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Original Research Article

# Examining the Impact of Seasonal Changes on Embodied Perception Capabilities and Behavior: A Case Study of Darakeh, Tehran

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## Abstract

**Problem statement:** Environmental psychology, as a broad scientific field, seeks to understand the nature and type of interactions between humans and their surrounding environment. In simpler terms, it examines how human behavior in space is influenced by exposure to behavioral environments. It is an undeniable fact that humans, as part of their environment, both influence and are influenced by their surroundings. However, the extent to which this cycle is affected by sensory stimuli, as well as the specific stimuli that alter behaviors, remains an open question.

**Research objective:** This study aims to explore the relationship between the perception derived from visual landscapes and the resulting changes in individual and collective behavioral patterns. To achieve this goal, the research utilizes the Darakeh area a space characterized by diverse sensory landscapes and a wide range of audiences.

**Research method:** The study employs two qualitative research methods: ethnographic (behavioral) studies and sensory walking to examine sensory-behavioral stations. These methods were applied over different time intervals during the spring and summer seasons to analyze behavioral changes and sensory landscapes.

**Conclusion:** The results indicate that sensory landscape variations during spring and summer significantly impact human behaviors in the Darakeh area. In spring, olfactory and visual senses are dominant, enhancing friendly interactions and momentary behaviors. Conversely, in summer, the sense of touch becomes more active due to climatic changes, increasing individual interactions with strangers. These sensory variations are directly linked to the physical characteristics of the environment and temporal cycles, highlighting the importance of environmental planning to enhance the quality of public spaces. Overall, diverse sensory stimuli, alongside physical elements, create a foundation for the formation and variation of behavioral patterns.

**Keywords:** *Perceptual Affordances, Embodied Perception, Behavior, Synomorphy.*

## Introduction and Problem Statement

In human societies, individuals' interaction with their surrounding environment is one of the fundamental pillars of human behavior, influenced by various factors such as physical characteristics, sensory landscapes, and seasonal changes. The selection of a space for presence

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and experience is a perceptual and behavioral process that humans engage in to meet their various needs. This complex interaction between humans and the environment plays a crucial role in shaping behaviors, patterns of social interactions, and aesthetic experiences. Through visual perception, individuals engage with spaces, which are often characterized by stable elements that change over the long term, initiating their spatial experience. However, it is through the senses of smell, taste, touch, and hearing that they perceive changes in their surroundings. Seasonal and sensory variations in the environment influence not only the level of perception but also the quality and nature of the behaviors that take place within a space. The blowing of the wind, the shifting shadows of trees, the heightened calls of crows or sparrows, and the scent of roasted corn in summer or hot beetroot in winter all signify the transformation of the sensory landscape across different time frames. Over time, one's experiences accumulate, and perception, shaped by the physical environment and diverse activities, gradually evolves. Consequently, this perception becomes the existential foundation of behavior, leading individuals to regulate and plan their actions based on their understanding of the environment—both in terms of its physical form and the activities occurring within it. This understanding dictates whether one is drawn to engage in ongoing activities or chooses to remain distant. The selection of behavioral niches is not merely about physical presence; rather, it entails a reciprocal relationship. Moreover, these behavioral settings are not necessarily permanent; they conclude once prevailing behavioral patterns fade, though they may not entirely vanish and can be revived over time. This cyclical process determines whether collective spaces remain vibrant or fall into decline. Therefore, examining public spaces based on their capability to convey specific messages to occupants aimed at facilitating perception and meaning-making is of great significance. Since the behaviors exhibited in a given space are fundamentally shaped by the perception of its occupants, understanding the influencing factors and the emotions experienced through the body within that space can provide valuable insights for guiding behaviors and reinforcing positive behavioral affordances. This study primarily aims to investigate the impact of sensory landscapes and seasonal changes on human behaviors, focusing on communal environments. Employing qualitative methods such as behavioral observation and sensory landscape analysis has provided a deeper understanding of these interactions. By relying on empirical evidence and scientific analyses, this research seeks to offer a more comprehensive understanding of the relationship between embodied perception and environmental behaviors.

## Research Background

Public spaces are among the most important elements in the spatial structure of the city. Places where most interactions and communications among citizens occur and provide the main context for functional activities and ceremonies of citizens (Andalib, 2010, 18). The existence of public spaces with the characteristic of sociability is an important complement to socializing individuals. Additionally, the sociability of public spaces leads to the promotion of solidarity, personal growth, and inclusivity for all citizens, regardless of gender, race, ethnicity, age, or social and economic status (Shojaei & Partovi, 2015, 96 & 97). Beyond their physical aspects, public spaces are perceptual and symbolic environments that, with systematic characteristics and composite nature, have an unbreakable link with the social time and culture of society. The cultural and social stabilization of society is effective in their perception, and these spaces also carry the historical and cultural heritage of society (Yazdani & Lavasani, 2010, 44).

In art and architecture, perception and fundamental thinking have always been integral to the urbanization process. Architecture throughout history has been a means of expressing intrinsic human thoughts and desires, attempting to depict and materialize its intellectual and cultural themes. Thus, the city can be considered the embodiment of ideas, historical backgrounds, and cultural roots of society (Abbasi et al., 2015, 293). According to Matak, the perception of humans of the world is a spatial perception and space is three-dimensional. Gibson, in the book "The Perception of the Visual World," writes, humans perceive this three-dimensional reality in the form of perspective, which, by means of stimulating stimuli and

their structure and the sensory changes received, establish a connection with him. (Gibson, 2014). The environment, including physical, functional, and social components, is proposed as a perceptual object. Environmental perception and receiving sensory data are realized through the five senses. The result of this process is sensory perception of the environment. The mind exhibits both cognitive and emotional reactions to the data received through the senses (Arnheim, 2016). Environmental perception is a process by which humans select the necessary data from their surrounding environment based on need. It is an external-internal mechanism, a mental or psychological process that actively selects and organizes sensory information and ultimately assigns meaning to it (Zabetian & Kheyroddin, 2019, 49).

The proximity range of the senses in an urban space allows for sensory interaction to occur and the perception process to begin. That is, the senses of sight, sound, smell, taste, or touch when stimulated, collect clues about the surrounding world, referred to as "systems." These systems have different ranges for exploration in urban space. Touch, smell, and taste provide information in the "near space," while vision and hearing can receive information over a wider range as "far space" (Wankhede & Wahurwagh, 2016, 742). Functional relationships between stimulus dimensions and experience factors, and determining these relationships by sensory mechanisms, are focal points for some proponents of this approach, while others emphasize the inherent laws of perceptual organization. Controlling or keeping constant factors such as set, motivation, and past learning are crucial. Even when these inputs are considered, they gain a secondary place, as exemplified in Wertheimer's laws of perceptual grouping (Wertheimer, 2017, 83).

Merleau-Ponty insists that the body is the primary means of accessing the world: "We are compelled first, even before we begin philosophizing, to come to terms with the embodied reality of our 'objective situation'." He describes how humans learn to grapple with this world through a process of searching and exploration, relying on their bodily skill sets and ever-expanding patterns of behavior (Ahmadi & Ghaiourfar, 2022, 43). Behavior is the most objective and observable human reaction to the environment. Individuals can use behavior as a non-verbal tool to communicate with others. The way an activity is performed is called behavior. Human behavior results from individual motivations and needs, environmental capabilities, the individual's mental image of the external world, their perception, and the meaning this image holds for them (Shahcheraghi & Bendarabad, 2016, 53). The behavioral pattern of individuals in urban spaces is the product of the connection and interaction of these factors. Various physical factors, including noise, weather conditions, and enclosed spaces, continuously affect human behavioral patterns. These movements and reactions are termed "behavior" (Altman, 1975). Table 1 reviews the progression of research conducted in the field of space perception and the behavioral patterns formed.

