sustainability

MDPI

Article

Fostering Urban Walking: Strategies Focused on Pedestrian Satisfaction

Natalia Distefano and Salvatore Leonardi *

Department of Civil Engineering and Architecture, University of Catania, Viale Andrea Doria, 6, 95125 Catania, Italy; natalia.distefano@unict.it

* Correspondence: salvatore.leonardi@unict.it; Tel.: +39-0957382202

Abstract: Urban mobility and sustainable transportation are fundamental for the European Union's goal of achieving climate neutrality by 2050. The EU encourages national governments to prioritize zero-emission urban transport systems that emphasize safety, accessibility, and inclusiveness. Promoting walking plays a fundamental role in sustainable urban mobility, offering advantages such as emission reduction, better air quality, and enhanced public health. Recent research underscores the importance of creating appealing and safe pedestrian environments to encourage walking. These efforts align with the United Nations' Agenda 2030 sustainability goals, particularly Objective 11, which aims to build inclusive, safe, and sustainable cities and communities. This paper explores the factors influencing pedestrians' willingness to walk and categorizes them into basic factors, performance factors, and excitement factors, on the basis of the three factors theory. Significantly, the study reveals that the importance of these factors varies based on demographics, mainly the age of the users. Understanding these factors and their relative significance for pedestrian satisfaction is crucial for shaping effective policies and urban planning strategies aimed at promoting sustainable mobility. By prioritizing pedestrian satisfaction and addressing the specific needs and preferences of diverse groups, cities can create more walkable and environmentally friendly urban environments. These findings offer valuable insights for policymakers and urban planners working toward EU climate-neutral objectives and enhancing the well-being of citizens.

Keywords: walking environment; user satisfaction; sustainable urban mobility; urban sustainability; pedestrian infrastructure; road safety and walking

check for updates

Citation: Distefano, N.; Leonardi, S. Fostering Urban Walking: Strategies Focused on Pedestrian Satisfaction. *Sustainability* **2023**, *15*, 16649. https://doi.org/10.3390/su152416649

Received: 26 October 2023
Revised: 30 November 2023
Accepted: 5 December 2023
Published: 7 December 2023

Copyright: © 2023 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/).

1. Introduction

The EU is committed to becoming climate-neutral by 2050. To achieve this, the transport sector must undergo a transformation that will require a 90% reduction in greenhouse gas emissions, ensuring modes of transport alternatives that reflect the principles of sustainable mobility. In the EU, transport emissions now account for around 25% of the EU's total greenhouse gas emissions and have increased in recent years. The goal of being the first climate-neutral continent by 2050 requires ambitious changes in the transport sector. In this context, urban mobility plays a fundamental role [1,2].

According to the European Mobility Framework, to date, 70% of European Union citizens live in cities where 23% of all greenhouse gas emissions from transport are generated. To reduce these emissions—by at least 55% by 2030 and 90% by 2050—the EU is incentivizing policies to encourage national governments to develop safe, accessible, inclusive, affordable, smart, resilient and above all with zero emissions urban transport systems.

In cities, the main challenge is to create conditions that can allow the development of synergies between road safety measures and sustainability. To this end, all policies should aim to discourage the use of cars in the city, and to create safer infrastructure for vulnerable users (pedestrians and cyclists). Reducing the number of cars will reduce CO_2 emissions, improve air quality, ease traffic congestion and help make the population more active and healthier [3]. Even more ambitious goals can be achieved by identifying interventions to allow safe and economic access to mobility for all members of society, in particular for the disabled and for the growing percentage of elderly people.

The challenges that road networks in urban areas are called to face are also contemplated in the sustainability objectives and the related targets identified by the UN Agenda 2030 [4]. In particular, Objective 11 of the Agenda (Sustainable cities and communities) aims to make cities and human settlements inclusive, safe, long-lasting, and sustainable. This objective provides for the guarantee of access for all users to safe and inclusive green surfaces and public spaces, especially for women and children, the elderly, and people with disabilities.

Following the objectives set by the EU, in many European countries the transport policies are aimed at providing more space for active mobility (pedestrian and cyclist) reflecting a different conception for transport and urban policies, more sustainable, therefore focused on health, inclusiveness, equity, and livability [5].

An essential element of sustainable urban mobility planning is active mode of transport, including walking. Therefore, in light of the increase in urban sustainability, walking must be recognized as an important mode of urban transport [6]. It has been known for some time that in order to achieve more sustainable urban mobility, intervention strategies must aim at discouraging the use of private cars and encouraging active modes and the use of public transport. In light of the increase in urban sustainability, walking must be recognized as an important mode of urban transport.

