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Research Paper

The Relationship between Sensory Stimuli Integration and Visual Preferences in Small Urban Parks

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Abstract
Small Urban Parks (SUP) are vital parts of cities that can enhance the quality of the public environment. Visual Preferences (VP) in SUPs, which consist of diverse stimuli, are affected by multisensory perception, including the combination of auditory, olfactory, and tactile stimuli. However, the relationship between sensory stimuli integration (sound, smell, touch) and people's VP has been neglected during the design process, which can influence the assessment of an environmental aesthetic and preferences. The main objective of the present study is to evaluate how multisensory can affect the VP of visitors through textual and photo questionnaires. Structural Equations Model and Regression were studied on 394 participants, chosen from 16 SUPs located in different parts of Tabriz, Iran. Results identified the "Human and Natural sounds, Human-Body and Natural smells" as influential factors on visitors' VP; however, touch stimuli had no significant impact. In this regard, paying attention to the visitors' experience of Natural Sound-Smell Stimuli and the Human-body Sound-Smell Stimuli are essential in designing SUPs. The outcomes of the current research provide a guideline for city planners and landscape designers regarding the relationship between senses and their practical implications in SUPs in order to promote people's VP and visitation.

Keywords: *Multisensory perception, Stimuli integration, Small urban park, Visual preference.*

1. INTRODUCTION

Connection with nature is considered one of the fundamental needs of humans, and its' merits are being investigated by many scholars (Hergül and Göker, 2021, Salazar et al., 2021). Improving mental well-being and physical health (Houlden et al., 2018), enhancing social life (Goldy & Piff, 2020), and affecting people's visual preferences (Mousavi & and Shahhosseini, 2021) and experiences (Chawla, 2020) are among the various benefits of human-nature connectedness. Due to the urban area's densification, building small green spaces such as SUP has interested policymakers (Kerishnan et al., 2020; Wang et al., 2021; Saeedi & Dabbagh, 2021). When compared to most urban parks, SUPs are smaller in size, bounded by buildings and are usually built in vacant lots and other abounded spaces (Kerishnan & Maruthaveeran, 2021). These urban open spaces are usually located in the center of development which can be easily accessed, therefore, are considered an essential part of the urban infrastructure (Chapman, 1999).

Urban open spaces can be improved by taking the quality of the SUPs into account (Lam et al., 2005; Liu et al., 2016). Since a successful design is considered to be a crucial element in a park's success (Submitter et al., 2020, Kerishnan & Maruthaveeran, 2021), judging the aesthetic of a landscape should not be only through visual features; instead, the Auditory, Olfactory, and Tactile (A.O.T) factors must be considered as well (Thompson, 2018; Kühne, 2019; Zhao et al., 2013). A proper design not only relies on

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the physical attributes of the environment (Mousavi Samimi & Sadraei Tabatabaei, 2022) but also on the users' perception, which relates to other senses (Abedi et al., 2011). However, the majority of research has looked at each sense (vision, auditory, tactile, and olfaction) separately, as if each sensory were completely distinct from the others; nevertheless, each of the human senses collects correlated information regarding the environment, which is integrated into the brain to deliver multisensory integration (Driver & Spence, 2000).

People experience their surroundings by perceiving several stimuli that result in recognizing a specific environment (Chen et al., 2009). The cutting-edge neurophysiological work of Stein and Meredith is largely responsible for the current growth in research on the subject of multisensory perception (Spence, 2012). Various studies have argued the way people merge cues for neural perception, emphasizing the effects that develop in multisensory integration (Körding et al., 2007). The integration of senses provides the necessary information for assessing environmental quality (Uzzell, 1989; Wang & Zhao, 2021) and also can increase our preferences (Lindstrom, 2006). In order to understand the characteristics of an environment, the relationship among all sensory inputs should be established (Visell et al., 2009; Magalhães et al., 2020). Perception of the environment is not limited to the visual aspects but is a multisensory experience; visual and A.O.T stimuli of the environment are elaborately interrelated (Ulrich, 1993). In general, the sensory experience can influence aesthetic experiences and preferences in any particular context (Cats-Baril & Gibson, 1987).

Mystery, coherence, refuge, and complexity are recognized as the most preferred visual elements of SUP environments (Shahhosseini, 2014), which is grounded on the most reliable theory concerning VP; the information-processing theory of Kaplan and Kaplan (Kaplan & Kaplan, 1989). Despite this, a current lack of knowledge regarding the effects of other sensory stimuli on VPs is striking (Velarde et al., 2007). Four categories of auditory stimuli are distinguished based on the types of sounds and the contexts in which they occur (Natural, Mechanical, Instrumental and Human sounds) (Yu & Kang, 2010). The categorization of Natural, Man-made, and Human-body related smells could be extracted from previous research regarding olfactory stimuli's impact on people (Rikowski & Grammer, 1999; Chen et al., 2009). Finally, two kinds of touch factors which are related to Natural and Man-made touches have an impact on people's feelings (Chen et al., 2009; Kelsch, 2006). Since each of the visual and A.O.T stimuli has different types, all of them should be considered in detail; therefore, the variables of the current study are categorized and shown in Table 1 in order to assess their correlation.

Due to the influence of A.O.T on perceptions and preferences (van der Putten et al., 2011; Yun, 2006; Staal et al., 2003), multisensory integration should be taken into consideration in environmental design. In order to improve visitors' preferences and increase their park visits, which will develop more appropriate SUPs, multisensory stimuli should be considered when designing and planning the landscape.

1.2. Objectives of the Research

The evaluation of urban parks' VP has become challenging due to its dependence on multisensory perceptions; however, there is no comprehensive analysis of the urban parks' multisensory preferences available. Therefore, the present study's main objective is to investigate the relationship between A.O.T stimuli and VP in SUPs.