Ma et al. (2023) state in their study that men tend to have a broader range of observations, while women spend more time looking and paying attention to symbolic elements. The pathways and visual contexts that attract attention had a negative impact on women's aesthetic evaluation of scenes, suggesting that women's visual experiences of landscapes are more influenced by the sense of safety and order provided by green spaces. Jo & Jeon (2022) argue that the most important physical characteristics of sound affecting the perception of urban texture are spectral content, followed by sound intensity and temporal variation—factors that create similar trends across different visual environments. Overall, the perception of auditory and visual elements, emotional responses, and general awareness of the urban context vary depending on the visual environment. Wang & Li (2022), in their study, emphasize that stimuli influence the perceived restoration of urban public spaces (UPSs), depending on the type of space. Urban green spaces rank highest in terms of perceived restorative potential, followed by commercial, sports, and exhibition spaces. The pandemic, by increasing the perceived risk of visiting these spaces, has intensified the negative impact on experiencing restoration. Feli et al. (2021) believe that incorporating synomorphy is one of the essential elements in spatial design. Therefore, physical and cognitive elements can enhance space quality for students, especially in behavioral and interactive spaces such as shared and

social areas. Zia et al. (2019), based on their studies, state that spatial features play a significant role in evaluating interactive behavior patterns with physical environments. Accordingly, managerial and social dimensions are also among the influential criteria. To prevent a high blinking rate and loss of eye-tracking accuracy due to participant fatigue, the number of selected photo samples should be increased. A static image with a fixed field of view cannot fully reflect a scene in a real environment. Hoseinzadeh Dalir et al. (2022) argue that behavioral patterns in an environment depend on the diversity of social activities, the quality of behavioral settings, the coordination of spatial form and function, and the alignment of activities with the socio-cultural characteristics of the community. Paknejad et al. (2021) affirm that given the diverse interests and personality traits of individuals, one cannot assume a uniform effect of indicators on spatial behavior. It is not possible to confidently determine whether a person will enjoy the organization and existing capabilities of a space. The influence of the physical environment and spatial structure on human behavior is undeniable. The extent to which spatial behavior is shaped depends on individual characteristics, the five senses, and mental imagery of the spatial structure. In their study, Tafakkor et al. (2020) conclude that temporal, demographic, physical, and socio-behavioral structures of a space are interconnected, and that behaviors occurring in a space whether positive or negative are influenced and directed by these structures. Sarmadi, et al. (2020), in their research, assert that perception resulting from an environment is the outcome of the adaptation of eighteen sensory perceptions and rational perceptions shaped by these senses, as well as by individuals' cultural backgrounds and teachings. These factors inevitably affect users' spatial understanding on an individual basis.

In summary of the reviewed literature, it can be stated that the prevailing behavioral patterns in a given environment whether continuous or temporary vary based on each individual's experiences and the way they construct meaning from their surroundings. This phenomenon occurs through the spatial features of the environment, which act as environmental cues transmitted to the individual's sensory systems. These cues influence whether a person accepts or rejects the behavioral setting in question and this relationship is reciprocal; the intensity and occurrence of behavioral patterns within the setting can, in turn, determine whether the space is accepted or rejected by the individual. Integrating all the discussed topics, various categories can be inferred concerning the dimensions of behavior and their mutual influence on or from the physical container. These dimensions produce outcomes that are also affected by factors external to the physical context in which the behavior occurs.

## Theoretical Foundations

### • Sensory landscape: The root of perception and meaning creation

The language of landscape is our innate language; humans have experienced landscapes by touching, seeing, hearing, tasting, smelling, and living in them before having words to describe their actions. Landscape connects place and people (Salehinia & Niroumand Shishavan, 2018, 21). The term "sensory landscape," coined by Porteous (1985), reflects the idea of a built sensory environment. Although the term resembles the eye-centered "landscape," sensory landscape expands the range of sensory interactions with a place beyond mere visual consumption (Rodaway, 2002). The sensory landscape of a destination is based on information received by each of the senses and can be defined as a set of five "scapes": visual landscape (sight), smellscape (smell), tastescape (taste), soundscape (audition), and touchscape (touch) (Medway, 2015, 191-209). Thus, sensory landscape and the extent of utilizing different human senses are qualitative criteria for measuring space. The five senses—hearing, smell, sight, touch, and taste first classified by Aristotle (384-322 BC), along with the sense of time, form the basis of sensory landscapes (Lotfi & Zamani, 2015, 45). Sensory landscapes also influence the level of social interaction in urban spaces. In noisy and crowded environments, people tend to avoid prolonged interactions due to sensory overload. In contrast, quieter spaces with soothing sounds and visually appealing settings encourage social gatherings and collective activities such as sitting on benches, chatting, or exercising (Zheng et al., 2024, 7). Cities should be designed to consider human sensory

interactions not only focusing on visual aspects but also integrating other senses such as sound, smell, touch, and movement. To better understand social, cultural, and environmental relationships in urban spaces, sensory dimensions must be seriously incorporated into urban design. Cities that offer diverse sensory experiences for their residents can foster social and cultural cohesion (Zardini, 2016, 144).

- **The role of body senses in environmental perception**

Aristotle considers the "sensory organ" identical to the faculty of sense in which that organ is located. Thus, if a person possesses a specific sense organ and there is no obstacle, perception, and understanding will occur (Sadegh Zadeh Ghamsari, 2010, 36). He categorizes passion into two types, considering the nature of the agent and the patient. Sometimes the agent has a nature opposite to the patient, and sometimes not. Aristotle refers to the second kind (Mokhtari, 2020, 33). Gibson's ecological approach to perception assumes that all potential uses of an object's meanings are directly perceivable in the visual field or in the structure of non-visual information, accessible by other perceptual systems. Individuals must know (and often learn) what to look for; perception of meaning is based on mental schemas (Shahcheraghi, 2010, 75).

Some emphasize the ecological aspect as part of nature, like Steiner, who uses "ecological flows" to describe objectivity, and Farina, referring to "living and non-living substrates" in an "ecological approach" to landscape. Additionally, Cosgrove, Forman, and Naveh highlight processual and ecological aspects, pointing to nature (Hemmati & Saboonchi, 2021, 19). Ecological urbanism suggests three possible research directions: evolution of aesthetic perception, deeper understanding of the human factor in ecology, and reflective learning through action and experience (Steiner, 2011, 334). According to Bentley et al. (2015), Most of the information that users deal with flows through the eyes. Thus, much of the concern in designing responsive environments is linked to discussions on visual sensory richness. Sensory richness isn't merely visual but is influenced by other senses, including movement, smell, hearing, and touch, which are design requirements. Gibson (2014) emphasizes the importance of affordances in perceiving and acting within environments, stating that how people perceive urban spaces—such as walkability, socialization areas, or relaxation spots significantly influences their behaviors. The relationship between sensory perception, individual experience, and time deeply shapes human behavior in urban spaces. Sensory perception acts as a gateway for engaging with the environment; visual elements like architectural designs and lighting influence perceptions of movement and safety, while auditory stimuli, such as background noise or music, affect mood and spatial engagement. Additionally, smells and textures evoke emotional and physical responses that either enhance or inhibit participation in a space.