Previous research has highlighted the need for measures to improve pedestrian infrastructure to encourage walking [7], emphasizing the crucial role of the built environment in encouraging or discouraging walking [8]. When people walk, they often choose more attractive routes, even if they are longer, regardless of the purpose, distance or time of day of the trip [9]. In Ref. [10], sustainability-oriented, ecological design criteria for the design of urban streets were proposed. This study presents design principles for "complete streets" through the addition of design criteria relating to aesthetics, the environment, livability, and safety. Sustainable criteria for complete streets should be consistently integrated by administrators, managers, and designers into the planning, design, and operation of streets, whether they are new or rehabilitated.

The literature review shows that the factors that influence walking can be divided into two areas: socio-economic factors, which depend on the individual characteristics of users (e.g., age, gender, main mode of transportation, etc.), and the characteristics of pedestrian paths. In Ref. [11], it is found that the age of users plays a crucial role in the design of aspects that are intended to promote and improve the walkability of neighborhoods. However, contradictory results are found regarding gender. The number of trips made on foot is higher for men in certain contexts [12], while the opposite is true in other situations [13,14]. According to Ref. [15], the urban environment influences the walking experience. In particular, socially active urban squares and pedestrian zones are very stimulating, as are narrower streets where you can perceive more details.

High density residential areas tend to have higher levels of pedestrian activity [16] and tend to attract services and retail, shortening walking distances to these destinations.

Population growth, especially in large cities, has led to an increase in car ownership and car use, which has negative social and environmental impacts. To address these problems, today's transport policy aims to promote green mobility. The main goal of sustainable mobility strategies is to reduce the number and duration of car trips. Key elements for promoting green mobility are providing more space for people, safer roads, and more time [17,18].

Users' perception of the street environment has a significant impact on their willingness to walk [19,20]. Pedestrian perception is of great importance when planning the street environment. Some studies suggest that users' assessment is a subjective parameter that depends on factors such as individual preferences, cultural values, and climate [21]. In order to identify and create a desirable pedestrian environment, pedestrians are the most appropriate group to evaluate their attitudes towards streets [22].

An experiment conducted in Bristol (UK) indicates that safety, comfort, and moderate sensory stimulation are fundamental elements to encourage walking [23].

An effective approach to increase the number of trips made on foot in an urban area is to improve users' overall satisfaction with the pedestrian infrastructure. The link be-tween the quality of the street environment and pedestrian satisfaction is widely recognized as a crucial factor for the success of sustainable mobility policies [24]. The hierarchical model of walking needs, proposed by Ref. [25], underlines to politicians the need to consider their contexts and their citizens in depth and therefore to adopt a multilevel approach to plan interventions aimed at encouraging the willingness to walk.

Therefore, local governments need to focus their economic resources on measures that increase pedestrian satisfaction in order to strengthen the relationship between satisfaction and willingness to walk. In order to define effective measures to improve user satisfaction, it is necessary to make a proper assessment of the importance that users attach to the factors that make up the street environment.

This study is based on the conviction that knowledge of the dynamics of transport demand and defining a strategic intervention plan based on users' judgments are of paramount importance for national and local mobility policies aimed at curbing pollutant emissions, saving energy, and improving the distribution of transport modes (to the benefit of a more sustainable socioeconomic and environmental level). Therefore, the objective of this article is to identify the attributes of the road system that have a major influence on pedestrians' judgment of road environment. Recently, the three-factor theory has been applied in various fields to relate user satisfaction to the importance they attribute to a factor. In this research we applied the Importance Grid based on the three-factor theory in order to classify the various aspects that can influence users' willingness to walk. It is believed that different categories of pedestrians could express different judgments, therefore the proposed methodology was repeated considering the different user groups.

The questions this study aims to answer are: Which of the scientifically accepted factors that influence willingness to walk are considered most important by citizens? Which of these factors actually influence pedestrian satisfaction? Are user judgments influenced by user characteristics? Answering these questions is critical before establishing policies for sustainable mobility, especially in locations that are not very walkable, as in the case study of this research.

In order to attain the stated objective, this work has been structured into the subsequent sections: Section 2 outlines materials and methods used to define the factors that influence users' willingness to walk and to carry out their classification. Section 3 shows the results of the analyzes for different categories of users. Section 4 is dedicated to discussion of the results with the aim of providing local administrations with indications on which to base policies for improving pedestrian paths.

2. Materials and Methods

This study is based on the hypothesis that the user's willingness to walk is directly related to satisfaction with the street environment, since the greater the satisfaction, the greater the probability that the user will make his trips on foot within that street environment. This hypothesis has recently been explored in the field of transport, in particular to evaluate users' willingness to use public transport [26,27] or bike sharing services [24].

Research shows that satisfaction involves a comparison between expectations and perceived performance. Traditionally, satisfaction is assessed using Importance Performance Analysis (IPA), where it is calculated as the product of two elements: the importance of the products or services offered and the performance of the organizations in providing these services [28].

