



# Article A Comparative Evaluation of Utility Value Based on User Preferences for Urban Streets: The Case of Seoul, Korea

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**Abstract:** Currently, there is a lack of objective evaluations clarifying characteristics of urban streets from the users' perspective, particularly regarding the most effective spatial composition. This study investigated the value of spatial components of urban streets preferred by users through a conjoint analysis based on utility value for six streets representing street types in Seoul and evaluated relative preferences for the main characteristics of urban streets in terms of amenity, placeness, and accessibility. The analysis showed that users consider "amenity" as the most important characteristic of urban streets; "green space composition" was rated highest for utility value. The value exchange relationship of utility related to placeness and amenity within a certain threshold level was also confirmed for each of the three characteristics of urban streets. These results show that prioritizing improvements to amenities and green space promotes urban streets policies and projects, and strengthening placeness-related spatial elements is effective once a certain amenity level is secured. This study contributes to the discussion how to minimize differences in planning and user experience for urban streets by objectifying the relationship between user preferences and characteristics of urban streets through utility value.

Keywords: urban streets; user behavior; user perception; utility value; conjoint analysis

### 1. Introduction

As the interest in quality of life becomes increasingly important in cities worldwide, efforts to interpret and improve public space, which is one of the most relevant spaces reflecting the activities and needs of citizens, are gradually expanding [1,2]. Specifically, urban streets, the realm through which the "publicness" of the city is expressed, are the most suitable place for interpreting various aspects of life and finding solutions for complex problems in cities, which are continually changing [3].

In the US, New York's 2007 "PlaNYC" campaign emphasized the innovation of urban streets as a traditional approach to human-centered cities and global urban agenda [4]. Asia is no exception to this trend. In South Korea, the "Pedestrian-friendly City, Seoul Vision," a Seoul-type urban streets policy implemented since 2013, is regarded as the most representative project for improving the human-centered urban environment [5]. The recent trend is also observed in other large cities in Asia, including Beijing, Shanghai, Tokyo, Nagoya, Sydney, and Kuala Lumpur, which have previously featured mainly vehicle-centered urban spaces that lack humanity [6,7].

However, despite the significance of urban streets and the expansion of policies and projects, some important facts have not been confirmed. For example, how well the spatial composition on urban streets, currently planned and maintained on-site, fits users' or citizens' demands. Current urban streets' maintenance and planning are based on thorough research of physical environments, user behavior, and planning guidelines [7–10]. However, a specific basis for how research results and planned ideas correspond to the



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**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). users' experience in real space is lacking. There is also insufficient objective quantitative research determining and comparing user preferences for various physical street spaces.

There is ongoing research to systematically identify and classify the relationship between the spatial components and major characteristics of urban streets [10–12], and efforts to analyze the main characteristics of urban streets—such as amenity, placeness, and accessibility spatially and in terms of user behavior at an individual level—are also ongoing [13–17]. However, there is little known about the relative importance of and relationship between these characteristics from the users' perspectives of urban streets. Since there are limits to the available resources for transforming urban streets, it is essential to plan and establish a direction to minimize inefficiencies caused by duplication and allow users the best experience and greatest utility.

This study examines the users' utility value for major physical elements of urban streets. In addition, it examines the causes and relationships of user preferences in terms of the main characteristics of urban streets. Urban streets vary in the types of sidewalks and lanes, how sidewalks are improved, and the size and use of buildings that comprise streets. However, the planning and maintenance of urban streets in Korea is largely dependent on the planner's perspective or values, without objective consideration of users' preferences. Therefore, from a user's perspective, it is worth evaluating how important and prioritized the physical components of urban streets are. That is, the study suggests that since the components of urban streets have different user preferences and utility, and the interrelationship between each utility does not always guarantee an increase in overall utility, it is important to consider user utility values to effectively utilize the limited resources.

From the view mentioned above, this study makes the two following contributions. First, user utility for major physical components of urban streets is assessed to quantitatively identify planning elements and priorities that should be considered most important in urban road planning and maintenance. Second, user preferences and relationships among major urban streets' characteristics that are considered important from a planning perspective are revealed in terms of utility value. Because the direction of planning and maintenance of urban streets can vary depending on urban planners and policy makers, it is important to secure quantitative preference indicators in order to effectively utilize limited resources and clarify priorities in policy decisions.