- **Behavior and behavioral environment**

Human behavior results from an interplay of individual motivations and needs, environmental affordances, mental representations of the external world, and the meanings derived from these perceptions. Consequently, every activity is shaped by these factors and can manifest in various behavioral forms. For example, sitting behaviors may include sitting on a bench, squatting, or reclining. Behavior stems from an individual's interpretations and perceptions of the social and built environment (Khatibi, 2013, 69). Culture plays a fundamental role in shaping behavioral patterns, which in turn determine how people utilize spaces. Generally, environment and culture are two primary factors shaping human behavior, both of which have been examined from various perspectives (Paknezhad & Latifi, 2018, 53). Behaviors exhibit an inherent order and pattern influenced by both internal personal factors and external environmental forces, making them interpretable. In essence, behavior represents a form of learning and an active response to environmental conditions, wherein individuals modify either their surroundings or their own behavior to fulfill needs and ensure survival (Tafakkor et al., 2020). Between the built environment and observed behaviors of inhabitants, cultural norms and social systems act as intermediaries. Various components of the built environment are interpreted through these norms, enabling people to engage with their residential spaces in an everyday

manner (Motalebi, 2022, 60). Given that individuals differ in their sensitivity to the aforementioned factors based on their personal characteristics, the concept of "behavioral environment" is defined as the portion of the environment composed of elements to which an individual exhibits sensitivity (Lang, 2009, 73-77). Theories of spatial cognition suggest that human interaction with space involves sensory integration and cultural context. This aligns with research indicating that physical attributes such as natural lighting and spatial configurations profoundly influence emotional states and cognitive functions (Pallasmaa, 2024). Kaplan & Kaplan (1989) introduced the environmental-behavioral congruence model, emphasizing how human perception of space affects behavior. According to this model, people are naturally drawn to spaces that they can easily comprehend, interpret, and navigate. Spaces characterized by visual clarity, appropriate complexity, coherence, and an element of mystery tend to be more attractive and foster positive behavioral patterns.

Given the significance of human interactions in urban spaces, collective spaces serve as essential platforms for facilitating these interactions by defining social activities and the dynamics between individuals and groups. This perspective has led to a paradigm shift from environmental determinism where design seeks to eliminate negative behaviors toward possibilism, which focuses on fostering positive behaviors through environmental design. Based on the interpretations of environmental influence and behavioral emergence, selecting a place for any activity requires mutual acceptance between the individual and the setting. This reciprocal relationship manifests at the most granular levels of behavior and can be conceptualized as "synomorphy," a term describing the interconnectedness between spatial form and human behavior.

- **Behavioral domains in the environment**

From Dewey's (1933) perspective, a genuine goal always originates from a motivation, and the prevention of the immediate execution of an impulse (interpreted as an event or encounter) transforms it into a desire. Motivation and desire do not operate independently but rather emerge through interaction with environmental conditions, leading to specific consequences. Motivation for a simple act such as walking is only realized in active engagement with the ground on which an individual stands. Under normal circumstances, there is no compulsion to pay significant attention to the ground; however, in a stimulating situation, careful observation becomes essential such as climbing a steep, rugged mountain with no designated path. Therefore, observation training is a prerequisite for transforming motivation into a goal (Dewey, 1986). Dewey developed a method for knowledge construction within a specific experience by observing conditions, recognizing past occurrences in similar situations, and synthesizing judgments about current observations to determine their implications (Pour Shafei et al., 2021, 3-4). Human behavior results from a combination of individual motivations and needs, environmental affordances, mental representations of the external world, and the meanings these representations hold. Consequently, activities influenced by these factors can take various forms and produce diverse behaviors. For instance, sitting behaviors may include sitting on a bench, squatting, or reclining. Behavior is shaped by an individual's perceptions and interpretations of the social and built environment. According to Gehl (1987), human activities in public spaces can be categorized into three types, each requiring distinct physical environmental characteristics: necessary activities, optional activities, and social activities (Khatibi, 2013, 66). Based on this classification, behavioral patterns and activity scopes in a given space are determined by users' perceptions of the environment. These perceptions depend on both internal characteristics of individuals (such as education, religion, tradition, family upbringing, literacy, and experiences) and external factors influencing individual or collective perception derived from the behavioral environment. Consequently, the behaviors analyzed in this study are classified into short-term and long-term interactions, momentary and unpredictable behaviors, maladaptive behaviors, routine behaviors such as walking, and individual behaviors such as attention and observation.

By integrating all the discussed concepts, this study aims to establish a conceptual and theoretical consensus among the examined perspectives. Addressing the research gap, this study connects common theoretical points to achieve

its primary research objective. To facilitate this process, Fig. 1 presents the theoretical framework of the research, illustrating how these ideas can be structured within a comprehensive model.

## Research Method

Given the qualitative nature of the research and the need to provide a comprehensive response to the research question, selecting an appropriate research method for data collection and field investigations of behavioral settings in target spaces is of utmost importance. To achieve this objective, two behavioral study methods within the ethnographic framework were combined with sensory diagrams. Cooper Marcus and Francis's approach to behavior mapping also included post-occupancy evaluation techniques (redesign), which emphasized systematic approaches and the functional realities of space rather than aesthetic concerns. While they acknowledged that aesthetics influence how a space is used and enjoyed, they argued that aesthetic critics primarily focus on form, whereas behavior mapping assesses the interaction between people and the spatial form (Mansourniaetal.,2016,78). Behaviormappingcanbe categorized into two types: 1) Stationary behavior mapping and 2) Movingbehaviormapping (Gehl&Svarre,2013). For conducting behavioral studies and creating behavioral maps, tools such as photography and videography were utilized. The video recording sessions were structured into 10-minute intervals, with two frames from each video being analyzed. Additionally, photography sessions were conducted in 40-minute intervals, with two frames analyzed from each session across five different periods. These studies were carried out without gender or age segmentation, focusing on observed behaviors in the space as identified by the researcher. The aim was to classify various activities and behaviors within the physical context under study, as illustrated in Fig. 2, which comprehensively presents the research process. In the sensory-walking technique, given the variations in sensory landscapes and the consistency of behavioral patterns

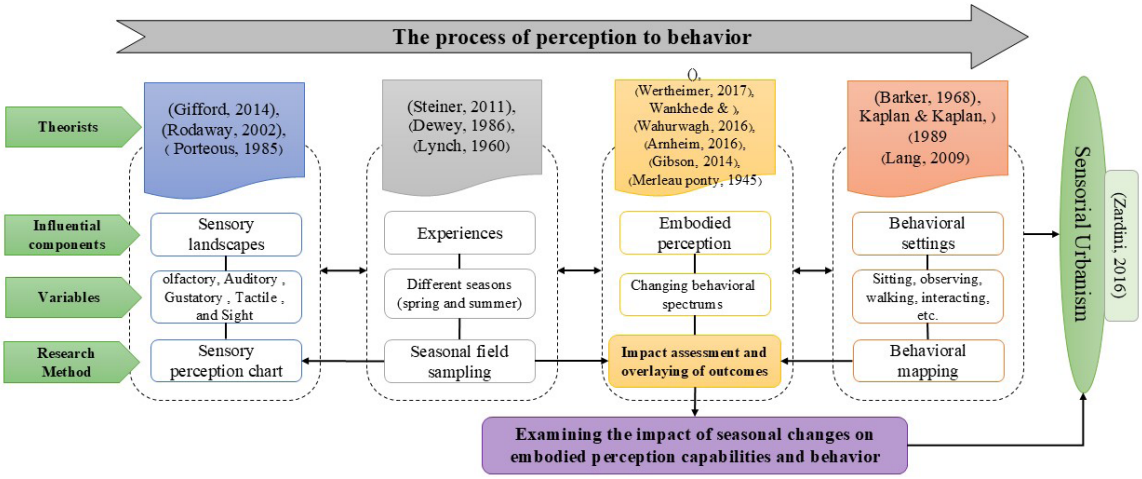


Fig. 1. The conceptual model of the research is based on the intellectual connections of theorists in the field of perception and behavior. Source: Authors.