2. METHODOLOGY OF RESEARCH

The current research applied a geographical cluster sampling approach by which the small urban parks in Tabriz were divided into two categories, namely historical (old) Tabriz and greater (modern) Tabriz, which are almost homogeneous and shape a robust statistical population. The criteria for selecting SUPs were parks with a radius function between 200 to 600 m2 and less than 20000 m2 area (Kelsch, 2006), comprising special features, such as vegetation, sitting area, water features, playground area, and exercise equipment (Marcus & Francis, 1997). Based on the mentioned criteria, the number of existing parks in Tabriz is 145 (city, 2020), and 16 parks were selected for the current study. According to Mitra and Lankford (1999), a minimum of 10% of the total elements would suffice for the data collection procedures (Figure 1).

Table 1. Classification of Variables (Source: Authors)

Variables	Dependent Visual Preference		Independent Sound		Smell		Touch	
References	*(Lee and Kozar, 2009, Mumcu and Duuml, 2010, Ramanujam, 2006)*		*(Ma et al., 2021, Deng et al., 2020, Anderson et al., 1983, Benfield et al., 2010, Brown et al., 2011, Carles et al., 1992, Coeterier, 1996)*		*(Carles et al., 1992, Kelsch, 2006, Pense-Lheritier et al., 2006, Todrank et al., 1995, Zhao et al., 2018)*		*(Chen et al., 2009, Kelsch, 2006, Pense-Lheritier et al., 2006)*	
Sub-variables	Complexity	(The richness in the environment characteristic and availability of different visual elements, which enhance the users' interest to examine them more closely)	Human sounds	• Whispering • Footstep • Conversation • Children screaming • Children playing • Voice of beggars • Park's guard	Human-body related smell	• Body odor • Perfumes • Soaps or shampoos	Natural touch	• Water • Soil • Tree • Vegetation • Rock • Flowers • Animal • Snow • Fruit
	Mystery	(Obtaining more information in order to have depth in the scene)	Mechanical sound	• Vehicle engine • Bicycle wheels • Motorbikes • Car horn • Construction • Car crash • Airplane	Man-made smell	• Cigarette • Hubble bubble • Food • Plant chemical spray • Garbage & sewage • Car exhaust • Construction dust • Stagnant water	Man-made touch	• Decorative elements • Sitting equipment • Playground equipment • Wall
	Legibility	(Understanding of the environment based on some elements such as a landmark, which allows the people to compare and function effectively)	Instrumental sound	• Musical instrument • Azan • Mobile phone • Music • Firework • Police or ambulance alarm	Natural smell	• Flower • Grass • Water • Tree • Soil (dry & wet) • Fire's smoke • Rain's smell		
	Coherence	(Organizing the pattern size, brightness, and the texture in the scene)	Natural sound	• Birds • Crickets • Leaves • Animals • Insects • Water • Thunder • Wind				