This study is structured as follows. The next section reviews academic approaches to evaluating user perspectives, focusing on the physical components and key characteristics of urban streets. The third section explains the subjects of analysis, user survey data, and analysis methodology such as conjoint analysis. The results of analysis are provided in the fourth section, which discusses the users' utility of physical components of urban streets and the preferences and values about major characteristics of urban streets such as amenity, placeness, and accessibility from a user perspective. The suggestions and policy implications of this study are described in the final section.

#### 2. Literature Review

Since Appleyard and Lintell [13], various studies have been conducted on the relationship between the physical spatial composition of urban streets and user behaviors and activities [7,16,18–20]. There is also an ongoing discussion to determine which system of evaluation is appropriate if the spatial composition and qualitative level of the street affect the user type [10–12,21]. At present, research concept about urban streets is the subject of narrow discussion of the suitability of the physical space composition for street activities; however, there is also a broader discussion of how well the representative public spaces called "urban streets" can accommodate various urban activities of individuals and express collective identity, and on how this relates to urban residents' quality of life.

In contrast, there is also active discussion that the urban streets should be interpreted both as a relationship between physical space and street activity and in terms of "place value" that forms individual or collective identity and accommodates various urban needs. The urban street is a place where the social value of an individual experienced in that space is expressed; it plays a role as a public realm that defines collective identity and social demands [1,9,22–24]. Thus, a place-based approach to determining how individuals or groups form subjective perceptions of the street is also important in interpreting impact of urban streets [15,24–26]. This approach can be understood as an effort to interpret users' sense of place for urban streets or three-dimensionally analyze the influence of placeness beyond the amenity or functional convenience of the street's physical spatial composition.

Recently, there has been much focus on the social exchange opportunities of individuals as well as urban economy and social functions provided by urban streets. Many researchers conceptualize such characteristics in terms of accessibility, which encompasses the determination of how smoothly one approaches the street physically and the function of the buildings and public space in the street's provision of economic and social opportunities [14,17,27]. Accordingly, the degree to which urban streets are expected to encourage street activities while imposing physical and psychological constraints on users' behavioral choices is also a central determinant.

Given the above discussion, it is appropriate to comprehensively interpret the spatial and functional context surrounding urban streets and individual and social expectation, which influences user behavior, in the dimension of subjective cognition regarding conceptual, spatial, and behavioral analyses of urban streets, in addition to objective analysis of the relationship of streets' physical spatial composition of streets to vehicle and user behavior. In the context of these current discussions, Seo and Kim [25] organized the main characteristics for interpretation of urban streets in three dimensions of amenity, placeness, and accessibility. Accordingly, in this study, the main spatial elements were classified based on these main characteristics of urban streets with comparative evaluation of physical status and user preferences.

However, the continuing challenge is to combine and objectify the characteristics objectively determined through perception and those subjectively determined through cognition for comparative evaluation. To resolve this problem, this study introduced a method for quantitatively comparing user preference and expectation by evaluating the levels of user preference through a separate dimension: utility value. The utility value is a unit that measures an individual's subjective satisfaction with a physical situation or goods. It can measure direct or indirect expectation for a combination of necessary goods based on objective criteria [28,29]. Thus, utility value is useful in for analyzing urban livability, which requires multi-dimensional interpretation of user preference related to various characteristics.

#### 3. Data and Methods

This study performed a case analysis of six streets located in Seoul the differences by street type and users' perceptions of the utility value for each component of urban streets.

#### 3.1. Target Sites of Case Analysis and Major Status

The in-depth interview of six experts in public space, transportation, and behavior determined that these six streets are representative of the type of streets in Seoul among district unit planning areas requiring planned management in terms of urban functional utilization and locational significance. Considerations included the primary uses of the streets and buildings as well as various road widths, from two to ten lanes; structural patterns of blocks that partially reflect the spatial structural type of the street space were also examined.

