A Comprehensive Study of Preferences Toward Urban Pocket Parks

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Abstract

Urban parks are inseparable part of green spaces that have been recognized for developing the surrounding environment's quality. Aesthetic comprehension in Urban Pocket Parks, as an environment which contains various stimuli, is influenced by multi-sensory perception that includes the integration of non-visual (tactile, auditory and olfactory) and visual stimuli. As the current research's objective was to determine the impact of multi-sensory on visual preferences, Structural Equations Model results on 16 Urban Pocket Parks in Tabriz, Iran, revealed that there was a significant relation between visual preferences and Sound (Human and Natural sounds), and Smell (Human-Body and Natural smells) stimuli, however, the influence of touch stimuli on visual preferences had not identified significant. As a consequence, evaluating the public experience of Natural Sound-Smell Stimuli and the Human-body Sound-Smell Stimuli are essential in designing urban pocket parks; accordingly, city planners and landscape architects can enhance users' visual preferences by considering these stimuli.

Introduction

Senses, as part of our comprehension about life and environment, have always influenced our emotions, actions, choices, memories, awareness, perceptions and preferences (Andermane, Bosten, Seth, & Ward, 2020; Krishna & Elder, 2010; Penning-Rowsell, 1982). Our surrounding is experienced through several senses which provides us with a sense of knowledge about a particular space (Chen, Adimo, & Bao, 2009). For example, regarding aesthetic perception, it was reported that multi-sensory stimuli and integration of all the senses (vision, olfactory, auditory and tactile) can give information for evaluating aesthetic quality (Etzi, Spence, & Gallace, 2014; Uzzell, 1989). On this basis, Lindstrom (2006) indicated that the experiences of multi-sensory can increase the users' preferences toward a specific product (Lindstrom, 2006).

Visual factors form about 87 percent of our environmental perceptions (Bell, 2013), and there is a huge focus on these factor as our environment has been surrounded by them (Arriaza, Cañas-Ortega, Cañas-Madueño, & Ruiz-Aviles, 2004; Soliva & Hunziker, 2009). Thereby, the conducted researches in the psychology and design field, are mostly related to visual stimuli than others (Akbar, Hale, & Headley, 2003; Twedt, Rainey, & Proffitt, 2019). Although eyesight has been the center of humans' perception, the other senses also play an important role in the development of our perception.

The multi-sensory shape representation suggested by other researchers, brings in the whole sensory system and affects the spatial configuration (Amedi, Jacobson, Hendler, Malach, & Zohary, 2002). It is assumed that in order to form the properties of amenity and the environment by an observer, the connection between all the events that occurred in the environment, the features of all the involved objects, and all sensory inputs' arrangement is used (Visell et al., 2009). Generally, the senses are not isolated in terms of their usage, and the combination of all senses or some of them work in harmony (Bundy, Lane, & Murray, 2002). The multimodal integration, gives a coherent representation of objects and appoint them meaning in the matter of perceptual experiences through including all senses.

Ulrich (1993) demonstrated that our environmental perception is a multi-sensory rather than being restricted to the visual sense (Ulrich, 1993). As a matter of fact, visual and non-visual stimuli of the landscape are always interconnected in a complex way and require more consideration in all aspects. Ultimately, Cats-Baril and Gibson (1987) described that aesthetic experience and preferences in any particular context can be affected by sensory experience (Cats-Baril & Gibson, 1987). Also it has been stated that content and space dependent functions such as spatial ability and orientation, can cause by different sensory stimuli and their convergence (Carles, Barrio, & de Lucio, 1999).

1.1. Urban Pocket Parks

Interaction with nature is assumed to be one of the vital needs of mankind and benefits of urban green spaces have been studied by many researchers (Mousavi Samimi & Shahhosseini, 2020); physical, mental (Wan, Shen, & Choi, 2020) environmental (Li, Fan, Li, Zhang, & Dong, 2020) and social benefits (Aram, Solgi, & Holden, 2019; Gaikwad & Shinde, 2019), lower perceived stress (Chiang & Li, 2019) and negativity (Schwartz, Dodds, O'Neil-Dunne, Danforth, & Ricketts, 2019) and promoted well-being (Özgüner & Kendle, 2006; Schnell, Harel, & Mishori, 2019), public health (Van den Berg et al., 2015) and pro-environmental behavior (Martin et al., 2020; Wan & Shen, 2015) are to name but a few. Nowadays, as a result of cities' densification, constructing the small green areas like urban pocket parks (UPP), have got the attention of policy makers' as opposed to the big urban parks (Blake, 2013; Kerishnan, Maruthaveeran, & Maulan, 2020; Lin, Lau, Qin, & Gou, 2017; Nordh & Østby, 2013). One UPP is able to promote the quality of life (El Maghraby, 2019), increase physical (Cohen et al., 2014) and residential property values (Mwende, 2018), improve health (Peschardt, Stigsdotter, & Schipperrijn, 2016) and social interaction (Salih, Ismail, & Mseer, 2020).