Therefore, to define intervention priorities in order to increase the performance offered by the road environment, it is essential to identify the importance that users attribute to each aspect of this environment. For this reason, this study classifies the factors that can influence users' choice to walk according to their importance. The method used in this study to make this comparison is the Importance Grid (IG) based on the three-factor theory of customer satisfaction [29]. This evaluation is based on the comparison between the importance declared by the respondents and that indirectly measured. Recent studies show that using direct and indirect measures of the same value together leads to more accurate interpretations of the value itself [30]. This approach has recently been used in the field of transportation [24,31–33], but never to classify typical pedestrian infrastructure factors.

Many studies have shown that users' choices of transport modes are linked to their demographic characteristics [34,35]. For this reason, the analysis carried out in this study was initially carried out for the entire sample of respondents and then for the different categories of users.

2.1. Importance Grid Analysis

The importance grid analysis was developed to categorize service attributes according to customer needs. IG assumes a different interpretation of Importance Performance Analysis (IPA), which is based on the idea that the relationship between performance and importance is causal, i.e., any change in performance leads to a corresponding change in importance. Consequently, the validity of the original IPA must be questioned as the importance of an attribute changes as the performance improves [36].

In scientific research, this analysis technique was introduced by Ref. [37], who determined the factors for customer satisfaction by indicating both the explicit importance and the implicit weighting of the derived attributes on a two-dimensional importance grid. Specifically, Ref. [37] suggests that by combining the explicit and implicit weightings of the derived attributes on a two-dimensional grid, three satisfaction factors can be identified (Figure 1).

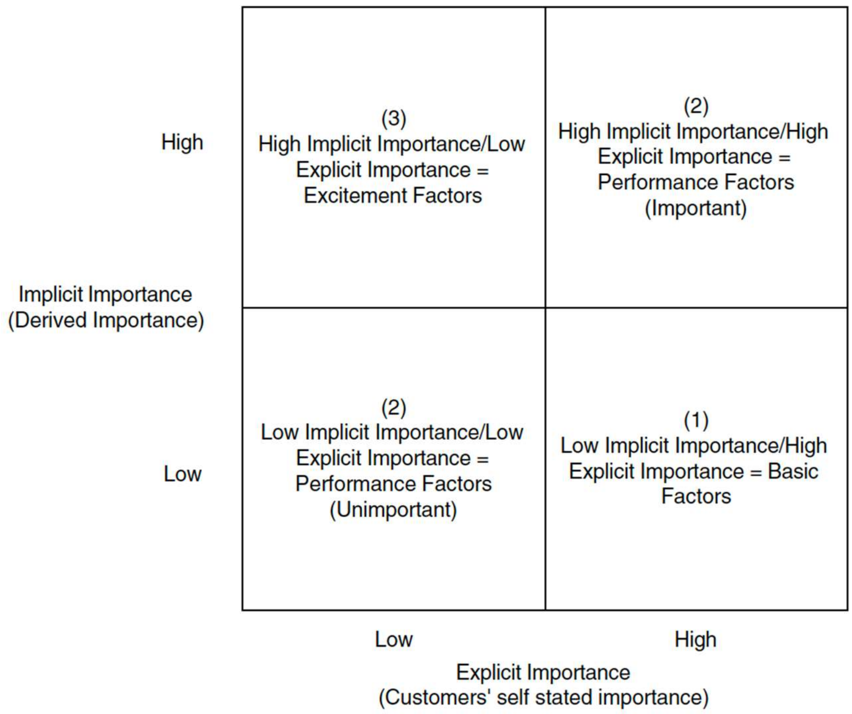

Figure 1. The importance grid.

As a rule, the explicit importance value is determined by asking each respondent to rate the importance of a certain element using a Likert scale and calculating the average value of all participants. In the case of implicit importance, on the other hand, the importance value for each element is determined using methods such as multiple regression, structural equation modeling, or partial correlation.

In this study, since the explicit importance scores were obtained using a Likert scale, it was considered appropriate to use an optimal scaling regression to evaluate the implicit importance scores. Namely, the optimal scaling regression performs a quantification of a qualitative variable expressed on an ordinal scale. In the quantification process, an optimal procedure associates the categories of the variable with values that have numerical properties and thus can be subjected to quantitative statistical techniques. In particular, in the case of ordinal variables, the original order of the categories is maintained even after quantification. There are many statistical techniques that can be considered as optimal scaling. In this study, we chose the CATREG technique (categorical regression with optimal scaling using alternating least squares). In the CATREG method, each value of a variable can be considered as a category, with labels for nominal variables, rank numbers for ordinal variables, and values for continuous variables. This method quantifies categorical variables, including response variables, while optimizing the multiple regression coefficient.

Furthermore, in order to insert the values within the GI, the average declared importance scores were normalized, so as to always have values between 0 and 1. The mean or median of the weights of both importances is used to identify the 4 quadrants into which the IG is divided.