For classifying the primary use of streets and buildings, six case areas were selected by combining additional functions based on two typical uses—commercial and residential. The areas selected represent four sub-types—work, culture, urban manufacturing, and neighborhood life—which have mixed functions in addition to the central commercial function, and two additional sub-types—apartment complex area and low-rise residential area—where single-family and multi-family houses are integrated with the main function of the dwelling were selected.

The primary status of the six selected streets, such as the detailed use and the physical composition, are shown in Table 1. First, Teheran-ro is located in the Gangnam area, where producer service functions such as finance and commercial function are integrated. Daehak-ro, in a special commercial district called a university district, has strong placeness as it is culturally specialized. Although Itaewon-ro is in a commercial district, it is a base for international cultural exchange. Yeongdeungpo-ro is in a complex area with large markets and distribution and logistics facilities. Gyeongin-ro is in an area where high-rise apartment complexes and mid- and large-sized shopping centers for neighborhood convenience are partially mixed. Yangjaecheon-ro is characterized by a nearby small river and a linear park; detached and multiplex houses are integrated to form a low-rise residential area.

Table 1. Major status and characteristics of streets for case analysis.

Site	Use	Length (Area)	Composition (Sidewalk Rate)	Block (Building) Density
Teheran-ro	Commercial and business	1400 m (496,418 m <sup>2</sup> )	10 lanes (26.1%)	1.29 block/ha (10.6 buildings/ha)
Daehak-ro	Commercial and culture	993 m	6 lanes	1.38 block/ha
	(Residential mix)	(339,637 m <sup>2</sup> )	(34.4%)	(19.0 buildings/ha)
Itaewon-ro	Commercial and neighborhood	1353 m	4 lanes	1.87 block/ha
	service (Residential mix)	(363,426 m <sup>2</sup> )	(32.9%)	(28.6 buildings/ha)
Yeongdeungpo-ro		1238 m	6 lanes	1.75 block/ha
	Commercial and semi-industrial	(497,752 m <sup>2</sup> )	(26.4%)	(22.8 buildings/ha)
Gyeongin-ro	Collective housing (Amertment)	1197 m	8 lanes	0.60 block/ha
	Conective housing (Apartment)	(666,907 m <sup>2</sup> )	(20.6%)	(5.4 buildings/ha)
Yangjaecheon-ro	Detached and townhouses (with	1169 m	2 lanes	2.19 block/ha
	neighborhood park)	(182,718 m <sup>2</sup> )	(31.7%)	(22.3 buildings/ha)

Note: ha = hectare (area equal to a  $10,000 \text{ m}^2$ ); A geographical location of each urban street is presented in Appendix A.

The data on the physical status of streets were constructed as digital information using CAD, ArcGIS, and Illustrator based on the digital topographic map (1:5000) of the National Spatial Information System (NSIC). Then, the detailed use of each building adjacent to the street was separately constructed through field surveys and combined with digital information.

#### 3.2. Survey on User Consciousness of Preference and Utility

In general, the surveys on user perception of the street environment have relied mostly on satisfaction evaluation and a semantic differential method which is a method of rating scale between two polar adjectives designed to measure the connotative meaning or attitude towards objects, events, and concepts. However, in a state where various conditions and concepts are mixed, securing objective criteria for relative evaluation is difficult. There are also problems associated with quantification errors in subjective preference. Contrarily, if the relative value of physical space is valued as a good or service and is evaluated as a decision-making utility, there is an advantage in that an individual's subjective satisfaction can be quantified from an economic point of view [30]. Furthermore, the evaluation of the relative importance of each factor and a scenario of user preference on the composition combination become possible.

In this study, several physical components and levels were first classified based on a survey on the physical status of the six streets in Seoul. Then, the users' preference value was examined through a survey, and a method of analyzing it as a utility value was adopted. First, ten major physical spatial components were selected through an indepth interview and discussion of experts about various street environment components identified in previous studies of Section 2. Subsequently, a pilot survey was conducted for 30 users. The results showed that utility and importance of four factors, such as sidewalk condition, public transport stops, street landscape, and rest and convenience facilities, were not statistically significant compared to other factors, or there was a tendency to cause confusion from duplicate responses from the perspective of users. Accordingly, in this study, two to three levels of six attributes for the physical composition of the streets were finally determined to be surveyed. The detailed items are shown in Table 2.