The most preferred UPP visual configurations are mystery, coherence, refuge and complexity (H Shahhosseini, Kamal Bin MS, & Bin Maulan, 2015), although, there is still a remaining gap related to multi-sensory content of UPPs (Velarde, Fry, & Tveit, 2007). Auditory, olfactory and tactile have strong impact on humans' perceptions and preferences (Staal, Pinkney, & Roane, 2003; van der Putten, Vlaskamp, & Schuivens, 2011; Yun, 2006), and should deeply be considered when designing an environment. Through implanting multi-sensory design attributes in the landscape, the fundamental platform can be facilitated for the people of the society to evaluate their expectations of environment. As a matter of fact, based on the gathered information about users' multi-sensory perception and cognitive processing, landscape features can help the users to decide what they prefer.

1.2. Research Objectives

Since the evaluation of landscape aesthetic preferences relies on multiple factors such as emotions, values, cultural aspects, demographic characteristics, multi-sensory perceptions and etc., it is considered to be a complicated task, yet, a comprehensive explanation of the landscape preferences according to these senses is not available. Therefore, evaluating the relationship between non-visual stimuli, which may have an impact on public visual preferences in UPP s, is the main objective of the current study.

Research Method

2.1. Study area

Tabriz as the capital of East Azerbaijan Province, located in northwest of Iran, has the semi-arid climate and regular seasons. The availability and functionality of UPP s in Iran and particularly in Tabriz, is arising as a new space in the urban area. According to Table 1, Tabriz green space Per capita is 15.5 m2, which is less than international standards (40m2). Not having adequate green space, more consideration is needed with regard to the Tabriz green spaces development.

2.2. Material and Method

The current study was conducted on 16 UPPs in Tabriz, Iran. Total number of volunteered respondents to participate in this survey was 394. The devised survey questionnaire for the research contains two parts including a textual questionnaire and photograph surrogates of actual scenes and the selection of scenes was done according to the consult of a group of experts. Meanwhile, the items that were extracted from Shahhosseini's work regarding Sound, Smell, and Touch Attributes in UPPs (Habib Shahhosseini, Kamal, & Maulan, 2014), have been differentiated the non-visual stimuli. In addition, the extracted stimuli are classified in the regard of the senses studding in current research (Fig 1).

With utilization of confirmatory factor analysis with application of Structural Equation Modeling (SEM) in four different models, this study aimed to identify the relationship among latent and observed variables of visual and non-visual preferences. As a matter of fact, in this approach, the correlation between the dependent variable and independent variables (individually and their correlations with each other) were analyzed.

A priori assignment of interrelation between variables is needed in order to analyze data by SEM as a confirmatory approach. As stated by Byrne (2001) with availability of some awareness regarding theories or experimental research, the relationship among underlying factors and the observed measures could statistically test by using Confirmatory Factor Analysis (CFA) (Byrne, 2001). This method can be used inductively by identifying an equivalent model to assess the values of factors. Through the identification of an equivalent model to assess the values of factors, this approach could be used inductively. Moreover, providing predictive validation among factors, identifying the direct and indirect relations between the latent variables, and also quantities all explained and unexplained variables on the model, can be done by this technique of analysis (Blunch, 2012; Byrne, 2001).

SEM in AMOS 18 program was conducted in order to explore probability of relationship between proposed variables and to analyze the goodness-of-fit of alternative models considering non-visual preferences (exogenous variables) and visual preferences (endogenous variables). Afterward, the path analysis was computed for estimating the standard regression weight for each path. In fact, the standardized regression coefficient or path coefficient was used to measure the significant and effect of each factor. In the meantime, for testing and estimating relations of statistical data combination in a specified model, general rule of thumb regarding Schermelleh-Engel's model fit evaluation (Schermelleh-Engel, Moosbrugger, & Müller, 2003) was applied. It is also necessary to state that all of the models were tasted in advance, in terms of their discriminant and convergent validity.

Results And Discussion

Unification of all senses could help achieving a vigorous final structural model in terms of understanding the impact of non-visual stimuli on visual preferences. Nevertheless, 4 different singular models were used in this study in order to test the interrelatedness between all senses. These singular models explained the impact of Sound, Smell and Touch stimuli on visual preference at UPPs. However, it is important to mention that as coherence had high correlation with other variables, it was removed from the all-structural models. Additionally, after testing the rate of Cronbach's Alpha, the spiritual sound was removed from final models (Habib Shahhosseini, 2014).