In this study, the three-factor theory proposed by Ref. [37] was modified to identify the factors that have the greatest influence on road users' decision to walk. Since the attributes of service quality can be categorized into three groups as described in Ref. [37], the factors that influence road users' willingness to walk can also be ranked using the importance grid. In detail, these are the following factors:

1. Basic factors: these are the minimum requirements that, if not met, lead to dissatisfaction, but do not contribute to user satisfaction if they are met or exceeded. These factors are what users expect and not finding them would lead to dissatisfaction. Users perceive these essential factors as basic requirements, take them for granted and therefore do not explicitly express the need for them. It is therefore essential to fulfil these factors consistently;
2. Performance factors: these factors lead to satisfaction when they are fulfilled or exceeded, and to dissatisfaction when they are not fulfilled. Performance factors are characterized by a linear relationship between their presence and the user's willingness to walk. Therefore, the higher the performance of these factors on the road environment, the greater the user's willingness to walk. They are divided into important factors and irrelevant factors according to their position in the importance grid. Governments must focus their resources on increasing these factors, especially the important ones;
3. Excitement factors: these are the factors that increase user's willingness to walk if present but do not reduce user's willingness if they are not present. The excitement factors are those that the user does not expect and, when they are provided, give rise to a lot of appreciation (the relationship between fulfillment and satisfaction, in this case, is exponential). Therefore, the Governments must focus on the performance of these factors only after having guaranteed those of the performance factors.

2.2. Data Collection

Both the direct and indirect measurement of the importance that users attribute to certain aspects of the street environment in relation to their willingness to walk is based on the responses obtained using a specially developed questionnaire. The questionnaire was created after a thorough review of the literature. In particular, a scoping review on numerous previous studies that aimed to evaluate the influence of the built environment on users' willingness to walk was carried out. Scoping reviews are an ideal tool to identify key characteristics or factors related to a given topic and give clear indication of the volume of literature and studies available as well as an overview (broad or detailed) of its focus [38]. A total of 24 attributes were identified to assess their influence on users' willingness to walk (Table 1). In line with the hierarchy of walking needs proposed in previous studies [25,39], this study categorizes the attributes of walkability into four main factors related to pedestrian paths: physical characteristics, comfort, safety, and attractiveness.

Table 1. Summary of the aspects that can influence pedestrian mobility included in the questionnaire and the studies investigating them.

	Item	Reference Literature
	Pedestrian infrastructure items relating to the Physical Characteristics (PC)	
PC1	Continuity of the sidewalk	[40]
PC2	Sidewalk width	[41]
PC3	Good condition of the sidewalk surface	[42]
PC4	Reduced slope of the path	[42,43]
PC5	Absence of driveways	[41,43]
	Pedestrian infrastructure items relating to the Comfort (C)	
C1	Absence of fixed obstacles (trees, poles, etc.)	[44,45]
C2	Absence of obstacles or obstructions (parked vehicles, merchandise from shops, etc.)	[44,46]
C3	Cleaning of the pedestrian path	[41]
C4	Presence of protection from atmospheric agents (trees, porches, etc.)	[41,47]
C5	Presence of benches or seats	[43,48]
C6	Ease of getting to a public transport stop	[49]
C7	Good artificial lighting system of the path	[43,46]
	Pedestrian infrastructure items relating to the Safety (S)	
S1	Not excessive width of the carriageway	[50]
S2	Low flows of vehicular traffic	[46,51]
S3	Presence of speed limits for vehicular flows	[51]
S4	Presence of traffic calming measures on the carriageway	[52]
S5	Presence of a parking lane adjacent to the pedestrian path	[42,50]
S6	Absence of large parking areas	[53]
S7	Ease of crossing at intersections	[54]
S8	Ease of crossing out of intersections	[54,55]
	Pedestrian infrastructure items relating to Attractiveness (A)	
A1	Presence of commercial activities (bars, shops, etc.)	[56,57]
A2	High artistic/landscape value of the streetscape	[56,58]
A3	Presence of other pedestrians	[46,59]
A4	High perception of security	[60,61]

The survey was formatted using Google Forms and consisted of a series of multiple-choice questions divided into two sections. The first section focused on collecting personal information, including gender, age, employment status, primary mode of transportation, and population size of residence (5 questions). The second section required participants to rate the attributes listed in Table 1 (24 questions). The questions in the second section of the questionnaire were of the type: Does the cleaning of the pedestrian path increase your willingness to walk? Each respondent was asked to answer each of the 24 questions using a 5-point Likert scale, ranging from 1 (strong unwillingness) to 5 (strong willingness).

3. Results

3.1. Sample Description

The online survey was published on the DICAr website (the website of the Department of Civil Engineering and Architecture of the University of Catania) and promoted through social media channels. In particular, survey participants were recruited using Simple Random Sampling, advertising on social media sites such as Facebook and Instagram, while doing something else online. The advertising message informed potential participants that the survey was related to transport issues and that the average duration was 10 min. In addition, it clearly stated that the survey was strictly anonymous and did not contain any personal and/or sensitive data that could lead to respondent recognition. In obtaining participant consent, a clear and explicit statement was presented both at the commencement and conclusion of the online questionnaire. Participants indicated their consent by actively clicking the checkbox corresponding to the following statement: "*By clicking 'Submit,' you confirm that you have read and understood the purpose of this study, are aware of the anonymity assurance, and provide consent for the use of your responses in accordance with ethical guidelines, including those outlined in the Declaration of Helsinki*". This method ensured a transparent and affirmative acknowledgment of participants' understanding and agreement throughout the study.

