall.
- There should be different activity areas in city parks that can offer various recreation opportunities, which would serve all age and cultural groups. Different cautionary references should occur in different areas of the park to find, grasp, and perceive the use of these areas. These cautionary sensory references facilitate access to various activities. For instance, an audible stimulus may occur at the children's playground entrance, while a fragrant stimulus may signal access to the resting area. An example would be; perceptible plants which would be planted at the entrances of places with different functions. Its shade, size, and scent will provide different sensory references. The references indicating other functions would encourage the users, mainly due to the fear or concern of safety.
- Landscape spaces such as city parks should have design integrity within themselves. For the independent and effective use of the space, the visually impaired user must perceive and understand the space structure (Giritlioglu, 1991; Por-

teous, 1996; Pallasmaa, 2006). A tactile map written in the Braille alphabet should be at the entrance of each park. It should include information related to the site, the circulation network, different activity and service areas, slope transitions, etc. Also, the map and information sheets in this format should be perceivable as auditory and tactile in different locations of the space. Placing these will positively affect the learning, understanding, and utilization of visually impaired individuals while preventing their disorientation in the park environment. It may also prevent these users from being lost in such broad open spaces. We also recommend placing auditory cues such as sprinklers that give distinctive sounds.

- The location, area and climatic characteristics of the park can contribute to the design and planning of the landscape, which is perceived as multidisciplinary. For the visually impaired users of a city park, many odors in the place (such as human, garbage, food, toilet, material scents) may provide a reference; thus, the seasonal climatic conditions might make a difference in the user experience of the space. One of the most pleasant olfactory sensory comes from plants. In urban park design, the planted areas provide airflow, increase air quality, and provide microclimate. The type, location, and scents of plants contain many references to the users of the park. It would be useful to consistently place these variable olfactory references at strategic points within the space while developing design and management strategies to emphasize their olfactory sensory inputs.
- While urban park vegetation areas have many different functions and factors, they can also contribute to space perception. The use of fruit trees, aromatic and edible plants in the space will increase both olfactory and gustatory references' power. At the same time, it will be a good source of education for children, such as having a diversity of plants, recognizing them, knowing their names, knowing their smells,

and growing with them. Taste references have a positive contribution to the perception of space. Subsequently, the eating and drinking facilities, peddlers, and picnic areas provide many tasteful references in the urban park. Besides, these references will affect the cognitive map of space by the visually impaired. Therefore, the designers should sensibly locate eating and drinking facilities, peddlers, and picnic areas in urban parks.

- All urban facilities in urban parks should be usable in all seasons and nights, with sufficient dimensions and structural features for all users. All these elements located on the side of walkways or in different areas of the space can provide various sensory references. For example, the floor arrangement with the reinforcement with different material can be considered a tactile reference. Besides, the placement of the reinforcements will create different acoustics in their environment and will be an essential reference source in the space.
- Urban parks should suit different users' socio-economic structure and cultural characteristics and their expectations and demands from open and green spaces. Hence these areas deserve a socially responsive design and a balanced manner with sensory references. In this way, the input of sensory references of the visually impaired users to the design principles will support the universal design (Mace, 1988; Imrie, 2012; Jenkins, et al., 2015) hence facilitating public places, events, and services without discrimination.

The multi-sensible perceptible city park design will add a positive effect to the use of the space for visually impaired users. In addition, considering sensory references under landscape design criteria will support the use of space without separating different user groups. The designer should be aware of the perception of sensory references and should consider diversifying the references in line with the use of different senses. In addition, while the designer balances the different sensory references in the whole space, s/he should avoid any uncomfortable effects for the user. Collaboration with the participating visually impaired individuals included in the design process will have a reinforcing effect on the multi-sensory perceived space design.

6. Conclusion

In this study, we explore the sensory references of visually impaired persons in defining landscape space. We also investigate the effects of multiple sensory perceptions in the design of an urban park. One to one interviews elaborate on how visually impaired individuals perceive various sensory reference signs to understand the spaces and to position themselves in and around of an urban park. Our findings show that the participants refer to their auditory and olfactory senses equally while experiencing the landscape. The participants secondarily utilize their tactile sensory, followed by the taste. Despite this, we conclude that the senses work in cooperation.

Accessibility of urban transportation is vital for a visually impaired individual to go to a city park. In particular, the distance between the place where the individual would visit and the area where he/she lives, the type of transportation to be used, and the proximity of the transportation network to the place of destination affect the individual's preference. Besides, the accessibility to and within the site affects the frequency of the trips to urban parks. A visually impaired person's previous acquaintance with the place is a critical factor in choosing and enjoying a park, hence the availability of adequate green spaces in each neighborhood. Subsequently, we emphasize that the visually impaired urban landscape relies on holistic urbanism that promotes sustainable transportation system, accessibility, and equity.

A sensory reference can have more than one meaning in space usage representation. Different sensory references that are perceived by different senses respond to the same space usage representation, accentuating space perception. Since it also supports the use of multiple senses for visually impaired individuals, it also facilitates perception of space. In addition, the use of other senses or references in terms of whether a reference is temporary or under-perceived will be highly effective in the individual's use of independent space. In all of these four sensory references, the references significantly impact the comfort of use of the visually impaired users in terms of their location, quality, and quantity in landscape design.

As a result, it is crucial to support multi-sensory perceived physical spaces in terms of an independent, effective, and comfortable use of visually impaired people in an urban environment. The transfer of multi-sensory perception to urban green space design decisions will be an essential solution for improving the comfort and satisfaction of these individuals' space use.

Urban parks contribute positively to the ecology, character, and image of the city. They have a high potential for recreational use to enhance the quality of life in city dwellers. They are landscape spaces promoting the balance between function, aesthetics, and ecology in the city. This study has identified three perceptual design features that must be improved in developing sensory references for urban park design: independent transportation and finding direction in the parks; landscape design and management of the park; access to different activities and facilities inside the parks.

The adoption of a design concept that promotes a multi-sensory urban landscape is essential for universal design. Finally, the cooperation of all design disciplines, all relevant institutions and organizations, visually impaired individuals, and all users are vital to integrating universal design principles in urban parks' design process.

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