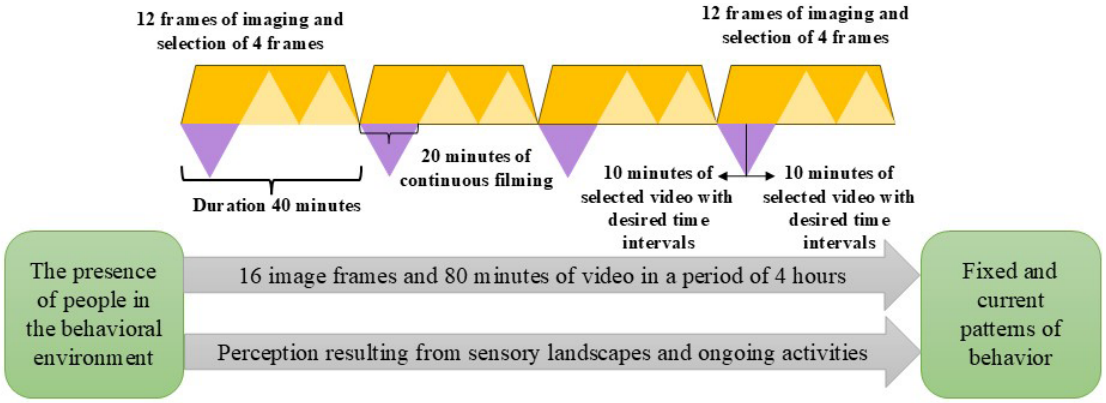


Fig. 2. Behavioral Study Method in Specific Time Intervals. Source: Authors.

within the space, the points selected for completing sensory diagrams varied depending on the spatial extent. However, in terms of distribution, efforts were made to ensure that the impact zones of sensory landscapes were chosen in an equally distributed and effective manner.

## Case Study

Darakeh is a neighborhood in northern Tehran, located near the districts of Evin and Velenjak and positioned west of Shemiran, as illustrated in Fig. 3. Due to its location at the foothills of Tehran's northern mountains, this area is considered one of the prime destinations for hiking in the city. The mountainous valley of Darakeh is situated in northwestern Tehran on the alluvial fan of the Darakeh River, overlooking Hesarak. It is bordered to the south by Evin and Saadat Abad and to the north by the heights of Tochal and Shahneshin. In terms of elevation, it ranges from a minimum of 1,590 meters at its southernmost point to a maximum of 3,944 meters at Tochal, with the valley extending approximately six kilometers in length. The selection of this study area can be justified by its diverse sensory landscapes, resulting from its geographical location, which aligns with the research objectives. The dense green domain and waterfront edges distinguish this neighborhood both in terms of visual landscape and tactile perception compared to similar urban spaces. Additionally, the presence of restaurants, cafés, and food carts enriches the olfactory and gustatory experience, setting it apart from other areas primarily focused on visual landscapes. Lastly, the continuous presence of key and ambient sounds contributes to a distinctive soundscape, making this area uniquely characterized by a pink noise environment.

## Finding

### • Behavioral and sensory studies of Darakeh public space

Behavioral differences mainly occur in specific settings with the greatest sensory richness during sensory landscape changes. To accurately identify these changes, different behavioral settings were segmented as evaluation points for behaviors and senses through diagrams. In Fig. 4, points were strategically chosen at varying intervals, guided by changes in behavioral ranges and sensory landscapes, to investigate behavioral patterns, record sensory observations, and generate diagrams based on these points.

As is evident, urban spaces exhibit diversity in terms of design, nature, and expectations. Streets and pedestrian-oriented spaces are among the key urban environments where behaviors emerge based on their location, texture, history, and existing functions whether aligned with the design objectives or not. The selected urban space in Tehran (Darakeh) serves as the case study for this research. In addition to its significant economic and

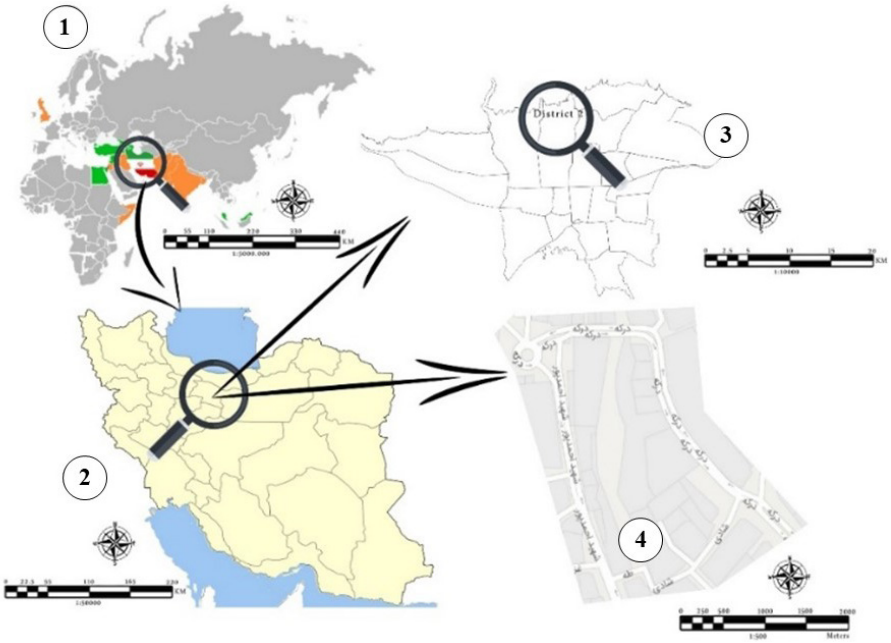


Fig. 3. Location of the studied sample. Source: Authors.


Fig. 4. Sensory Data Collection Points of Darakeh Space Based on Movement System. Source: Authors.

social functions, this space is also highly important due to the diversity of sensory landscapes it offers. Behavioral changes resulting from seasonal variations, whether in static or dynamic activities, are an undeniable reality. These behavioral shifts, occurring across a spectrum of actions both positive and those leading to social irregularities are directly linked to changes in the sensory landscapes of the studied spaces. Such changes can influence the organization of behavioral settings based on different activity ranges. Fig. 5 illustrates the behavioral spectrum of the studied space during spring and summer, based on field observations previously discussed in the methodology section. Additionally, Figs. 6 & 7 depict the categorization of these behaviors across different seasons.

To understand behavioral maps accurately, besides categorizing behaviors into compatible and anomalies, the frequency of their occurrence is important. This indicates behavioral relationships with sensory landscapes and their impact on strengthening or weakening behavioral domains. Table 1 describes the number of occurrences of each behavior (according to the behaviors mentioned in the theoretical foundations).