3.1. CFA Model on Sound Stimuli

The regression weight estimates for the connection between sound stimuli and visual preferences is illustrated in Table 2 and it was demonstrated by the singular model that only Human Sound (P value = 0.006) and Natural Sound (P value = 0.008) had significant correlation with visual preferences.

The model seemed to be suitable with standardized of RMSEA (.039); TLI (.910); GFI (.901); CFI (.918); IFI (.919). Moreover, other important extra measurement was p=.001 and AGFI= .887 (Fig. 2). In regard of receiving loading factor ≥ 0.50 (below cut off value of 0.50) by all observed variables, model's R2 was .17, which is slightly close to average value for R2.

There are infrequent data in regard to the relationship between sound factors and visual preferences. However, it was noted in some of the available and the most relevant studies that different factors such as demographic, behavioral, and psychological characteristics, which can be considered from both social and physical aspects, have an effect on sound preferences, therefore, sound, mainly in urban areas, is considered to be a complex system (Cain, Jennings, & Poxon, 2013; Semidor, 2006). The quality of perceived sound and its connection with visual features, could help our conception of environmental valuation (Brown, Kang, & Gjestland, 2011). In a related study, Southworth (1970) indicated that human and natural sounds, as opposed to the noisy sound of certain vehicles, were appreciated more by people (Southworth, 1970).

Likewise, Southworth (1970) analyzed the sound as a non-visual stimulus in the nature, and demonstrated that the dynamic value of the landscape can be enhanced by the relationship between image and sound (Southworth, 1970). Also its worthy to note that the availability of green space and the sound of children playing inside that, would cause social interaction and probability of increase social ties (Chiesura, 2004). Natural sounds like bird singing, wind, and water through foliage appears to have important impact on human's visual preferences by evoking pleasant feelings (Gidlöf-Gunnarsson &

Öhrström, 2007). Moreover, the study conducted by Clark and Stankey (1979) indicated that users' preferences ca be diminished by the non-mechanical and mechanical sounds (Clark & Stankey, 1979).

3.2. CFA Model on Smell Stimuli

With the intention of measuring the correlation between the smell stimuli and visual preferences, another singular model was conducted.

The outcome of the test revealed that while Human-body smell (P value = 0.000) and Natural smell (P value = 0.001) had significant correlation with visual preferences, environmental smell had negative correlation which were not considered significant (Table 3). Final model, with standardized estimates of RMSEA (.039), TLI (.910), GFI (.901), CFI (.918) and p=.000 seemed to be fit. Additionally, R2 value for model was .16, which was close to sound's R value (Fig. 3).

The accessibility of information about impact of smell, particularly in the landscape environment, have not been considered as much as needed. In the study conducted by Todrank et al., (1995), which people-related odors (e.g. shampoos, soaps, lotions, musty, sweaty) were used as a mean to analyze visual and olfactory conditions, results indicated that public preferences can be affected by odors (Todrank, Byrnes, Wrzesniewski, & Rozin, 1995). The result of another research about china's Hangzhou Flower garden revealed that the smell in the environment can be recognized by most of the participants and olfactory, especially natural smell, could have a significant influence on landscape preferences (Chen et al., 2009). Moreover, Klesch (2006), argued that smell of flower and annuals smell which are considered natural smell, are capable of providing a scented border in the spaces (Kelsch, 2006).

3.3. CFA Model on Touch Stimuli

The impact of touch stimuli on visual preferences were tested by final singular model. The current research took step in order to apply the need scale for touch, concerning man-made touch (Peck & Childers, 2003). An unexpectedly outcome demonstrated that all included unfulfilled variables within this model with consideration of achieving a fit model in regards of standardized valuation of measurement criteria, revealed that public sense of touch in the small parks was not significant at 0.05. In the meantime, the relationship among selected variables through full fledge structural model was not supported by the model with R2 = 0.0 (Fig. 4, Table 4).

As stated before, the information about senses in the landscape field and its relationship with Touch stimuli are insufficient. In a study conducted by Whitaker et al., (2008) regarding to the role of vision and touch assessment in the perception of texture, demonstrated that either of the senses affect the texture's perception in an independent way, but a complementary manner (Whitaker, Simões-Franklin, & Newell, 2008). Information regarding objects can be classified referring to their material features (such as weight and texture) or/and geometric aspects (such as shape, size, and orientation). However, objects characteristics can be represented with the contribution of tactile and visual senses. On the other hand, Ayres and Robbins (2005) stated that individual's cognitive and perception processing system can be influenced by the integration between touch sense and relative information from tactile sensation (Ayres & Robbins, 2005). After touching or seeing an object, the human body would permit the brain to encode the information in order to make conceptual decisions for recognition, action or aesthetic judgment, which can relate to its quality or attractiveness. According to Antrop (2000) and Lee et al., (2008) since common tendency to touch various objects can be influenced by feeling dirt, cleanness has been determined as one of the landscape characteristic (Antrop, 2000; Lee, Ellis, Kweon, & Hong, 2008). In other word, human assessment and decision making processes could be affected by cleanness as a landscape value (Grimm, Grove, Pickett, & Redman, 2000), and in this regard, the lack of public interest in terms of sense of touch in the UPPs could be logical.