Table 2. Attributes and levels of the main physical components of urban streets for user utility assessment.

Attribute		Level	Content		
Amenity	Sidewalk type and width	Segregation of pedestrian and vehicle + sidewalk rate of less than 30% Segregation of pedestrian and vehicle + sidewalk rate of 30–50% Pedestrian-vehicle mixed + irrelevant sidewalk rate	The width of the sidewalk is less than 4 m, and safety fences are installed on the road The width of the sidewalk is more than 4 m, and safety fences are installed on the road Pedestrian-vehicle mixed sidewalk and road without segregation of pedestrian and vehicle		
	Traffic condition	Boulevard with a speed limit of less than 60 km/h Street with speed limit of 30 km/h or less Alley with speed limit of 30 km/h or less + roadside parking	Road with 6–10 lanes with high vehicle speed Road with 4–6 lanes with low vehicle speed Securing roadside parking space in an alley in 2–4 lanes with low vehicle speed		
Placeness	Streetscape (Road type)	Green landscape Artificial landscape	Landscaping facilities such as plants are abundant, and distribution of some adjacent parks Artificial sidewalks and convenience facilities are mainly distributed		
	Building size on street	Small Small to large Medium to large	Small buildings with 3 to 5 stories are mainly distributed Mix of buildings with 3–5 stories and buildings with 10–15 stories Medium and large-sized buildings with more than 10 to 15 stories are mainly distributed		
Accessibility	Main use of street	Single-use Mixed-use	Specific uses such as business facilities Commercial facilities and other uses		
	Use of ground floor	General restaurant (cafe) + Wholesale and retail stores General restaurant (cafe) + Business and service facilities General restaurant (cafe) + Cultural and welfare facilities	Distribution of general restaurants, cafeterias, and wholesale/retail stores on the ground floor Mix of general restaurants, cafeterias, and business and service facilities on the ground floor Mix of general restaurants, cafeterias, and cultural and welfare facilities on the ground floor		

For the utility value evaluation of user preferences in this study, all combinations of properties and levels were investigated by the full profile method in principle. Basically, to investigate the user value for all situations, user responses for all combinations of attributes and levels should be received, but partial arrangement considering interaction combinations can achieve the same effect. There are a total of 324 combinations of complete arrangements that consider the attributes and levels, as shown in Table 2, but they can be abridged into 16 scenarios through orthogonal and factorial design that considers interaction. For the stimulus presentation of the user questionnaire, a situational image, which is one of the pictorial description methods, was presented in parallel with the phraseological description to help users understand, and the method of presenting the profile card for each situation was used. Finally, a group of profile cards based on 16 combinations was composed.

The survey on user preference in this study was conducted by a street-corner interview method through a professional researcher in weekdays and weekends for a total of three weeks. The total number of users who responded to the survey was 518. Seventy valid samples, excluding the incomplete response and the response with omission, were secured for each street, totaling 420 final valid samples. Seventy valid samples per street were determined as a scale for securing the confidence level (95 ± 4.8%) for the conjoint analysis. The demographic distributions such as gender and age group were evenly organized over

each street. The user survey design process described above and the conjoint analysis process to analyze user utility and preference are shown in Figure 1.



Figure 1. User survey design and analyzing flow diagram.

#### 3.3. Conjoint Analysis Model and Estimation Method

The conjoint analysis model used a part-worth function analysis to estimate the part-worth and relative importance for the physical components of urban streets while maintaining the heterogeneity of respondents. The user utility value for the physical components of urban streets is calculated based on 16 profile scenarios composed of six sub-attributes in Table 2, and the relative importance of main attributes such as amenity, placessness, and accessibility is calculated by summing the individual relative importance of sub-attributes belonging to the main attribute. The main effect model without interaction was set as follows.

$$U_{i} = \beta_{0} + \sum_{t=1}^{m_{1}-1} \beta_{1t} X_{1t_{i}} + \dots + \sum_{t=1}^{m_{j}-1} \beta_{at} X_{at_{i}} + e_{i}(i = 1, 2, \dots, n, j = 1, 2, \dots, a)$$
(1)

here,  $U_i$  is the preference ranking of *n* profiles, *a* is the number of attributes, *n* is the number of profiles,  $m_j$  is the *j*-th attribute level,  $X_{1t}$ ,  $\cdots$ ,  $X_{at_i}$  is an indicator variable defining the level of each attribute, and  $e_i$  is an error term.