- **Sensory note-taking**

Changes in the occurrence of variable behavioral patterns are undeniably highly dependent on an individual's perception of their surrounding environment. Sensory landscapes, as the environment's constituent elements, send a message that encourages the receiver to engage in various activities and behavioral ranges. Therefore, it is necessary to examine the state of sensory landscapes, which form the basis for creating meaning and understanding concepts from space, to determine the effects of sensory enrichment on individuals' behaviors. Considering the previous emphasis on embodied perception and taking into account Merleau-Ponty's phenomenological philosophy, Fig. 8 displays the sensory diagrams related to the aforementioned points during the spring and summer seasons.

## Discussion

According to Barker, the environment generates behavioral settings and plays a more significant role in determining behavior than the individual. This means that a behavioral setting defines the spectrum of possible behaviors that may occur. In his view, each behavioral setting contains identifiable stimuli, including both physical and social aspects. Therefore, modifying objects within a behavioral setting can lead to behavioral changes (Emamgholi et al., 2012, 30). Lang (2009), affirming Barker's theory of behavioral settings and aligning with his perspective, defines behavioral settings as stable combinations of activity and place that include the following components: a recurring and repeatable activity or an ongoing behavioral pattern, a specific environmental

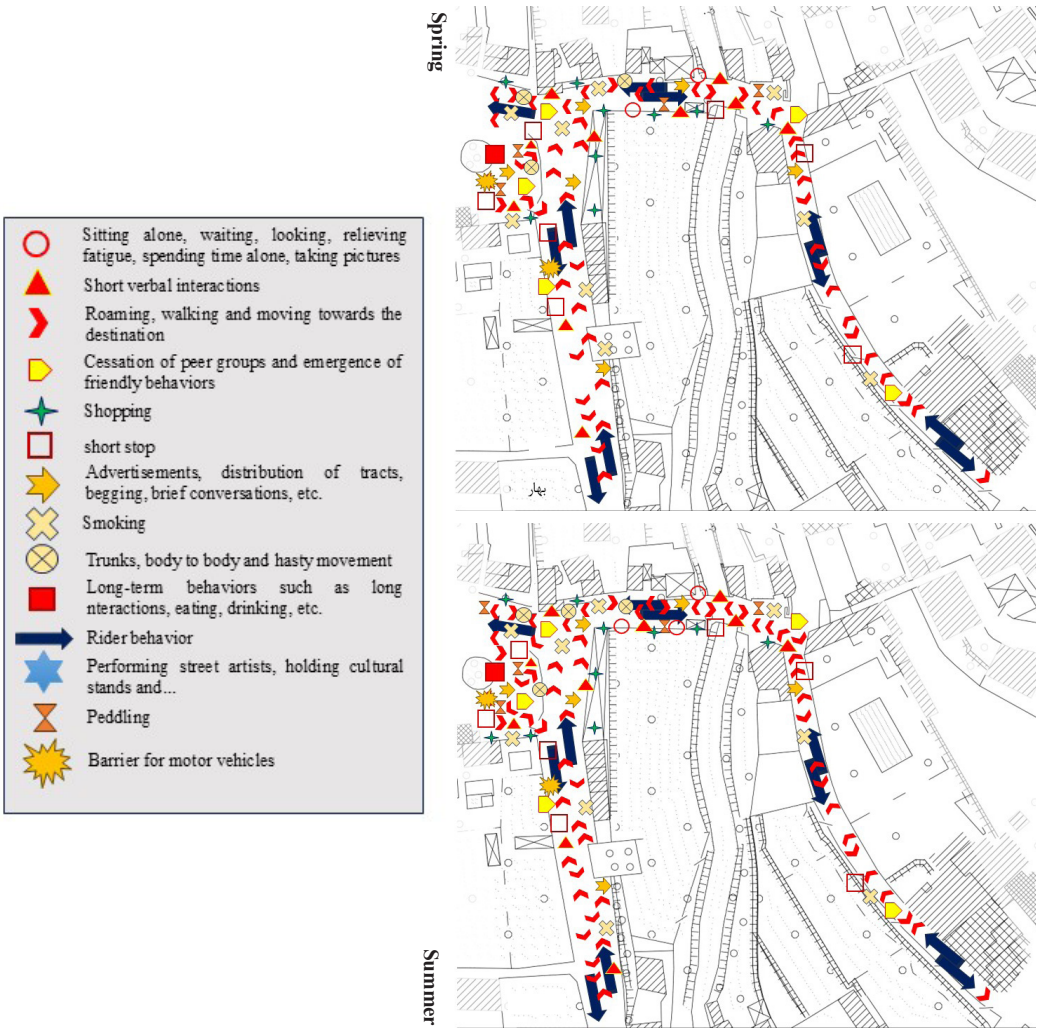


Fig. 5. Occurrence of Behaviors in Spring and Summer Seasons in Darakeh Public Space. Source: Authors.

Fig. 6. Spring behavioral Settings in Darakeh space. Source: Authors's archive.

Fig. 7. Spring Behavioral Settings in Darakeh space. Source: Authors's archive.

or physical layout, a consistent relationship between the two (isomorphy), and a defined time frame. In Milligan's (1998, 2003) perspective, individuals' active engagement with a place creates shared meanings. These meanings become layered within a place, and through the act of interpreting them, place identity and place attachment emerge and are shared with others. The strong connections between sensory experiences and the meanings of

urban spaces illustrate spatial socialization and sensory experiences that occur through urban landscapes, soundscapes, smellscapes, and tactile landscapes. In the present study, the collective space under investigation has been divided into micro-spaces, each considered a behavioral setting with its own unique sensory landscapes that influence the communication of activity-related and physical messages to individuals. Findings indicate that during spring and summer, despite the presence of similar target groups, variations in behavioral manifestations within the space are evident due to seasonal sensory changes affecting users' perception. Fig. 9 presents an overlay of behavioral occurrence frequency charts within each setting and the intensity of sensory stimuli at each location. This visualization illustrates how specific behaviors are stimulated through one or more sensory modalities.

The results of this study align with previous research, demonstrating that olfaction and vision are key factors in social interactions and human behaviors. To compare the findings related to the effect of sensory landscapes on behavior, as illustrated in Fig. 9, it can be stated that: 1) The effect of olfaction on users' behavior: Numerous studies have been conducted on the influence of olfaction on behavior, which can be further examined. For instance, research in 2014 showed that fragrances could enhance social interactions and elicit positive emotions in individuals. Supporting this notion, the chart indicates that

Table 1. Breakdown of Behavior Occurrences in Behavioral Settings of Darakeh Public Space in Spring and Summer Seasons. Source: Authors based on: Tafakkor et al., 2019; Khatibi, 2013; Gehl, 1987.