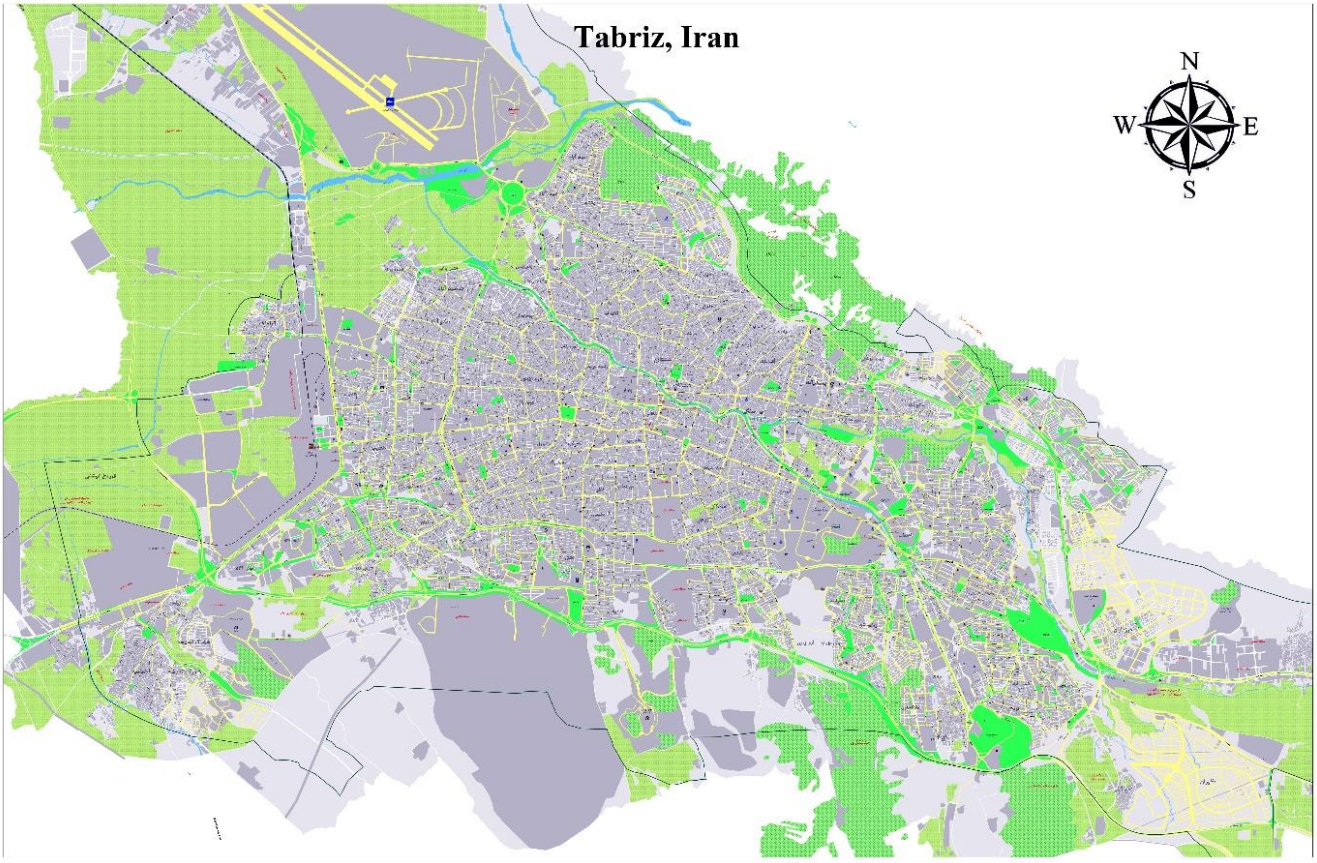

Fig 1. Selected Small Urban Parks (Source: Google maps)

2.1. Research Method and Data Analysis

The prepared questionnaire consists of a textual questionnaire and photographs of SUP, which were previously selected with the assistance of a group of experts (nine assistant professors in the field of landscape architecture with related research experience, using the Semantic Differential Scale Method (Osgood et al., 1957)). The expert group chose the three best photos that were representative (with the highest mean) of coherent, complexity, mystery, and legibility (Shahhosseini et al., 2015). Afterward, the relationship between chosen images and A.O.T were studied with the use of a textual questionnaire.

After conducting the pre-test (N = 35) and ensuring the reliability of the data, the primary test was performed; Cronbach's Alpha was calculated to assess the reliability of the questions, which except Coherence (one of VP's factors), all of them were above 0.7, demonstrating internal consistency.

The number of the selected SUPs' daily visitors was obtained based on asking the parks' guardians and direct observations. The research population was approximately 7525 people, and the sample size was calculated using Raosoft's formula (Raosoft, 2004). In total, 394 people present in 16 SUPs in spring 2020 were selected by the simple random sampling method and invited to participate in the research (Figure 2).

Participants under 18 years old (Lyons, 1983) and with an art background (Wohlwill & Kohn, 1976), were excluded from the study for having different preferences.

To identify the correlation between VP and A.O.T, the Structural Equation Modeling (SEM) (Rice et al., 2020) and standard regression coefficient were conducted in AMOS 18 software (Blunch, 2012).

SEM includes creating a model to represent how various parts of an observable phenomenon are correlated to one another and evaluates multivariate causal relationships. Since SEM tests the direct and indirect effects on pre-assumed causal relationships, it differs from other modeling methods (Klem, 2000).

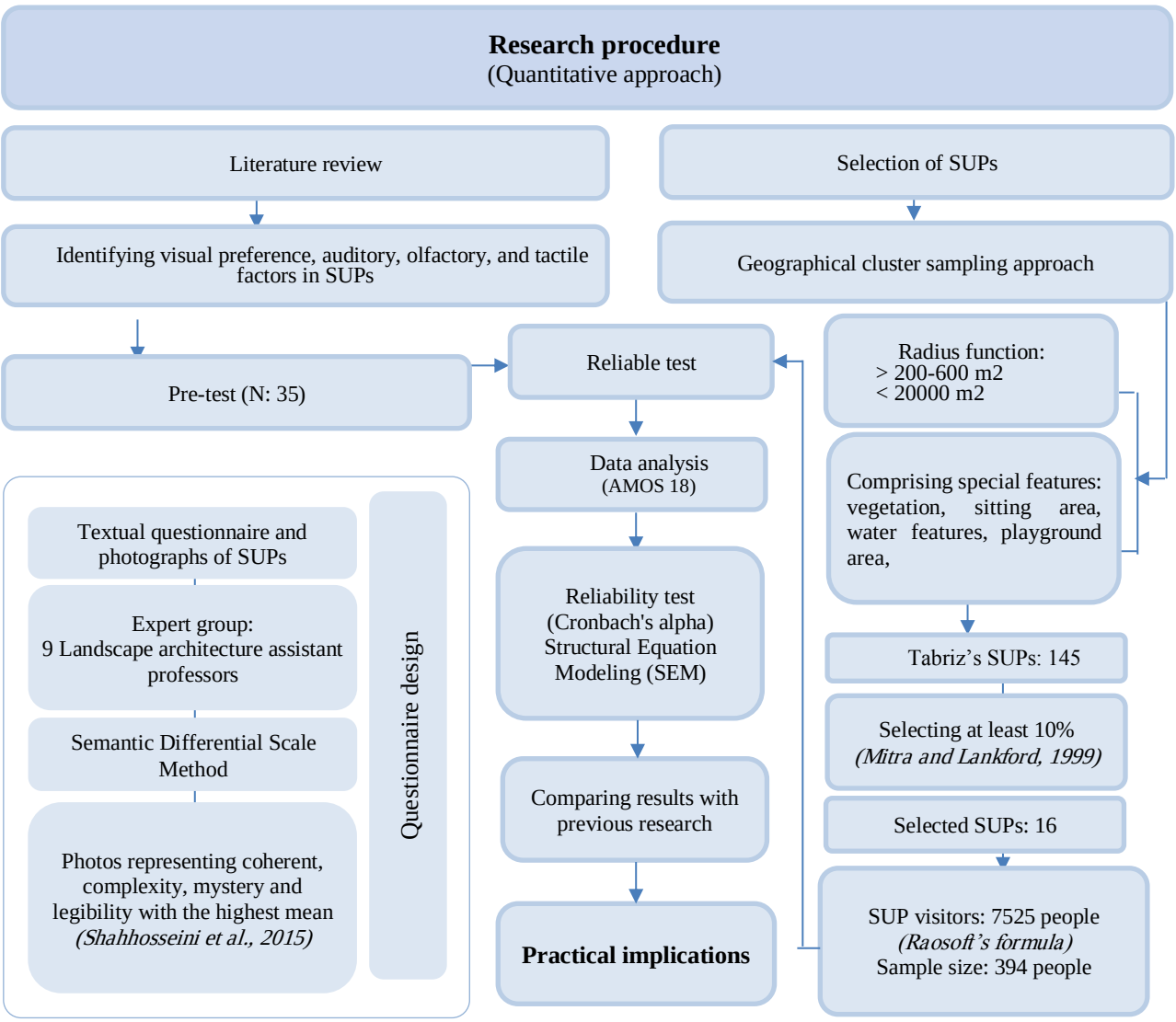

Fig 2. Research design (Source: Authors)