For part-worth estimation through conjoint analysis, an appropriate estimation method should be used according to the characteristics of the preference data. In cases in which score survey is used as a basis, least squares estimation is most often applied. However, in the case of a ranking survey, MONANOVA, which is the estimated method of [31], can be applied. This method is suitable when respondents rank each profile according to their preference. Moreover, it is known that there is no significant difference in validity between the results of a conjoint analysis using Kruskal's MONANOVA estimation method and least squares estimation [32].

Explanatory variables in the conjoint analysis model are expressed in the form of indicator variables. Therefore, after deriving the coefficient of the conjoint model according to the adopted estimation method, it should be changed such that the sum of the coefficient estimates for each attribute level becomes zero. Through this process, part-worth for each respondent is obtained, and the result of calculating the average of the part-worth for all respondents is the final part-worth. The size of the part-worth represents relative preference rather than absolute preference. Thus, after calculating the range of part-worth by level, the average of all respondents was calculated, and the percentage of each attribute was calculated to obtain the relative importance.

Since the respondents' responses were measured by ranking in this study, monotonic regression was considered appropriate [33]. Also, because respondents judge their preference for the level of each sub-attribute by ranking, the scale values for each attribute do not affect the analysis of main effect model.

With the conjoint model set through the above process, the estimated value  $\hat{\beta}_{jt}$ ,  $\cdots$ ,  $\hat{\beta}_{at}$  was obtained in this study. Part-worth  $\alpha_{jt}$  for the *t*-th level of the *j*-th attribute is obtained in the following manner.

$$\alpha_{jt} = \begin{cases} \beta_{jt} & \text{for } t = 1, \dots, m_j - 1 \\ -\sum_{a=1}^{m_j - 1} \hat{\beta_{jt}} & \text{for } t = m_j \end{cases}$$
(2)

Meanwhile,  $\gamma_j$ , which is relative importance of six sub-attributes, was calculated with the relative weight of the part-worth range for each level, as shown below. Also, the relative importance of the main attribute is identified as the sum of the relative importance of each of the two sub-attributes belonging to the detail. The overall relative importance was obtained based on the average of individual importance.

$$\gamma_j = 100\omega_j / \sum_{j=1}^{a} \omega_j \left(\omega_j = \max(\alpha_{jt}) - \min(\alpha_{jt})z\right)$$
(3)

Next was verification of how well the estimated parameters predict the preference, which is a dependent variable. In general, Kendall's tau or Spearman's Rho is used for sequence data. In the case of a rating scale, verification is conducted through Pearson's correlation [30]. In this study, the fitness was verified using both Kendall's tau and Pearson's correlation coefficient. The aforementioned conjoint analysis, user utility value, and relative importance result were computed using IBM SPSS Statistics ver. 25.

#### 4. Results and Discussion

#### 4.1. User Utility and Relative Importance for the Physical Components of Urban Streets

The results of analyzing the users' utility values for the physical spatial components of six urban streets in Seoul showed that physical facilities and convenience related to amenities such as pedestrian-vehicle type, sidewalk width, and traffic condition were determined to be physical components with the highest utility. The sum of the relative importance of these attributes was 47.8%. The sum of the relative importance of the users' utility for the type of pedestrian path and the size of the roadside building, assumed as a physical component related to placeness was 34.7%. The sum of the relative importance of users' utility for the use of street and ground floor of buildings, which are physical components related to accessibility, was analyzed to be 17.5%. The details are shown in Table 3 and Figure 2.