| Time and Environment of Observations | | | Current Behavioral Patterns (Stable and Variable) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Season** | **Physical environment** | **The time period of observation** | **Momentary behaviors such as taking pictures, sheltering in the canopy, singing, etc.** | **Collective or individual maladaptive behaviors** | **Hanging out and long stops** | **Walking, aimless movements, and short standing** | **Acting to gain attention, attention, and attention** | **Friendly interactions, short chats, jokes, waiting and...** | **One-on-one interactions with strangers** |
| Spring | A-AB | First observation | 2 | 6 | 0 | 17 | 1 | 0 | 1 |
| | B-BC | | 5 | 12 | 4 | 20 | 11 | 6 | 12 |
| | C-CD | | 4 | 20 | 9 | 40 | 17 | 10 | 26 |
| | D | | 1 | 18 | 6 | 26 | 6 | 2 | 8 |
| | A-AB | Second observation | 0 | 9 | 0 | 26 | 0 | 1 | 5 |
| | B-BC | | 9 | 10 | 2 | 39 | 5 | 8 | 18 |
| | C-CD | | 4 | 15 | 12 | 43 | 14 | 10 | 37 |
| | D | | 0 | 6 | 5 | 22 | 6 | 4 | 12 |
| | A-AB | Third observation | 0 | 11 | 1 | 27 | 1 | 3 | 2 |
| | B-BC | | 12 | 8 | 2 | 36 | 9 | 8 | 26 |
| | C-CD | | 4 | 18 | 6 | 31 | 9 | 16 | 32 |
| | D | | 2 | 8 | 2 | 42 | 7 | 4 | 6 |
| | A-AB | Fourth observation | 0 | 16 | 1 | 19 | 5 | 2 | 6 |
| | B-BC | | 7 | 14 | 4 | 25 | 14 | 10 | 14 |
| | C-CD | | 5 | 29 | 11 | 46 | 20 | 13 | 29 |
| | D | | 4 | 13 | 3 | 38 | 4 | 2 | 11 |
| | Average of observations | A-AB | 0.5 | 10.5 | 0.5 | 22.25 | 1.75 | 1.5 | 3.5 |
| | | B-BC | 8.25 | 11 | 3 | 30 | 9.75 | 8 | 17.5 |
| | | C-CD | 4.25 | 2.5 | 9.5 | 40 | 15 | 12.25 | 31 |
| | | D | 1.75 | 11.25 | 4 | 32 | 5.75 | 3 | 9.25 |
| | Total behavioral incidence | | 59 | 213 | 68 | 497 | 129 | 99 | 245 |

Rest of Table 1.

| Time and Environment of Observations | | | Current Behavioral Patterns (Stable and Variable) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Season | Physical environment | The time period of observation | Momentary behaviors such as taking pictures, sheltering in the canopy, singing, etc. | Collective or individual maladaptive behaviors | Hanging out and long stops | Walking, aimless movements, and short standing | Acting to gain attention, attention, and attention | Friendly interactions, short chats, jokes, waiting and... | One-on-one interactions with strangers |
| Summer | A-AB | First observation | 3 | 8 | 1 | 21 | 3 | 2 | 4 |
| | B-BC | | 10 | 18 | 13 | 31 | 19 | 19 | 20 |
| | C-CD | | 7 | 16 | 15 | 51 | 22 | 25 | 31 |
| | D | | 3 | 20 | 11 | 30 | 5 | 9 | 11 |
| | A-AB | Second observation | 1 | 5 | 1 | 14 | 2 | 11 | 8 |
| | B-BC | | 6 | 7 | 6 | 31 | 14 | 22 | 13 |
| | C-CD | | 9 | 9 | 19 | 39 | 11 | 12 | 32 |
| | D | | 0 | 2 | 7 | 31 | 13 | 11 | 8 |
| | A-AB | Third observation | 1 | 5 | 0 | 19 | 6 | 15 | 10 |
| | B-BC | | 15 | 13 | 8 | 44 | 12 | 21 | 14 |
| | C-CD | | 7 | 10 | 15 | 22 | 6 | 31 | 21 |
| | D | | 0 | 10 | 1 | 28 | 2 | 11 | 11 |
| | A-AB | Fourth observation | 1 | 10 | 0 | 27 | 1 | 8 | 3 |
| | B-BC | | 20 | 21 | 12 | 48 | 10 | 29 | 17 |
| | C-CD | | 19 | 17 | 24 | 55 | 32 | 28 | 14 |
| | D | | 2 | 4 | 7 | 40 | 9 | 13 | 15 |
| | Average of observations | A-AB | 1.5 | 7 | 0.5 | 2.25 | 3 | 9 | 6.25 |
| | | B-BC | 12.75 | 14.75 | 9.75 | 38.5 | 13.75 | 22.75 | 16 |
| | | C-CD | 10.5 | 13 | 18.25 | 41.75 | 17.75 | 24 | 24.5 |
| | | D | 1.25 | 9 | 6.5 | 32.25 | 7.25 | 11 | 11.25 |
| | Total behavioral incidence | | 104 | 175 | 140 | 531 | 167 | 267 | 232 |

the effect of olfaction is mainly on the extent of friendly behaviors and interactions. 2) The effect of vision on social interactions: Research focused on the influence of visual perception on social behaviors has clearly shown that visually appealing environments can reinforce positive emotions and increase social interactions. The findings of this study also emphasize that vision plays a significant role in behaviors such as walking, standing, and observing. 3) The role of seasons and environmental changes: Seasonal changes can affect sensory experiences and, consequently, social behaviors. For example, in spring, people tend to engage more in social interactions in public spaces. The findings of this study also highlight that momentary behaviors and friendly interactions are more prominent in spring compared to other behavioral spectrums. 4) The effect of touch on social interactions: Some studies indicate that tactile perception can have positive effects on environmental awareness and social interactions. Elizabeth Grosz (1995) argues that bodies in urban spaces mutually influence one another. She describes the body as a tangible, material, living entity composed of flesh, organs, nerves, and a musculoskeletal structure, which functions as a cohesive whole only through social teachings. This study also demonstrates that an increase in tactile perception and its impact on social interactions, particularly in summer, and the changes