3. RESEARCH FINDINGS

3.1. Relationship between Sound Factors and VPs

The relation between sound stimuli and VP's regression weight estimates has demonstrated that only Natural Sound (P value = 0.008) and Human Sound (P value = 0.006) have a significant correlation with VPs (Table 2).

3.2. Relationship between Smell Factors and VPs

In order to measure the relationship between VPs and the smell stimuli, regression weights were calculated for them. The results showed that while environmental smell had a negative correlation with VPs and was not considered significant, Natural smell (P value = 0.001) and Human-body smell (P value = 0.000) had a significant relationship (Table 3).

3.3. Relationship between Touch Factors and VPs

Regression weights were conducted to analyze the effects of touch stimuli on VPs. An unexpected outcome for all of the touch factors (natural and man-made) demonstrated that there is no significant correlation between SUP visitors' sense of touch and VPs (Table 4).

3.4. The Final SEM

The A.O.T factors' correlation with visitors' VPs was evaluated by the final SEM of the research. The outcomes revealed that the human-body sound-smell stimuli (SSS) (standardized coefficient (SC) = .39 / P value= .013) and the Natural SSS (SC= .30 / P value= .012), had a significant and positive relationship with the visitors' VPs. Additionally, the correlation between the visitors' VPs with the Environmental Sound-Smell

stimuli was not supported by the revised SEM (SC= -.05), the Instrumental Sound (SC= -.19), the Man-made Touch (SC= -.07) and the Natural Touch (SC= -.01). Also, all of the variables which did not have significant values, revealed a negative influence on the visitors' VPs (Figure 3, Table 5). Moreover, the Discriminant validity among all of the independent variables was observed.

Table 2. Regression weights Estimates or significant Estimates of relationship among Sound Factors and VPs (Source: Authors)

Items- constructs			Estimate[1]	S.E.[2]	C.R.[3]	P[4]
Visual preferences	<---	Mechanical sound	.094	.058	1.620	.105
Visual preferences	<---	Instrumental sound	.015	.076	.194	.847
Visual preferences	<---	Natural sound	.269	.102	2.640	.008
Visual preferences	<---	Human sound	.318	.116	2.741	.006
Legibility	<---	Visual preferences	1.000			
Complexity	<---	Visual preferences	.904	.158	5.736	***
Mystery	<---	Visual preferences	.832	.148	5.630	***

Note: [1] Estimate of regression error; [2]Approximate standard error; [3]Critial ratio, the critical ratio is the parameter estimate divided by an estimate of its standard error; [4]Values of standard estimate; ***p<.05

Table 3. Regression weights Estimates or significant Estimates of relationship among Smell Factors and VPs (Source: Authors)

Items- constructs			Estimate[1]	S.E.[2]	C.R.[3]	P[4]
Visual preferences	<---	Environmental smell	-.013	.063	-.214	.831
Visual preferences	<---	Natural smell	.300	.092	3.255	.001
Visual preferences	<---	Human- Body smell	.217	.062	3.508	0.00
Legibility	<---	Visual preferences	1.000			
Complexity	<---	Visual preferences	.760	.135	5.630	***
Mystery	<---	Visual preferences	.681	.127	5.368	***

Note: [1] Estimate of regression error; [2]Approximate standard error; [3]Critial ratio, the critical ratio is the parameter estimate divided by an estimate of its standard error; [4]Values of standard estimate; ***p<.05

Table 4. Regression weights Estimates or significant Estimates of relationship among Touch Factors and VPs (Source: Authors)

Items- constructs			Estimate[1]	S.E.[2]	C.R.[3]	P[4]
Visual preferences	<---	Man-made Touch	.019	.049	.393	.695
Visual preferences	<---	Natural Touch	.037	.050	.734	.463
Legibility	<---	Visual preferences	1.000			
Complexity	<---	Visual preferences	.889	.163	5.468	***
Mystery	<---	Visual preferences	.741	.143	5.194	***

Note:[1] Estimate of regression error, [2]Approximate standard error, [3]Critial ratio, the critical ratio is the parameter estimate divided by an estimate of its standard error, [4]Values of standard estimate; ***p<.05

Table 5. Estimates of Regression Weights (The Final Structural Model) (Source: Authors)

Items- Constructs			Estimate[1]	S.E.[2]	C.R.[3]	P[4]
Visual Preference	<---	Human-Body Sound- Smell Stimuli	.537	.216	2.490	.013
Visual Preference	<---	Environmental Sound-Smell Stimuli	-.051	.100	-.508	.611
Visual Preference	<---	Touch Man-made	-.053	.072	-.731	.465
Visual Preference	<---	Natural Touch	-.009	.091	-.095	.924
Visual Preference	<---	Instrumental Sound	-.184	.118	-1.558	.119
Visual Preference	<---	Natural Sound-Smell Stimuli	.361	.143	2.524	.012
Legibility	<---	Visual Preference	1.000			
Natural Smell	<---	Natural Sound-Smell Stimuli	.986	.139	7.087	***
Natural Sound	<---	Natural Sound-Smell Stimuli	1.000			
Human- Body Smell	<---	Human-Body Sound-Smell Stimuli	1.080	.264	4.094	***
Human Sound	<---	Human-Body Sound-Smell Stimuli	1.000			
Environmental Smell	<---	Environmental Sound- Smell Stimuli	1.000			
Mechanical Sound	<---	Environmental Sound -Smell Stimuli	1.183	.227	5.201	***
Complexity	<---	Visual Preference	.805	.140	5.744	***
Mystery	<---	Visual Preference	.153	.028	5.492	***