As a result of user utility analysis of physical components related to amenities of urban streets, the utility for the pedestrian-vehicle mixed street as shown in Figure 3 was found to be -0.384, clearly reflecting non-preference. Regarding vehicle traffic condition, users preferred the street with a speed limit of less than 30 km/h, although the difference in user utility was relatively small. Therefore, users preferred streets where there are few obstacles, such as roadside parking, and sufficient sidewalk width is secured so that pedestrians can walk comfortably under the condition of the spatial composition of the streets with a secure sense of safety from vehicles.

Attribute		Level	Overall		Men		Women	
			Utility	Relative Importance	Utility	Relative Importance	Utility	Relative Importance
Amenity	Sidewalk type and width	Segregation of pedestrian and vehicle + Sidewalk rate of less than 30%	0.191	36.01%	0.15	35.26%	0.23	36.43%
		and vehicle + Sidewalk rate of 30–50%	0.193		0.17		0.22	
		Pedestrian-vehicle mixed + irrelevant sidewalk rate	-0.384		-0.32		-0.45	
	Traffic condition	Boulevard with speed limit of less than 60 km/h	0.029	11 84%	0.00	9.11%	0.06	13.68%
		Street with a speed limit of less than 30 km/h	0.080	11.0470	0.06		0.10	
		than 30 km/h + curb parking	-0.110		-0.06		-0.16	
Placeness	Streetscape (Road type)	Natural green centered Artificial facility centered	$0.235 \\ -0.235$	29.31%	$0.25 \\ -0.25$	36.34%	$0.22 \\ -0.22$	22.95%
	Building Size on street	Small buildings Mix of small, medium, and large-sized buildings Medium and large-sized buildings	-0.002	5.38%	0.02	3.81%	-0.03	
			-0.042		-0.03		-0.05	6.87%
			0.044		0.01		0.08	
Accessibility	Main use of street	Single-use Mixed-use	$0.044 \\ -0.044$	5.55%	$0.04 \\ -0.04$	5.88%	$0.05 \\ -0.05$	5.14%
	Use of ground floor	Restaurant + wholesale and retail stores Restaurant + business and service facilities Restaurant + cultural and welfare facilities	0.054	11.92%	0.01	9.60%	0.10	14.93%
			-0.122		-0.07		-0.18	
			0.069		0.06		0.07	
Constant			5	5.815	5	5.788	5	.844
Number of samples (N)		420		217		0.049	203	
Kendall's tau (p-value)		0.850 (0.000) *		0.883 (0.000) *		0.845 (0.000) *		

Table 3. User utility value and relative importance of spatial components for urban streets.

\* Secured 99% level of statistical significance with p-value = 0.000 < 0.01.



Figure 2. Analysis results of the user utility value of physical spatial components for urban streets.



**Figure 3.** Pedestrian obstacles due to narrow sidewalk width and roadside parking: (**a**) Yeongdeungpo-ro and (**b**) Gyeongin-ro. Source: Captured by author.

The classification analysis of user utility by gender showed the tendency of women to dislike the safety threat and traffic obstacles caused by vehicle traffic in the streets was significantly greater than that of men, even by age group, particularly people in their 50s or older. Thus, securing safety and walkability centered on the mobility disadvantaged was confirmed as a crucial factor for user utility in the physical composition of urban streets.

The user utility analysis of physical components related to placeness showed a clear preference for green-oriented streets as shown in Figure 4, with a utility size of 0.235; the relative importance was 29.3%, which was the largest among all components. According to Cullen [34], trees are one of the most common urban landscapes, and people often feel the atmosphere of the surrounding space depends on the presence of trees. Moreover, concurrent synchronization can be sensed in the harmony of trees and the architectural environment. This relationship plays an important role in cognition of placeness in the urban landscape of streets. The plant density of case areas was 7.7–18 (trees/100 m), which had density of less than 16–17 in generally recommended. Thus, users judge that the level of plant composition of streets does not meet the expectation; the expected utility for a nature-friendly landscape composed of more trees is estimated to be the greatest.



Figure 4. Street with sufficient plants and landscaping: (a) Teheran-ro and (b) Yangjaecheon-ro. Source: Captured by author.