3.4. The Final Structural model of the Study

The correlation between public's visual preferences and the non-visual factors (olfactory, auditory, and tactile) in the UPPs was examined through the final structural model of the study.

The results demonstrated that out of six models' factor loadings, the Human-Body sound-smell stimuli (SSS) (standardized coefficient = .39) with the P value of .013 and the Natural SSS with the P value of .012 (standardized coefficient = .30), had positive significant correlations with the public's visual preferences. Meantime, the revised structural model did not support the relationship between the public's visual preferences with the Environmental Sound-Smell stimuli (standardized coefficient = -.05), the Instrumental Sound (standardized coefficient = -.19), the Furniture Touch (standardized coefficient = -.07) and the Natural Touch (standardized coefficient = -.01). Unexpectedly, all the mentioned latent variables, which did not receive any significant values, had a negative influence on the visual preferences (Fig. 5, Table 5). In addition, the discriminate validities between all the six independent variables were valid.

Conclusion

The current study evaluated the relationship between non-visual stimuli and visual preferences through applying a SEM to the public users of UPP s. From the public's point of views, it is conducted that Natural sound and smell, Human-body smell, and Human sound have an important effect on visual preferences, but the impact of touch stimulus on the UPP did not consider significant. The outcomes provide fundamental information for policy makers to increase their attention in terms of developing all kind of stimulations. Ultimately, through giving more consideration to multisensory concept and its application on the UPPs, the result could be involved throughout the design as well. Findings of this research can help designers to enhance public visitation and attract their attention to develop successful UPPs by using relevant and appropriate combination of design features in these environments. Accordingly, attention to UPPs as part of the urban space initiative could be improved to positively contribute to national commemoration, neighborhood place making, as well as revitalization efforts, and enhance the ecological benefits through sustainable practices. The impact of all senses' combination on visual preferences will be discussed by same authors on their upcoming research. Usage of sound levels, sound sources, and smell intensity in UPPs regarding to visual preferences would be suggested for the future studies.

The current study's Final structural model, which examined the correlation between visual preferences and the non-visual factors in the UPPs, has revealed the importance of two new-extracted constructs (the Natural SSS and the Human-body SSS). These new extracted constructs had significant values towards the visual landscape preferences in the UPPs. Nonetheless, the other tested constructs namely the Touch factors (Natural and Furniture Touch) and the Environmental SSS as well as the Instrumental sound did not significantly influence the public's visual landscape preferences.

Declarations

Ethics approval and consent to participate

Informed consent was obtained from all individual participants included in the study.

Consent for publication

The participant has consented to the submission of the case report to the journal.

Availability of data and materials

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declared no Competing interests

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Declaration of conflicting interests

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Authors' contributions

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Tables

Table 1. Green spaces at Tabriz city (city, 2017)

Amount of Tabriz Parks	Total area of Tabriz Parks (m2)	Total area of Tabriz Green Space (m2)	Tabriz Green Space Per capita (m2)
250	13,395,790	28,000,000	15.5

Table 2. Regression weights Estimates or significant Estimates of relationship among Sound Factors and Visual Preferences

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 Visual preferences

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	***
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 Visual preferences

Items- constructs			Estimate[1]	S.E.[2]	C.R.[3]	P[4]
Visual preferences	<—	Furniture 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)

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 (Furniture)	-.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