Note: [1] the Estimate of regression error, [2] Approximate standard error, [3] the Critical ratio, the critical ratio is the parameter estimate divided by an estimate of its standard error, [4] standard estimate values; ***p<.05

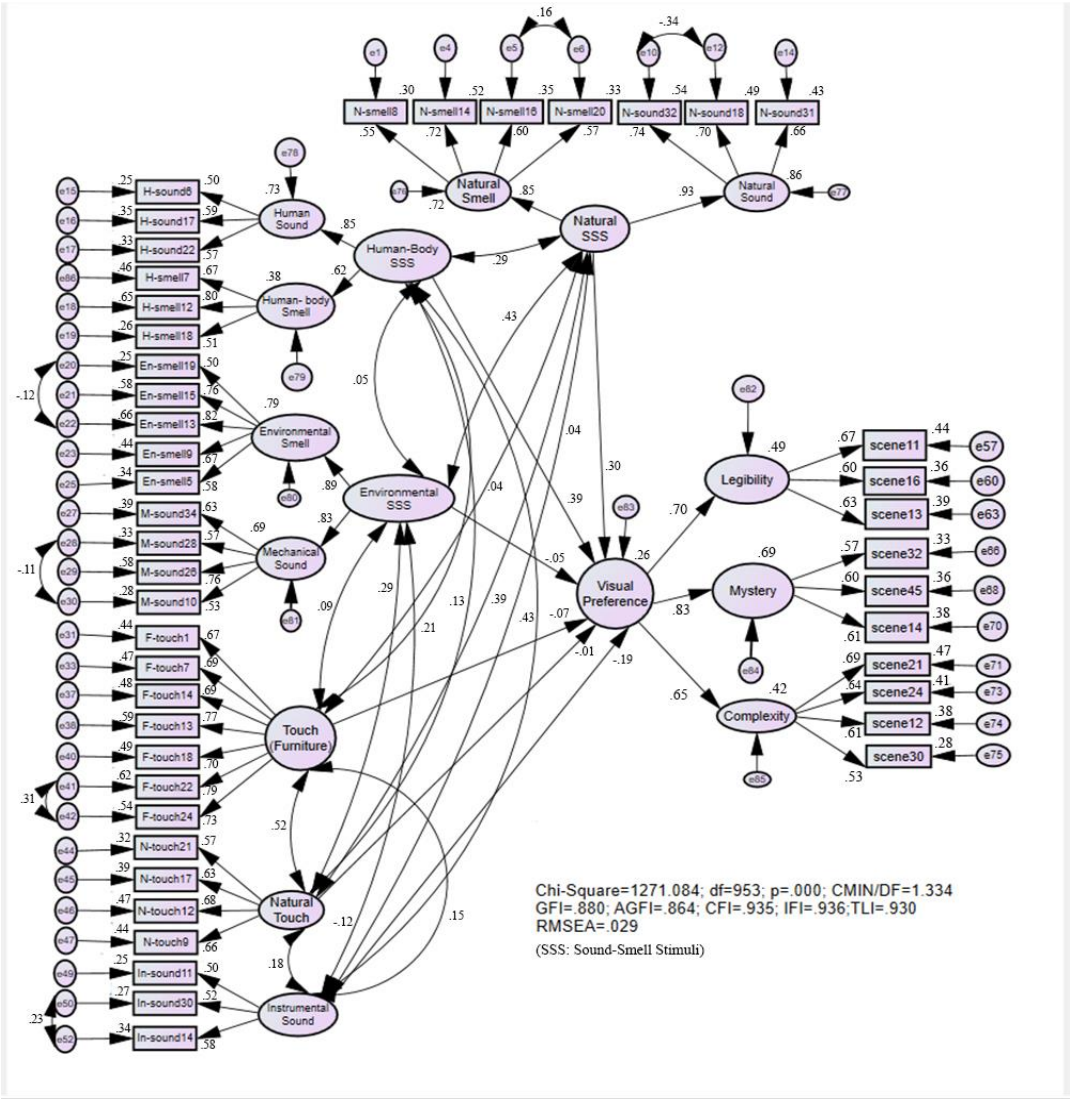

Fig 3. The Final Structural Model (Source: Authors)

4. DISCUSSION

Since different factors such as behavioral, demographical, and psychological traits have an impact on sound preferences in urban spaces, it is believed to be a complex system (Cain et al., 2013; Liu et al., 2019). Sound and its integration with the visual aspect of the environment, assist people's comprehension regarding environmental quality (Brown et al., 2011; Jeon & Jo, 2020) and also can affect visitors' experience in parks (Li et al., 2018). To be specific, natural and human sounds are more appreciated by people rather than vehicles' noisy sounds, which is completely in accordance with the current study's results (Southworth, 1970; Wang & Zhao, 2019). By raising pleasant feelings in people, natural sounds such as water, wind, and birds singing, have a positive impact on human VPs (Deng et al., 2020; Van Hedger et al., 2019; Abdalrahman & Galbrun, 2020); however, mechanical sounds diminish users' preferences (Clark & Stankey, 1979; Ma et al., 2021). By applying instructions like reducing speed limits, noise pollution should be lowered in parks (Rice et al., 2022). Additionally, children's sounds while playing in a park can increase social interactions and social ties (Chiesura, 2004).