Then, why do users prefer a green-oriented street as a space for leisure and relaxation? The utility value analysis of this study confirmed that users strongly prefer plant-centered streets and green space regardless of the location of the street, the person's gender, and economic characteristics. A differential preference for spaces rich in trees and green space has been proven in many studies. Green space that can improve the health of urban residents, relieve stress, and provide a pleasant rest and leisure space is an essential service facility for enhancing the quality of life of urban residents. In particular, trees and green parks built on the side of streets have been found to benefit mental health

recovery, such as relieving anxiety and stress [29,35–38]. Hence, in terms of preference and utility, the green-oriented street primarily improves amenity-related characteristics such as emotional comfort and safety, and simultaneously, it needs to be considered as a relevant spatial solution that can enhance the quality of placeness through the creation of a nature-friendly landscape.

Lastly, as a result of analyzing user utility of physical components related to accessibility, relative importance was 17.5%, indicating that utility is not high relatively, but a certain level of value was secured. The relative importance of using the ground floor of buildings was evaluated to be significant with 11.9%. As shown in Figure 5, a mixed composition of general restaurant (cafe) and wholesale/retail shops or cultural/welfare facilities was found to have a utility of 0.054–0.069. The utility for the composition of business and service facilities was -0.122, confirming the tendency of dislike of this mix. It should be noted that the sensitivity of the utility of the composition on the ground floor of buildings was found to be higher in women than men. The utility of preference for wholesale and retail stores was 0.10 for women and 0.01 for men, and the utility of preference for business service facilities was -0.18 for women and -0.07 for men, thus reflecting a gap. The relative importance was confirmed to be 14.93% for women and 9.60% for men. The results indicate that women consider opportunities for various consumption activities provided by the street as more important than men.



**Figure 5.** Cases of the use of the buildings on the street ground: Daehak-ro (above, wholesale and retail stores and restaurant) vs. Teheran-ro (below, business and financial services). Source: Captured and created by author.

# 4.2. Exchange Relationship between User Utility Value Related to Placeness and Amenity and Feasibility of Forming a Threshold Level

Another characteristic fact of user preference and utility for urban streets identified in this study is that utility values related to placeness and amenity may form an exchange relationship within a certain threshold level. The analysis of user utility for six streets with distinct urban contexts and locational characteristics showed that the utility of the placeness-related components was evaluated relatively high when the utility of amenity-related components was low; the inverse relationship was also established, as shown in Figure 6. The user utility value evaluation is based on the premise of determining the relative value between attributes. However, given that the sum of the utilities related to amenity and placeness tends to be differentially distributed within approximately  $\pm 7\%$  of 80%, it can be assumed that the utility related to amenity and placeness in users'



consciousness is exchanging values. Further, the relative importance of the utility value related to accessibility remains constant at around 20%, and thus, the possibility of being determined somewhat independently can also be considered.

Figure 6. The relationship between perception of amenity for a green-oriented street and locational cognition.

In this study, the user satisfaction survey results for each street and the results of user utility analysis were compared to verify the tendency of value exchange of user utility for amenity and placeness of urban streets more specifically. As shown in Figure 7, a positive (+) relationship was clearly observed in which the user utility of the placeness-related physical spatial elements is high for the street where user satisfaction is high in terms of placeness regarding the street's physical composition. Furthermore, a negative (-) relationship was also clearly observed such that the user utility of amenity-related physical spatial elements is high inversely for the street where the overall satisfaction of user perception for amenity is low. These results indicate that the utility of the placeness-related spatial composition is highly rated for the street with high user satisfaction for placeness, and the utility of amenity-related spatial composition is not relatively highly evaluated for the street with high user satisfaction for amenity.



**Figure 7.** Relationship between user satisfaction and the importance of relative utility for commercial streets: (**a**) Placeness and (**b**) amenity.

The process in which contradictory trends are revealed can be explained based on the system through which users' preference of placeness and amenity is formed. As the perception-cognition system by Gibson (1966) [39], user preferences for amenity tends to be directly determined by the primary perception of the physical space of streets: a higher level of poor physical space is associated with stronger demands for improvement from the individual's psychological perspective. In other words, better physical condition related to street amenity is associated with decreasing demands for improvements from the individual's psychological perspective; as a result, the user utility of physical spatial elements related to amenity that has already been satisfied also decreases.