A sample of 562 people participated in the online survey. Table 2 shows the main socio-demographic characteristics of the main sample. The respondents were almost evenly split between men and women, with a slight preponderance of men (51.25%), and the majority were between 21 and 35 years old (41.99%). A small proportion of respondents (27.76%) lived in a large city (more than 50,000 inhabitants).

Table 2. Sample socio-demographic characteristics.

Variable	Items	Total	%
Gender	0: Male	288	51.25
	1: Female	274	48.75
Age	0: <20 years	126	22.42
	1: 21–35 years	236	41.99
	2: 36–65 years	112	19.93
	3: >65 years	88	15.66
Place of Residence (Number of inhabitants)	0: Less than 20,000	200	35.59
	1: Between 20,000 and 50,000	206	36.65
	2: Greater than 50,000	156	27.76

3.2. Analysis

The dataset acquired from the online questionnaire underwent a thorough analysis employing a factorial Analysis of Variance (ANOVA) test. The primary aim was to investigate the influence of diverse factors—presented as independent variables in the questionnaire—on respondents' willingness to walk, serving as the dependent variable.

Within Table 3, the ANOVA results, encompassing Mean Square, F, and *p*-values, shed light on the extent of variability within and between specified groups. This analytical approach was systematically applied to both the overall sample of respondents and subgroups categorized by gender (male/female) and age groups.

Table 3. ANOVA Test.

	Mean Square	F	*p*-Value
Total (All respondents)	8.333	67.316	0.000
Men	4.548	31.517	0.000
Women	4.313	38.890	0.000
Age0	1.732	8.735	<0.001
Age1	3.957	49.169	0.000
Age2	1.694	8.316	<0.001
Age3	1.977	6.412	<0.001

The choice of ANOVA was based on its effectiveness in assessing mean differences among multiple groups, a pertinent consideration for our multivariate study. Therefore, the logic of the ANOVA, on which this analysis is based is "At least 1 group is different from the other". The results consistently revealed a statistically significant pattern across all samples, with *p*-values consistently falling below the 0.005 threshold. This stringent criterion supports the assertion that the observed differences in willingness to walk are unlikely to have occurred by random chance alone.

The established statistical significance not only affirms the independence of observations but also enables a detailed investigation into the factors influencing respondents' willingness to walk. ANOVA's capability to discern variance contributions from various factors simultaneously enhances the depth and reliability of our understanding of the dynamics at play within different respondent categories. This analytical approach contributes to a more comprehensive exploration of the factors shaping walking preferences among respondents. To determine the statistical significance of the sample, the dataset from the online questionnaire was subjected to a factorial ANOVA test. Table 3 shows the results of the analysis of variance for the total sample of respondents and for the subgroups in terms of categories of respondents (male/female and age groups). In all ANOVA tests, the dependent variable is consistently the respondents' willingness to walk, while the independent variables are the factors that the respondents were asked to evaluate.

The first step in analyzing the data derived from the questionnaire was to evaluate the average values of explicit importance for each factor, considering first the total sample of respondents and then the individual categories of respondents. The average importance values obtained in this way are shown in Table 4.

Table 4. Average values of explicit importance.

	Total	**Men**	**Women**	**Age0**	**Age1**	**Age2**	**Age3**
PC1	0.701	0.689	0.714	0.659	0.682	0.732	0.773
PC2	0.722	0.712	0.734	0.675	0.686	0.750	0.852
PC3	0.744	0.722	0.766	0.722	0.697	0.790	0.841
PC4	0.513	0.503	0.524	0.464	0.485	0.612	0.534
PC5	0.568	0.578	0.557	0.552	0.551	0.576	0.625
C1	0.680	0.665	0.695	0.631	0.669	0.728	0.716
C2	0.676	0.681	0.672	0.623	0.661	0.674	0.795
C3	0.748	0.726	0.772	0.683	0.739	0.772	0.835
C4	0.754	0.760	0.748	0.734	0.767	0.737	0.773
C5	0.688	0.672	0.704	0.651	0.686	0.710	0.716
C6	0.739	0.708	0.772	0.675	0.750	0.799	0.727
C7	0.839	0.816	0.863	0.798	0.850	0.853	0.852
S1	0.548	0.536	0.560	0.524	0.536	0.594	0.557
S2	0.736	0.724	0.748	0.710	0.712	0.786	0.773
S3	0.682	0.667	0.699	0.647	0.665	0.723	0.727
S4	0.609	0.613	0.606	0.611	0.595	0.656	0.585
S5	0.593	0.590	0.597	0.583	0.581	0.616	0.614
S6	0.593	0.580	0.606	0.567	0.591	0.620	0.602
S7	0.765	0.745	0.786	0.738	0.748	0.826	0.773
S8	0.731	0.710	0.754	0.714	0.737	0.759	0.705
A1	0.712	0.667	0.759	0.659	0.710	0.746	0.750
A2	0.812	0.790	0.836	0.786	0.824	0.839	0.784
A3	0.681	0.658	0.704	0.635	0.686	0.746	0.648
A4	0.794	0.757	0.832	0.726	0.805	0.817	0.830
Mean	0.693	0.678	0.709	0.657	0.684	0.727	0.724