Figures

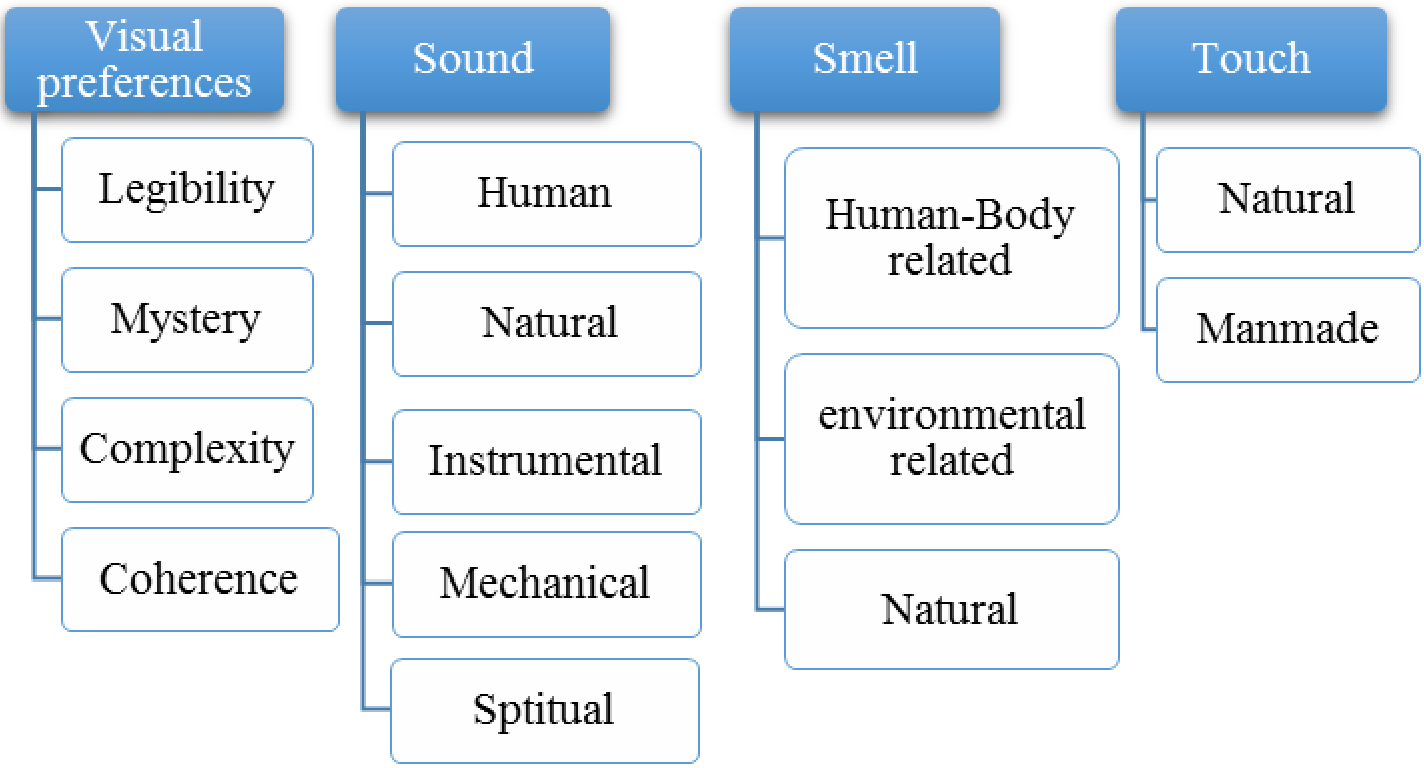

Figure 1

Classification of Variables