Contrarily, a significant part of user preferences for placeness is valued by cognitive thinking related to the beauty or originality of the spatial composition of the street and personal place attachment. The cognitive preference related to placeness tends to be reinforced by place attachment or place identity in the system of thinking. As a result, the relative value of placeness is sometimes evaluated fairly higher from a subjective point of view [15,40–42]. Accordingly, clearer and stronger preference for user-perceived placeness-related characteristics is associated with relatively higher user utility. In terms of amenity, the mechanism of value exchange between utilities can be assumed, in which a part of the objective level of utility of spatial characteristics where comparative inferiority occurs is diminished. Overall, user utility for urban streets can have a relationship of relative value exchange between the utility for amenity and the utility for placeness within the threshold level.

#### 5. Conclusions

This study examined users' preferences and utility values about physical components of urban streets. Through this, it was intended to contribute to establishing directionality for effective urban street physical planning techniques and methods from a user perspective. It also intended to discuss the relationship and balance between various characteristics that urban streets should have. From a user's perspective, consolidating the framework for urban streets to be planned and maintained can provide a very important opportunity for sustainable urban environments by increasing walking and leisure and social activities on urban streets.

In the analysis, the results and implications can be summarized as follows. First, among the main characteristics of urban streets, users determined that spatial elements related to amenity were the most important, followed by placeness and accessibility. In the case of spatial configuration, pedestrian-vehicle mixed streets were clearly not preferred. This result shows that the utility for securing a sense of safety from vehicles is important. Thus, strengthening the characteristics in terms of amenity that can guarantee safety and walkability is essential to forming urban streets. For the composition of ground floor of buildings, users responded more sensitively to the purpose than the physical spatial composition according to size. Especially, on the use of ground floor of buildings, user preference was high for retail shops or cultural facilities. Thus, the composition of street facilities in terms of accessibility characteristics, which trigger various street activities, should be considered important in the urban design stage.

Second, the preference for a green-oriented street was the highest regardless of its locational characteristics or user group. Considering the recent trend that many urban streets depend on the construction of artificial facilities, the current policy and direction of projects for urban streets can be evaluated as being rather different from preferences. The green street forms a landscape that enhances the users' perceived amenity while creating a clear sense of place. Hence, this spatial composition should be considered a primary focus for promoting policies and projects related to urban streets in the future.

Third, the user utility for urban streets can form an exchange relationship within a certain threshold level in terms of determining the characteristics related to placeness and amenity. As a result of analysis on user utility, the sum of the relative importance of utility related to amenity and placeness-related characteristics formed a threshold level of around 80% and the relative importance of the accessibility-related utility was maintained independently at approximately 20%. According to the comparison with the results of user satisfaction survey by street, the utility for placeness-related spatial composition was higher for the street with high user satisfaction for placeness. Conversely, the utility of amenity-related spatial composition was relatively low for the urban street with high user satisfaction for amenity. This result means that the physical improvement associated with amenities should be considered first in the planning and maintenance process of urban streets. And if more than a certain level of amenity is secured, focusing on reinforcing spatial elements in terms of placeness will promote positive user experience on urban streets.

This study has a case study constraint that it targets large cities with relatively high urban vitality in the context of Korea. Accordingly, the generalization of the results may be limited for application to streets in differing cultures. Therefore, it is necessary to compare and evaluate user utility for streets in different countries with various urban contexts to ensure that relationships and priorities between key characteristics of urban streets are still valid. This comparative study can contribute to generalizing planning guidelines based on user preferences for urban streets. It is also necessary to compare or quantify utility values for physical components of urban streets that are not addressed in this study. This approach is not only effective in enhancing objectivity in decision-making of plans or policies, but also in improving satisfaction among users who are owners of urban streets.

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# Appendix A. Geographical Location of Six Urban Streets to be Analyzed in Seoul

**Figure A1.** Geographical location of six urban streets to be analyzed in Seoul. Source: Modified and created by author based on GISDB (Geographic Information System Data Base) provided the Seoul Metropolitan Government and the Seoul Development Institute [43].

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