As described in Section 2.1, the implicit importance was calculated using CATREG-type optimal scaling regression. In particular, zero-order correlations were considered, i.e., those between the transformed independent variables and the transformed dependent variable. The implicit importance values obtained in this way are listed in Table 5.

Table 5. Values of implicit importance.

	Total	Men	Women	Age0	Age1	Age2	Age3
PC1	0.668	0.638	0.721	0.596	0.654	0.494	0.853
PC2	0.518	0.649	0.762	0.314	0.657	0.571	0.901
PC3	0.533	0.489	0.558	0.749	0.413	0.643	0.868
PC4	0.053	0.02	0	0.01	0.02	0.435	0.049
PC5	0.389	0.479	0.303	0.283	0.15	0.325	0.707
C1	0.627	0.378	0.668	0.42	0.649	0.571	0.701
C2	0.405	0.422	0.548	0.391	0.562	0.546	0.833
C3	0.752	0.719	0.787	0.416	0.771	0.626	0.780
C4	0.823	0.806	0.841	0.771	0.854	0.76	0.822
C5	0.405	0.363	0.444	0.48	0.38	0.703	0.782
C6	0.818	0.782	0.854	0.731	0.845	0.627	0.714
C7	0.907	0.889	0.926	0.832	0.677	0.917	0.881
S1	0.214	0.141	0.247	0.042	0.13	0.327	0.253
S2	0.784	0.756	0.814	0.771	0.73	0.582	0.719
S3	0.72	0.707	0.734	0.442	0.344	0.728	0.828
S4	0.435	0.42	0.474	0.282	0.285	0.589	0.360
S5	0.445	0.439	0.455	0.305	0.302	0.511	0.517
S6	0.437	0.336	0.459	0.178	0.44	0.509	0.469
S7	0.824	0.796	0.852	0.794	0.81	0.896	0.797
S8	0.455	0.409	0.847	0.729	0.844	0.534	0.425
A1	0.731	0.36	0.818	0.669	0.7	0.589	0.810
A2	0.873	0.847	0.705	0.831	0.891	0.873	0.858
A3	0.393	0.363	0.718	0.597	0.671	0.818	0.530
A4	0.65	0.725	0.82	0.617	0.653	0.801	0.842
Mean	0.577	0.539	0.640	0.510	0.560	0.624	0.679

3.3. Factors Classification Based on IG

Once the explicit importance and implicit importance values are known, it is possible to classify the factors that may influence users' decision to walk, identified in Table 1, using importance grids (IG), according to the theory of three factors. The average values of the two importance factors were used to classify the 4 quadrants of the importance grid. The aspects judged by respondents as important performance factors fall in the upper right quadrant; in the lower right quadrant there are the aspects considered basic factors; the aspects judged to be unimportant performance factors fall in the lower left quadrant and the aspects considered excitation factors are found in the upper left quadrant. The following figures show the importance grids for each user category considered.

Figure 2 shows that about 80% of the factors considered fell into the quadrants representing the performance factors, with the important performance factors minimally outweighing the unimportant factors. Among the performance factors, good artificial lighting system of the path (C7) and the high artistic/landscape value of the streetscape (A2) were the most important for the entire sample. On the other hand, the least relevant aspect is the reduced slope of the path (PC4). Only three aspects are classified as basic factors and two are excitement factors.

The distribution of points on IG reflects a pronounced linear relationship between the explicit importance and implicit importance scores for all factors. This means that there are no points near the vertices top left (excitement factors) and bottom right (basic factors). Therefore, no factor was perceived as particularly exciting, and none meant highly expected by users (basic factors).

Even for the items that characterize the user category "gender", the majority of factors (83%) fall into the quadrants that represent the "Performance Factors" (Figure 3). Moreover, similar to IG for the whole sample, there are linear relationships between the explicit and implicit importance scores for all factors in both graphs. In addition, the absence of points near the outer corners of the quadrants is noted in both the lower right and upper left.