Regarding olfactory stimuli, a number of studies have concluded a strong connection between vision and olfaction (Zhao et al., 2018, Seo et al., 2010, Wada et al., 2012), which indicate that a specific odor may awaken a memory of a landscape an also can cause comfort (Ba & Kang, 2019); therefore, the odor is widely used in landscape designs. The outcomes of the research that used people-related smells (soaps, shampoos, and lotions) to analyze the olfactory and visual relationships, demonstrated that people's preferences can be influenced by different smells (Todrank et al., 1995). Another study revealed that environment smells can be identified by a large number of people; therefore, olfactory, especially natural smell, can have a remarkable impact on landscape preferences (Chen et al., 2009). In addition, it is discussed that the smell of flowers (natural smell) can establish a scented boundary between different spaces (Kelsch, 2006).

The information regarding VPs and their connection with touch sense in the landscape field is limited. In a study regarding texture comprehension, it is concluded that the sense of touch can affect the texture's perception, but in an insufficient way (Whitaker et al., 2008). The combination of tactile sensory and respective information from its sensation can affect people's perception (Ayres & Robbins, 2005). After touching an object, the human brain will encrypt the perceived information to make decisions for aesthetic judgment, which could be related to its quality or attractiveness. Since the feeling of cleanness can affect the habitual inclination of touching various objects, it is acknowledged as a landscape characteristic (Antrop, 2000; Lee et al., 2008). That is to say, cleanness can influence decision-making and the processes of human evaluation (Grimm et al., 2000); therefore, the lack of visitors' inclination in touching various objects in the SUPs could be logical.

5. CONCLUSION

Besides drawing the attention of researchers and designers to A.O.T stimuli impact on visitors' VP, the practical implication of the current study is to suggest that by adding natural and human-body related olfactory and auditory stimulations, managers and designers can promote visitor's VP and increase their visitations which will result in developing more successful SUPs.

Landscape designers and park managers can incorporate nature-related sound and smell in SUPs by adding, increasing, or refining greenery (i.e., trees, grass, bushes) and water features (i.e., fountains, pools). Regarding human-body related auditory such as children playing sound, park guard, and whisperings, designers can consider playing these sounds in the parks' environment with indirect and subtle speakers, or providing settings that naturally create humans verbal interactions and consequently, human-body sounds. Human-body related smells like perfume, soap, and shampoo odors which characterize and embody the feeling of cleanness, can also be included in SUPs' design by artificial means such as planting trees or flowers that their scents resemble these odors (e.g., Wild Soapwort), and adding related aromas in water features and greenery.

LIMITATIONS AND FUTURE STUDIES

The intensity of olfactory and level of auditory stimuli were not considered in the current study; therefore, future research can evaluate the different intensities of smells as well as various levels of sounds such as low, moderate, and high, and their overall impact on VPs. Additionally, since this research was conducted only in SUPs and on people over 18 years old with professions rather than art and architecture, other types of the open urban environment and demographic groups can also be assessed on this matter.

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Contributions

All authors contributed equally in preparing this manuscript.

REFERENCES

Abdalrahman, Z. & Galbrun, L. (2020) Audio-visual preferences, perception, and use of water features in open-plan offices. *The Journal of the Acoustical Society of America* 147, 1661-1672.

Abedi, M., Mofidi, M. & Behzadfar, M. (2011) Investigation role of sensory stimulus in perception of urban spaces. *International Journal of Academic Research* 3, 201-205.

Antrop, M. (2000) Background concepts for integrated landscape analysis. *Agriculture, ecosystems & environment* 77, 17-28.

Ayres, A. J. & Robbins, J. (2005) *Sensory integration and the child: Understanding hidden sensory challenges.* Place: Published, Western Psychological Services.

Ba, M. & Kang, J. (2019) A laboratory study of the sound-odour interaction in urban environments. *Building and Environment* 147, 314-326.

Blunch, N. (2012) *Introduction to structural equation modeling using IBM SPSS statistics and AMOS.* Place: Published, Sage.

Brown, A., Kang, J. & Gjestland, T. (2011) Towards standardization in soundscape preference assessment. *Applied Acoustics* 72, 387-392.

Cain, R., Jennings, P. & Poxon, J. (2013) The development and application of the emotional dimensions of a soundscape. *Applied acoustics* 74, 232-239.

Cats-baril, W. L. & Gibson, L. (1987) Evaluating landscape aesthetics: A multi-attribute utility approach. *Landscape and Urban Planning* 14, 463-480.

Chapman, G. A. (1999) Design variables and the success of outdoor neighborhood recreational facilities.

Chawla, L. (2020) Childhood nature connection and constructive hope: A review of research on connecting with nature and coping with environmental loss. *People and Nature* 2, 619-642.

Chen, B., Adimo, O. A. & Bao, Z. (2009) Assessment of aesthetic quality and multiple functions of urban green space from the users' perspective: The case of Hangzhou Flower Garden, China. *Landscape and Urban Planning* 93, 76-82.

Chiesura, A. (2004) The role of urban parks for the sustainable city. *Landscape and urban planning* 68, 129-138.

City, O. O. P. A. G. S. O. T. (2020) Urban green space per capita in Tabriz, Iran. *In.* (ed.)^(eds.).

Clark, R. N. & Stankey, G. H. (1979) Determining the acceptability of recreational impacts: an application of the outdoor recreation opportunity spectrum.

Deng, L., Luo, H., Ma, J., Huang, Z., Sun, L.-X., Jiang, M.-Y., Zhu, C.-Y. & Li, X. (2020) Effects of integration between visual stimuli and auditory stimuli on restorative potential and aesthetic preference in urban green spaces. *Urban Forestry & Urban Greening* 53, 126702.