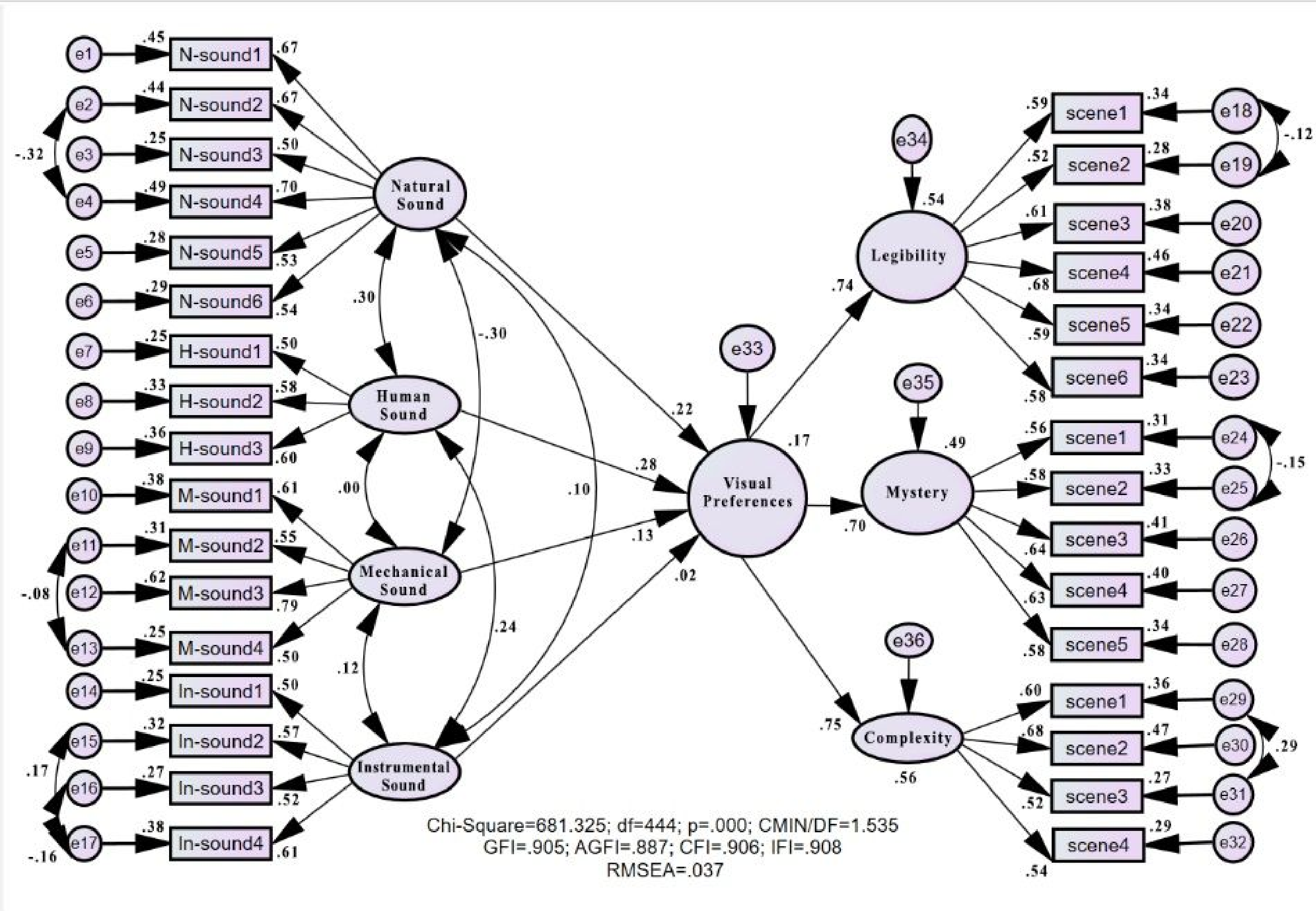

Figure 2

VP (Sound Factors) CFA Model

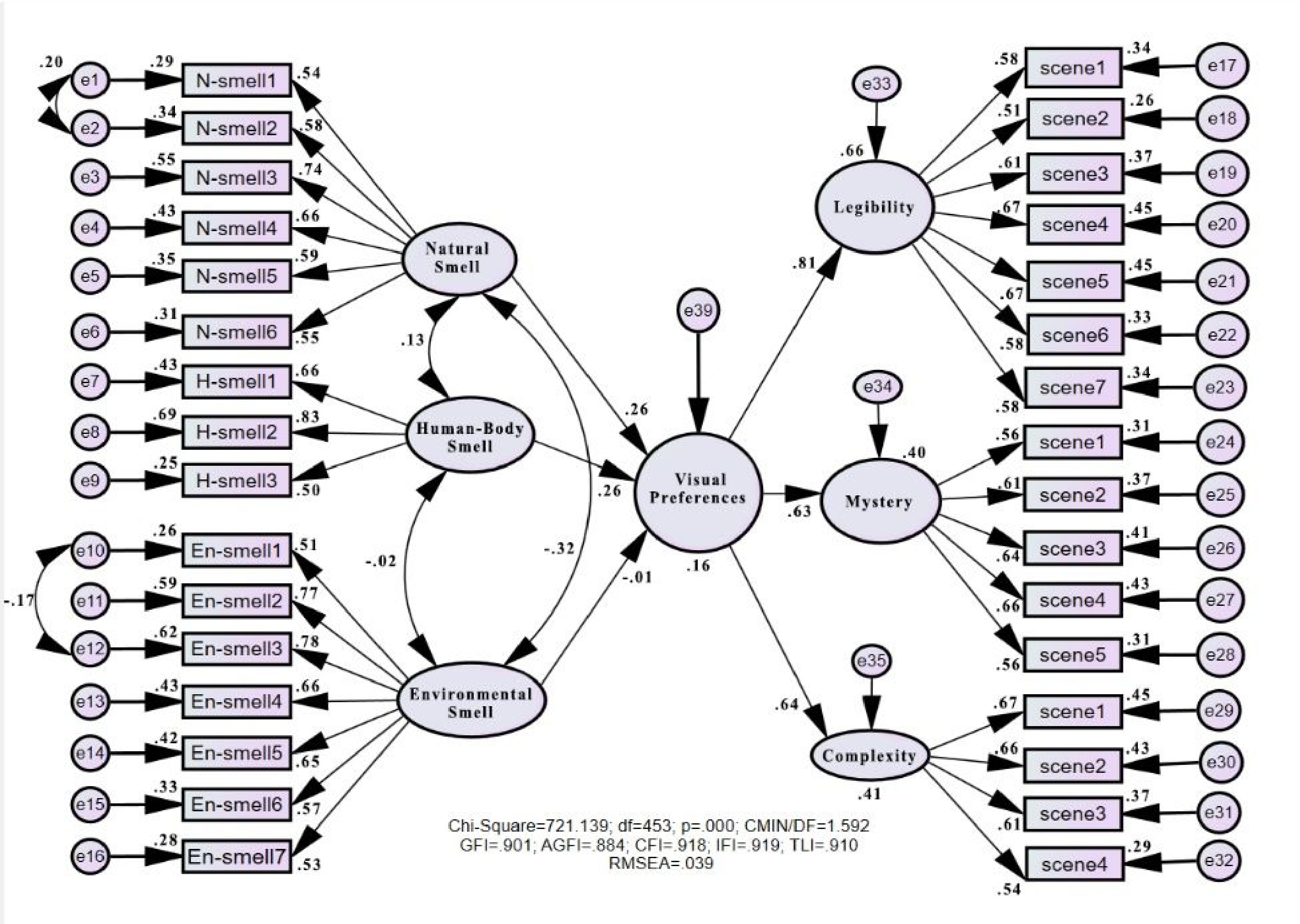