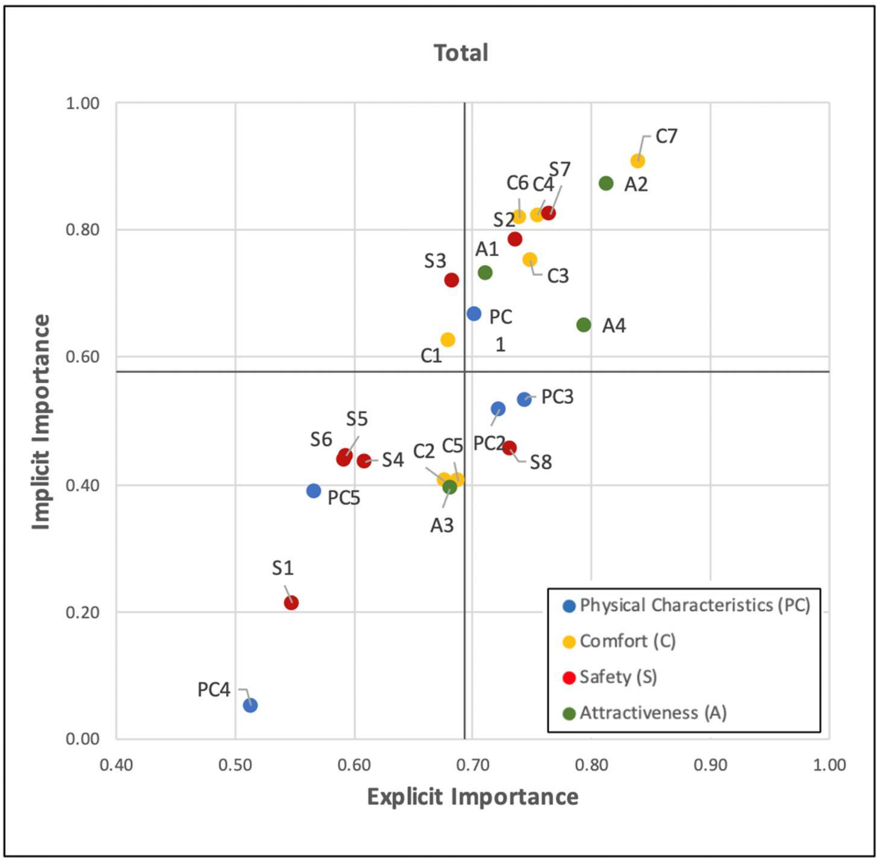

Figure 2. Importance grid for the total number of respondents.

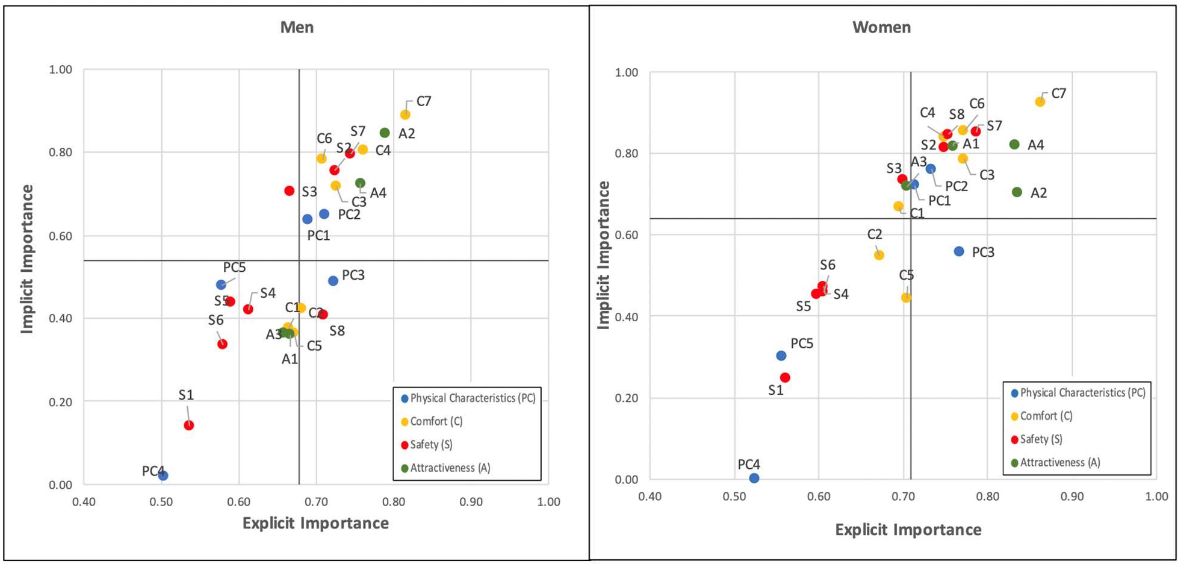

Figure 3. Importance grids for the respondent's gender.

Figure 4 shows the importance grids (IG) for the four items in the "age" category. Respondents in age group 3 (>65 years) indicate the highest number of important performance factors and no basic factors. In addition, the unimportant performance factors for this user category do not follow the typical linear trend. In other words, this suggests that these users lack a true awareness of the factors that fall in the lower left quadrant.