Driver, J. & Spence, C. (2000) Multisensory perception: beyond modularity and convergence. *Current biology* 10, R731-R735.

Goldy, S. P. & Piff, P. K. (2020) Toward a social ecology of prosociality: why, when, and where nature enhances social connection. *Current opinion in psychology* 32, 27-31.

Grimm, N. B., Grove, J. G., Pickett, S. T. & Redman, C. L. (2000) Integrated approaches to long-term studies of urban ecological systems: Urban ecological systems present multiple challenges to ecologists - pervasive human impact and extreme heterogeneity of cities, and the need to integrate social and ecological approaches, concepts, and theory. *BioScience* 50, 571-584.

Hergül, Ö. C. & Göker, P. (2021) Evaluating Eco-Cities With A Sustainable Perspective In Human-Nature Interaction. *Avrupa Bilim ve Teknoloji Dergisi*, 561-567.

Houlden, V., Weich, S., Porto De Albuquerque, J., Jarvis, S. & Rees, K. (2018) The relationship between greenspace and the mental wellbeing of adults: A systematic review. *PloS one* 13, e0203000.

Jeon, J. Y. & Jo, H. I. (2020) Effects of audio-visual interactions on soundscape and landscape perception and their influence on satisfaction with the urban environment. *Building and Environment* 169, 106544.

Kaplan, R. & Kaplan, S. (1989) *The experience of nature: A psychological perspective.* Place: Published, CUP Archive.

Kelsch, P. (2006) Designing small parks: A manual for addressing social and ecological concerns. *American*

Planning Association. Journal of the American Planning Association 72, 518.

Kerishnan, P. B. & Maruthaveeran, S. (2021) Factors Contributing to The Usage of Pocket Parks—A Review of the Evidence. *Urban Forestry & Urban Greening*, 126985.

Kerishnan, P. B., Maruthaveeran, S. & Maulan, S. (2020) Investigating the usability pattern and constraints of pocket parks in Kuala Lumpur, Malaysia. *Urban Forestry & Urban Greening* 50, 126647.

Klem, L. (2000) Structural equation modeling.

Körding, K. P., Beierholm, U., Ma, W. J., Quartz, S., TENENBAUM, J. B. & SHAMS, L. (2007) Causal inference in multisensory perception. *PLoS one* 2, e943.

KÜHNE, O. (2019) Aesthetic Approaches to Landscape. *Landscape Theories.* Springer.

LAM, K.-C., NG, S.-L., HUI, W.-C. & CHAN, P.-K. (2005) Environmental quality of urban parks and open spaces in Hong Kong. *Environmental monitoring and assessment* 111, 55-73.

Lee, S.-W., Ellis, C. D., Kweon, B.-S. & Hong, S.-K. (2008) Relationship between landscape structure and neighborhood satisfaction in urbanized areas. *Landscape and Urban Planning* 85, 60-70.

Li, J., Burroughs, K., Halim, M. F., Penbrooke, T. L., Seekamp, E. & Smith, J. W. (2018) Assessing soundscape preferences and the impact of specific sounds on outdoor recreation activities using qualitative data analysis and immersive virtual environment technology. *Journal of outdoor recreation and tourism* 24, 66-73.

Lindstrom, M. (2006) Brand sense: How to build powerful brands through touch, taste, smell, sight and sound. *Strategic Direction*.

Liu, C., Qi, T. & Ma, X. (2016) The research on the impact assessment of visual landscape of country parks in Beijing. *Journal of Environmental Engineering and Landscape Management* 24, 37-47.

Liu, J., Wang, Y., Zimmer, C., Kang, J. & Yu, T. (2019) Factors associated with soundscape experiences in urban green spaces: A case study in Rostock, Germany. *Urban Forestry & Urban Greening* 37, 135-146.

Lyons, E. (1983) Demographic correlates of landscape preference. *Environment and behavior* 15, 487-511.

Ma, K. W., Mak, C. M. & Wong, H. M. (2021) Effects of environmental sound quality on soundscape preference in a public urban space. *Applied Acoustics* 171, 107570.

Magalhães, E., Jacob, J., Nilsson, N., Nordahl, R. & Bernardes, G. Physics-based Concatenative Sound Synthesis of Photogrammetric models for Aural and Haptic Feedback in Virtual Environments. 2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), 2020. IEEE, 376-379.

Marcus, C. C. & Francis, C. (1997) *People Places: Design Guidlines for Urban Open Space*. Place: Published, Wiley.

Mitra, A. & Lankford, S. (1999) *Research methods in park, recreation, and leisure services.* Place: Published, Sagamore Pub.

Mousavi Samimi, P. & Sadraei Tabatabaei, N. (2022) Preschool children's indoor and outdoor playground HSV color preferences. *Color Research & Application* 47, 745-757.

Mousavi Samimi, P. & Shahhosseini, H. (2021) Evaluation of resident's indoor green space preferences in residential complexes based on plants' characteristics. *Indoor and Built Environment* 30, 859-868.

Osgood, C. E., Suci, G. J. & Tannenbaum, P. H. (1957) *The measurement of meaning.* Place: Published, University of Illinois press.

Raosoft, I. (2004) Sample size calculator. *Available from: ww raosoft com/samplesize*.

Rice, W. L., Newman, P., Zipp, K. Y., Taff, B. D., Pipkin, A. R., Miller, Z. D. & Pan, B. (2022) Balancing quietness and freedom: Support for reducing road noise among park visitors. *Journal of Outdoor Recreation and Tourism* 37, 100474.