Figure 3

VP (Smell Factors) CFA Model

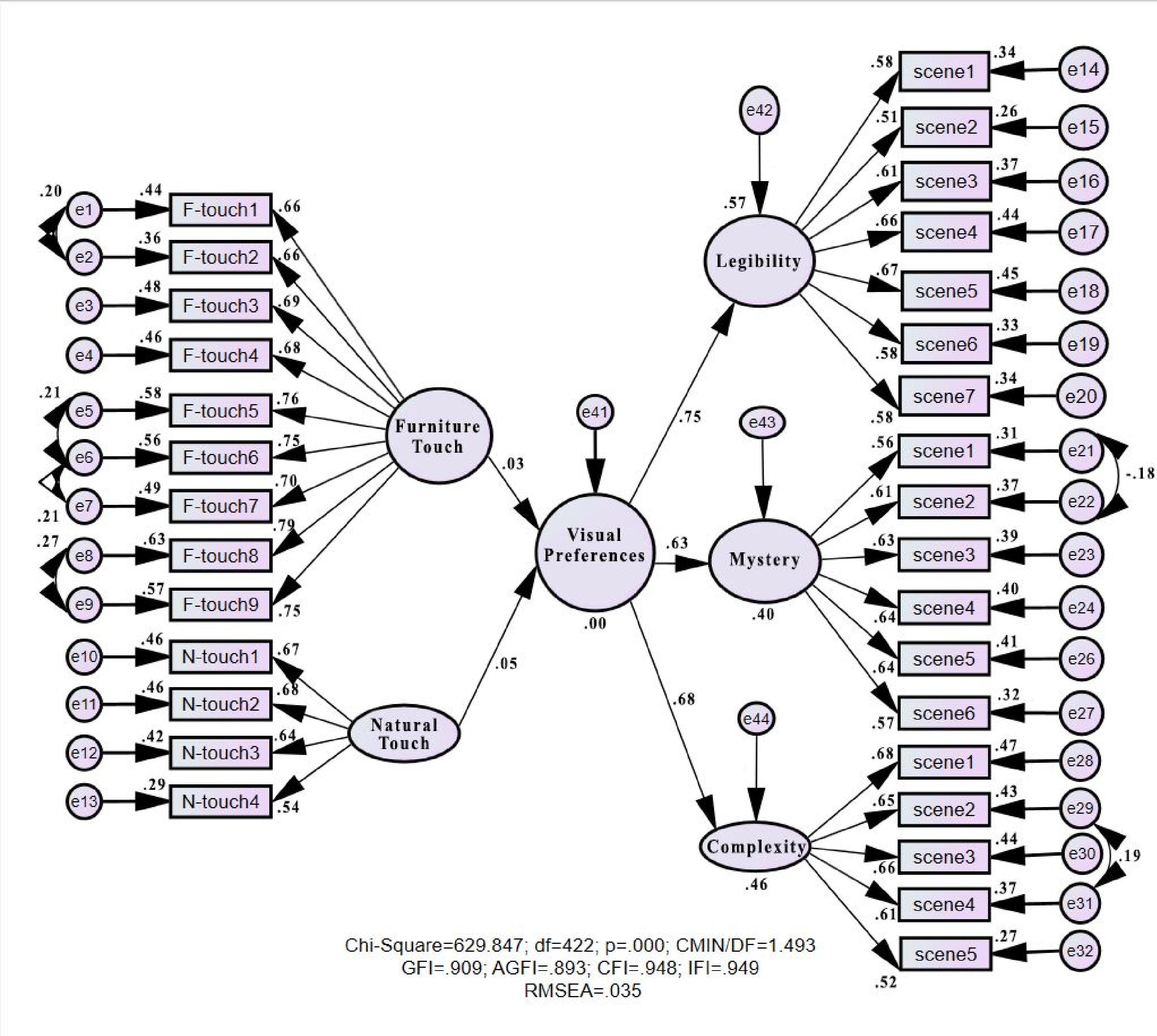

Figure 4