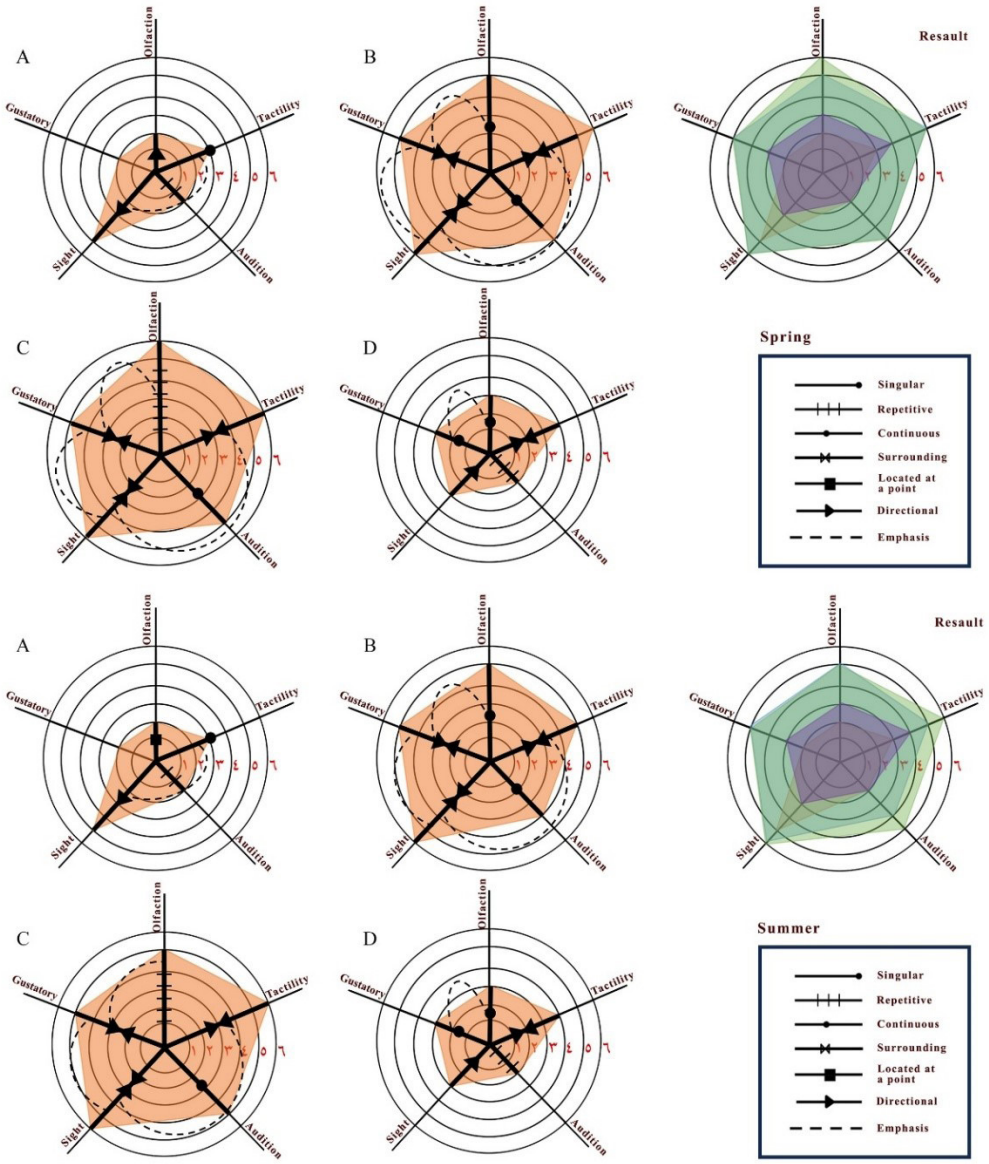


Fig. 8. Sensory Diagrams of Specified Points in Spring and Summer Seasons of Darakeh Public Space. Source: Authors.

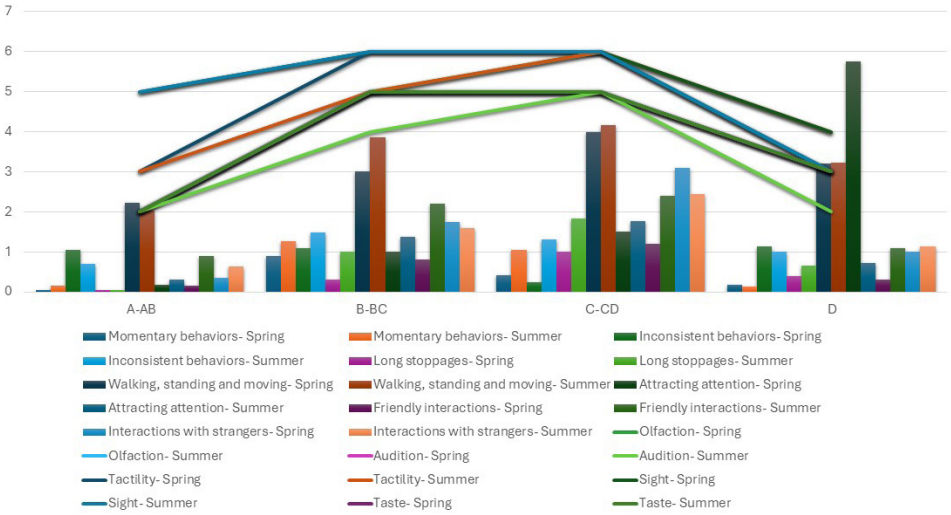


Fig. 9. The Impact of Sensory Landscapes on the Behavioral Output of Each Setting. Source: Authors.

in tactile landscapes in Darakeh, along with increased movement and presence in the space, are entirely evident. Accordingly, the outcome of the two charts analyzing the effect of sensory landscapes on behavior in terms of different behavioral spectrums can be expanded and interpreted as follows: 1) Momentary behaviors: In spring, these behaviors are primarily influenced by olfaction, which is more evident in zones C and D. 2) Non-conforming behaviors: Generally, these behaviors occur in summer and are mainly influenced by olfactory landscapes. 3) Walking and standing: In spring, these behaviors emerge with a focus on visual perception in zones C and D. However, in summer, olfactory and tactile landscapes play a more significant role in behavioral settings. 4) Prolonged stays: In spring, olfactory and visual landscapes in zones B and C are more likely to trigger these behaviors, whereas in summer, olfaction remains the strongest sensory landscape influencing this behavioral spectrum. 5) Friendly interactions: Friendly interactions are also present in zones A and C, influenced by olfactory landscapes. It is also worth mentioning that taste, as a complementary sense to olfaction, plays a significant role here. 6) One-on-one interactions with strangers: These interactions occur in summer, focusing on tactile and olfactory landscapes, primarily in behavioral settings B and C. 7) Attracting attention: In spring, visual and olfactory landscapes significantly impact zones C and D, while in summer, olfactory landscapes play a key role.

Based on the third section of the interpretation of Fig. 9, and according to seasonal variations and changes in visual landscapes in spring and summer (during which field surveys were conducted), the following conclusions can be drawn: 1) Spring: Olfactory landscapes play a dominant role in behavioral settings B and C, whereas visual landscapes are mostly influential in zones A and D. This observation is independent of the frequency of behaviors, as the focus is on the degree of influence rather than mere occurrence. 2) Summer: In summer, despite changes in sensory landscapes compared to spring, olfaction remains the most influential factor in zones C and D. However, tactile landscapes in behavioral settings B and C significantly affect behavioral spectrums. These surveys confirm that olfaction is one of the most powerful and influential sensory landscapes affecting the attractiveness or avoidance of people in behavioral environments. In general, seasonal variations in behavior demonstrate that in spring, there is a greater diversity of behaviors influenced by multiple factors, and each location is affected by a combination of sensory landscapes. In summer, behavioral environments show a greater concentration on a few dominant sensory factors, which might be attributed to changing weather conditions or differing human needs.

The fourth section of the analysis includes a comparison of the selected locations for data collection and behavioral studies. Accordingly, in Zone A, it appears that in spring, olfactory and visual landscapes were more significant, whereas in summer, no major changes in their influence were observed. Zone B was significantly influenced by auditory (key sounds and sound signals) and gustatory factors in spring. However, in summer, changes in sensory landscapes led to olfaction and tactile perception becoming the dominant sensory influences. In Zone C, the most notable differences were observed in summer, where behaviors were influenced by tactile and gustatory factors. The last location, Zone D, exhibited significant changes, with the influence of olfactory factors increasing notably in summer. The varying intensity of sensory landscapes across different seasons and locations underscores the need for specialized planning for each location and season to optimize sensory environments. This can only be achieved through long-term user feedback and extended observational studies across different periods.