Rice, W. L., Taff, B. D., Miller, Z. D., Newman, P., Zipp, K. Y., Pan, B., Newton, J. N. & D'antonio, A. (2020) Connecting motivations to outcomes: A study of park visitors' outcome attainment. *Journal of Outdoor Recreation and Tourism* 29, 100272.

Rikowski, A. & Grammer, K. (1999) Human body odour, symmetry and attractiveness. *Proceedings of the Royal Society of London. Series B: Biological Sciences* 266, 869-874.

Saeedi, I. & Dabbagh, E. (2021) Modeling the relationships between hardscape color and user satisfaction in urban parks. *Environment, Development and Sustainability* 23, 6535-6552.

SALAZAR, G., MONROE, M. C., JORDAN, C., ARDOIN, N. M. & BEERY, T. H. (2021) Improving assessments of connection to nature: A participatory approach. *Frontiers in Ecology and Evolution* 8, 498.

Seo, H.-S., Roidl, E., Müller, F. & Negoias, S. (2010) Odors enhance visual attention to congruent objects. *Appetite* 54, 544-549.

Shahhosseini, H. (2014) *Influence of Non-visual Factors on Visual Preferences of Visitors to Small Urban Parks in Tabraz, Iran.* Universiti Putra Malaysia.

Shahhosseini, H., Kamal Bin Ms, M. & Bin Maulan, S. (2015) Visual preferences of small urban parks based on spatial configuration of place. *Iran University of Science & Technology* 25, 84-93.

Southworth, M. (1970) The sonic environment of cities. *Ekistics*, 230-239.

Spence, C. (2012) Managing sensory expectations concerning products and brands: Capitalizing on the potential of sound and shape symbolism. *Journal of Consumer Psychology* 22, 37-54.

Staal, J. A., Pinkney, L. & Roane, D. M. (2003) Assessment of stimulus preferences in multisensory environment therapy for older people with dementia. *British journal of occupational therapy* 66, 542-550.

Submitter, G., Arifwidodo, S. & Chandrasiri, O. (2020) Better Park Design Contributes to Physical Activity Improvement. *Journals and Arifwidodo, Sigit and Chandrasiri, Orana, Better Park Design Contributes to Physical Activity Improvement (December 31, 2020). Reference to this paper should be made as follows: Arifwidodo, S*, 260-266.

Thompson, C. W. (2018) Landscape perception and environmental psychology. *The Routledge companion to landscape studies.* Routledge.

Todrank, J., Byrnes, D., Wrzesniewski, A. & Rozin, P. (1995) Odors can change preferences for people in photographs: A cross-modal evaluative conditioning study with olfactory USs and visual CSs. *Learning and motivation* 26, 116-140.

Ulrich, R. S. (1993) Biophilia, biophobia, and natural landscapes. *The biophilia hypothesis* 7, 73-137.

Uzzell, D. L. (1989) *People Nature and Landscape: A Research Review: Environmental Psychological Perspectives on Landscapes.* Place: Published, Landscape Research Group.

Van Der Putten, A., Vlaskamp, C. & Schuivens, E. (2011) The use of a multisensory environment for assessment of sensory abilities and preferences in children with profound intellectual and multiple disabilities: A pilot study. *Journal of applied research in intellectual disabilities* 24, 280-284.

Van Hedger, S. C., Nusbaum, H. C., Heald, S. L., Huang, A., Kotabe, H. P. & Berman, M. G. (2019) The aesthetic preference for nature sounds depends on sound object recognition. *Cognitive Science* 43, e12734.

Velarde, M. D., Fry, G. & Tveit, M. (2007) Health effects of viewing landscapes–Landscape types in environmental psychology. *Urban Forestry & Urban Greening* 6, 199-212.

Visell, Y., Fontana, F., Giordano, B. L., Nordahl, R., Serafin, S. & Bresin, R. (2009) Sound design and perception in walking interactions. *International Journal of Human-Computer Studies* 67, 947-959.

Wada, Y., Inada, Y., Yang, J., Kunieda, S., Masuda, T., Kimura, A., Kanazawa, S. & Yamaguchi, M. K. (2012) Infant visual preference for fruit enhanced by congruent in-season odor. *Appetite* 58, 1070-1075.

Wang, P., Zhou, B., Han, L. & Mei, R. (2021) The motivation and factors influencing visits to small urban parks in Shanghai, China. *Urban Forestry & Urban Greening* 60, 127086.

Wang, R. & Zhao, J. (2019) A good sound in the right place: Exploring the effects of auditory-visual combinations on aesthetic preference. *Urban Forestry & Urban Greening* 43, 126356.

Wang, R. & Zhao, J. (2021) Examining the Coexistence of People's Satisfaction and Ecological Quality in Urban Green Space. *Journal of Urban Planning and Development* 147, 05021002.

Whitaker, T. A., Simões-Franklin, C. & Newell, F. N. (2008) Vision and touch: Independent or integrated systems for the perception of texture? *Brain research* 1242, 59-72.

Wohlwill, J. F. & Kohn, I. (1976) Dimensionalizing the environmental manifold. *Experiencing the environment.* Springer.

Yu, L. & Kang, J. (2010) Factors influencing the sound preference in urban open spaces. *Applied Acoustics* 71, 622-633.

Yun, H.-J. (2006) A Study on the multi-sensory preferences and image influences of outdoor leisure spaces. *Journal of the Korean Institute of Landscape Architecture* 34, 23-31.

Zhao, J., Huang, Y., Wu, H. & Lin, B. (2018) Olfactory Effect On Landscape Preference. *Environmental Engineering & Management Journal (EEMJ)* 17.

Zhao, J., Luo, P., Wang, R. & Cai, Y. (2013) Correlations between aesthetic preferences of river and landscape characters. *Journal of Environmental Engineering and Landscape Management* 21, 123-132.

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