VP (Touch Factors) CFA Model

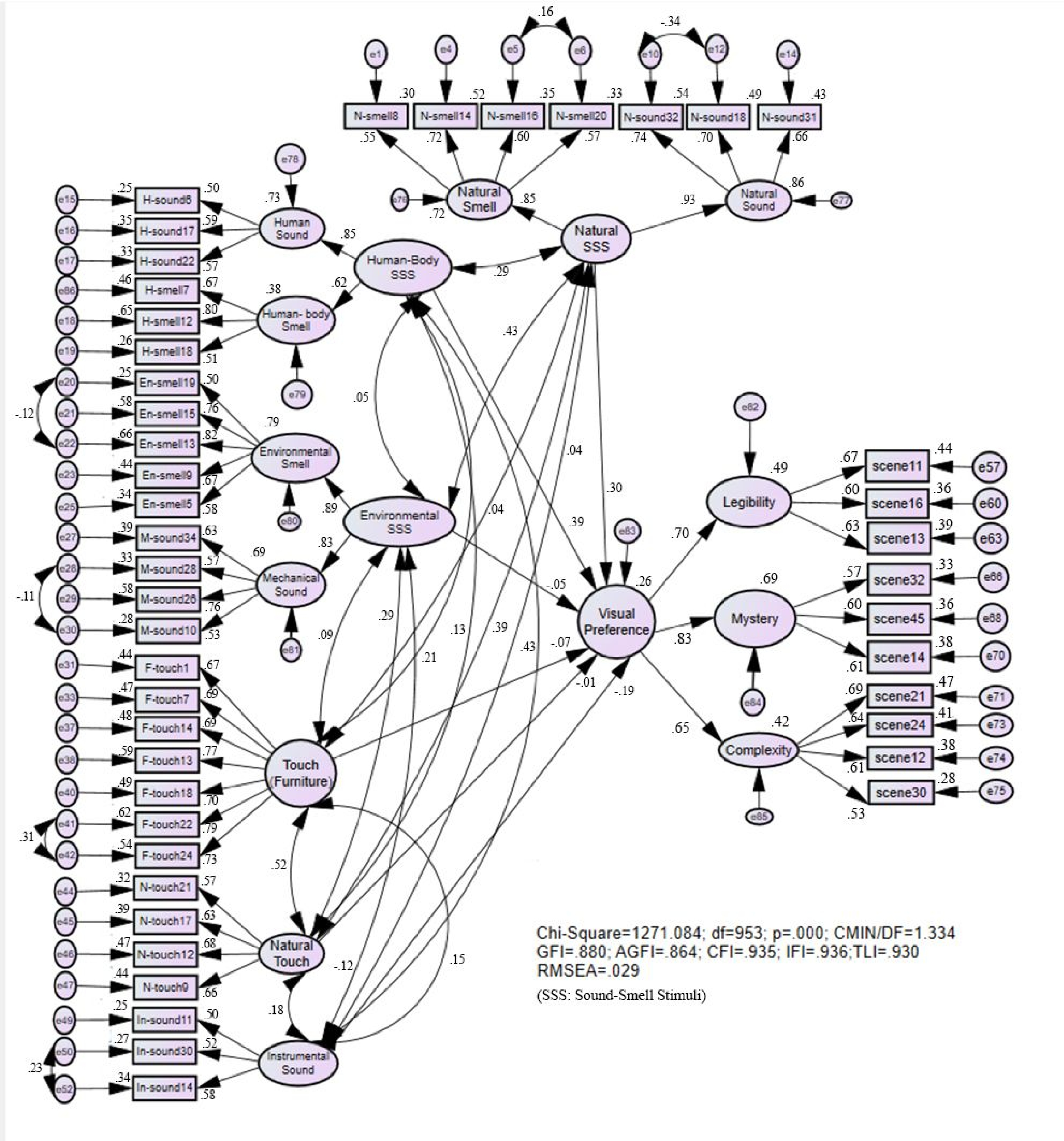

Figure 5

The Final Structural Model