## Conclusion

The differences in behavioral spectrums undoubtedly stem from various factors rooted in human personality and nature. However, the connection between these changes within a physical setting can be considered the primary reason for the non-personal dimensions of behavioral transformations. Behaviors are regarded as voluntary or involuntary responses of an individual to surrounding environmental stimuli, where sensory stimulations trigger these responses. Therefore, according to Fig. 10, which is derived from the final results of the study, it can be stated that peripheral environmental changes (in terms of

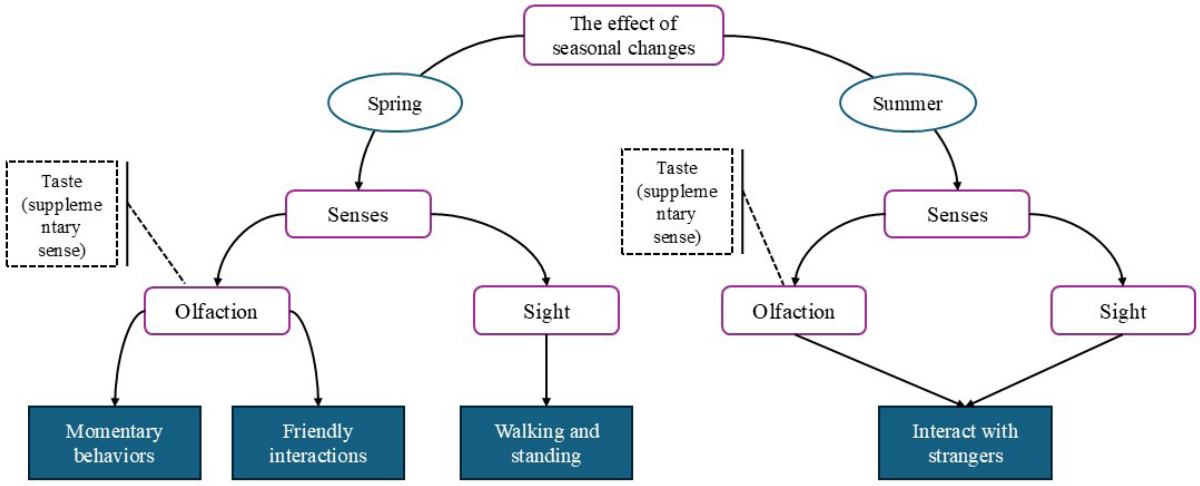


Fig. 10. The Effect of Sensory Landscape Changes on Behavioral Occurrences in Darakeh Space. Source: Authors.

different sensory landscapes) serve as the foundation for the formation or alteration of behavioral patterns, directing the frequency or type of occurrences.

The impact of sensory landscapes and seasonal changes on human behaviors in collective environments is clearly observable. Olfactory and visual landscapes in spring, in particular, lead to increased friendly interactions and spontaneous behaviors, while in summer, the sense of touch and climatic changes have a greater influence on individual interactions with strangers and collective behaviors. Analyzing behavioral patterns indicates that sensory stimuli play a decisive role in the selection of collective spaces and the types of behaviors occurring within them. Additionally, the intensity and extent of these behaviors vary across different settings depending on environmental conditions and seasons. Behaviors encompass various environmental reactions and social interactions that differ according to the nature of each setting. For instance, the data from paths A-AB and C-CD indicate more significant changes compared to other paths, reflecting the intensity and frequency of stable and dynamic behavioral patterns in these two settings relative to other behavioral locations. One of the key characteristics of behavioral settings is the "non-generalizability of behavioral patterns." Accordingly, the data reveal that certain behaviors may not occur at all or be highly limited in one setting, while the same behaviors manifest more frequently in others. For example, in path C-CD, specific types of behaviors (such as interactions with strangers) increased significantly during the summer, whereas in path D, a noticeable decrease was observed. The same pattern applies to spontaneous behaviors such as taking photographs or seeking shade, which occurred frequently in setting B-BC but significantly declined in setting A-AB. In spring, behaviors were more concentrated in paths C-CD and D, demonstrating the influence of unique sensory landscapes in these areas during this season. In summer, behaviors increased significantly in paths B-BC and A-AB. These differences are likely related to environmental changes (such as weather conditions, alterations in landscapes, or seasonal activities). In spring, a total of 497 occurrences of behaviors such as wandering and movement were recorded, compared to 531 occurrences in summer, indicating a greater tendency for walking and movement in summer. However, the distribution of behaviors in spring appeared to be more uniform. In summer, specific behaviors, such as interactions with strangers and friendly engagements, increased and had a more heterogeneous distribution. The primary distribution of behavioral patterns across different settings is influenced by the varying degrees of embodied perception of the surrounding environment, which, in conjunction with the element of time, alters the occurrence intervals and causes fluctuations in behavioral intensities.

In both seasons, path C-CD recorded the highest number of behaviors, highlighting its crucial role in the network of behavioral interactions. Significant differences in recorded behaviors, such as prolonged gatherings and spontaneous actions, showed remarkable variations between the two seasons, likely due to interactions at specific times

and the influence of sensory environments associated with these behaviors. The occurrence of behaviors in different settings is highly dependent on environmental and temporal characteristics. The observed variations emphasize the structural features of these settings, known as "synomorphy."

The structural similarity between the environment and behavior represents an interactive and reciprocal relationship between humans and the physical setting in which they are present. This means that learning is an inherent characteristic of a setting, functioning in overlapping layers over time and adding to an individual's experience. Thus, a comprehensive understanding of environmental structure, as another key feature of behavioral locations, is an inseparable characteristic of these settings. Despite these interpretations, it is important to note that one of the fundamental attributes of these settings is the inability to transfer existing behavioral patterns to another setting. This phenomenon naturally stems from perceptual changes influenced by the surrounding environment. However, this perception is not solely derived from environmental factors but also includes individual experiences. For example, if table tennis tables in a park successfully create a sports-related behavioral setting and modify established patterns, this success is not necessarily guaranteed in another location, where the same tables might instead become spots for sleeping or loitering by vagrants. Therefore, the non-transferability of behaviors observed in the Darakeh environment, particularly in locations A-AB and destination D, can be attributed to this characteristic.

Seasonal changes not only affect the physical container and appearance of the behavioral environment but also play a key role in an individual's selection process. This factor, alongside personal needs, serves as a primary determinant in choosing a space for presence. The concept of interaction implies that a behavioral setting is chosen by an individual, and conversely, the setting itself selects the individual. This dynamic is clearly observable in the Darakeh space, where friendship groups, sports groups, or individuals select the space to fulfill their various needs. The predominant occurrence of interactive behaviors in settings B-BC and C-CD attests to the mutual acceptance of these locations across a wide spectrum of activities.

Finally, it is worth noting that the collective space of Darakeh, with its diverse range of mandatory, voluntary, and social activities, along with corresponding behavioral patterns, possesses the capability to cater to a vast array of needs. However, certain spatial deficiencies, such as the lack of geometric adjustments in vehicular pathways on one hand and negative behaviors, such as criminal groups and smoking in various locations on the other, have significantly limited these potentials. Based on the findings, it can be concluded that the design of urban environments should consider sensory and seasonal changes to meet the diverse needs of users and enhance social interactions. Additionally, identifying and managing sensory landscapes can contribute to improving the quality of users' experiences in public spaces. This study emphasizes that the coordination between physical factors and environmental sensory stimuli creates a foundation for reinforcing positive behaviors and reducing behavioral anomalies. Consequently, collective space design should be structured in a way that, by considering seasonal cycles and environmental characteristics, facilitates effective interaction between humans and the environment. The incorporation of sensory elements, such as enhancing olfactory and visual landscapes in spring or optimizing tactile experiences in summer, can improve the quality of users' experiences in these spaces. Ultimately, this research identifies the role of sensory landscapes in influencing human behaviors and provides strategies for enhancing the quality of urban and natural environments. The positive effects of sensory stimuli, alongside the proper management of collective environments, can lead to the creation of more desirable spaces for social interactions and the enhancement of quality of life. The findings of this study not only serve as a basis for future research in environmental psychology but also have practical applications in urban planning and the design of collective spaces. By utilizing these findings, steps can be taken toward creating dynamic, flexible, and responsive environments that meet human needs.

## Declaration of No Conflict of Interest

The authors declare that they have no conflict of interest in conducting this research.

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