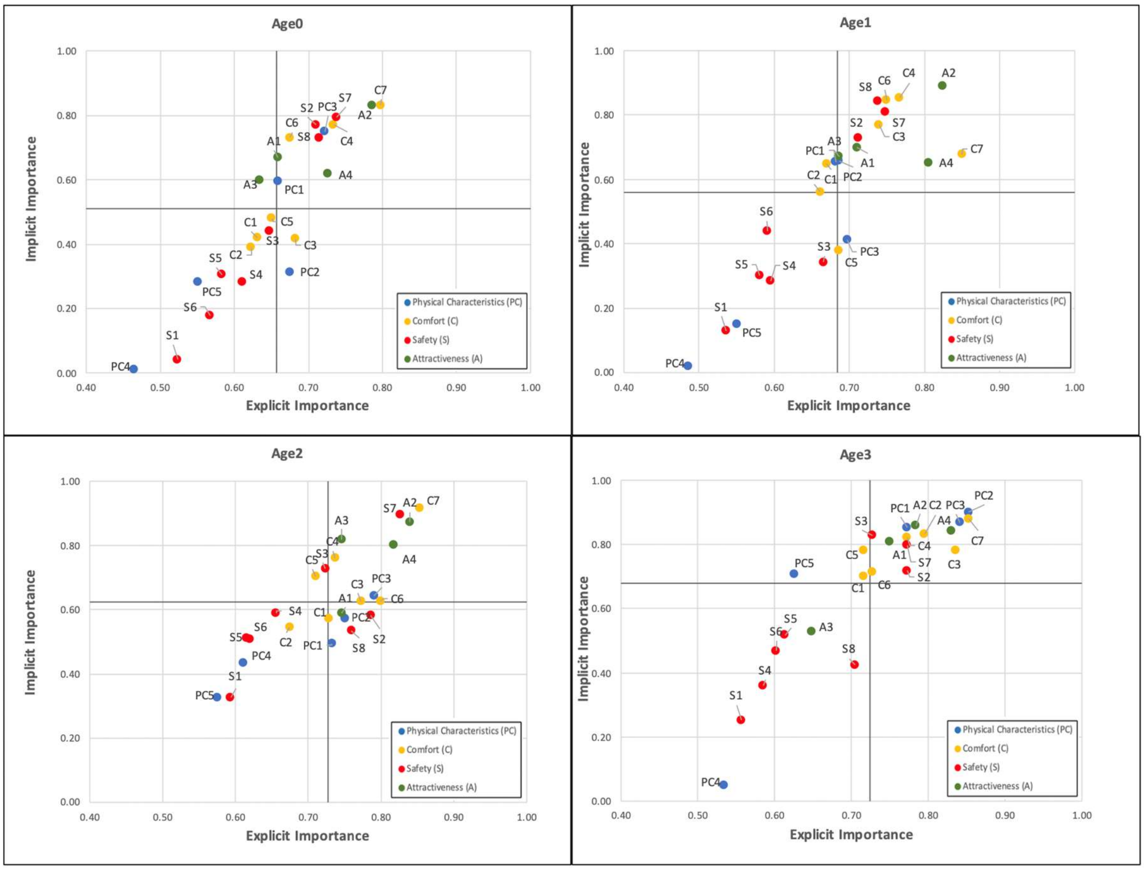

Figure 4. Importance grids for the respondent's age.

4. Discussion

The following subsections discuss the classifications within the three factors identified as influential on users' willingness to walk, divided into the four main categories (Physical Characteristics, Comfort, Safety, and Attractiveness) into which they were categorized.

4.1. Physical Characteristics

From the entirety of the respondents, it appears that the adequate width of the sidewalk and the good condition of the sidewalk surface are considered as "Basic Factors". These factors are those that pedestrians expect to encounter on their routes and therefore do not significantly increase their willingness to walk. The only factor from the physical characteristics of the sidewalk" category that has an impact on users' willingness to walk is the continuity of the sidewalk, although it is relatively close to the average importance scores and has no particular influence. None of the factors in this category are considered "Excitement factors", i.e., factors that users do not expect and that, when present, significantly increase their satisfaction with walking.

When comparing the gender-specific diagrams (Figure 3), it is noticeable that there is no difference in the judgments of men and women about the physical characteristics of the sidewalk. The lack of a consistent gender difference in participation in walking for transportation was previously demonstrated in Ref. [62]. However, when analyzing the subgroups of the sample based on gender, the only difference compared to the analysis of the entire sample relates to the rating of PC2 (adequate sidewalk width), which serves as a positive influencing factor for both men and women.

Figure 4 shows that the four respondent groups, differentiated by age, assign different importance to the elements of the Physical Characteristics of the path category. Consistent with Ref. [63], all respondents agree that the longitudinal slope of the path is insignificant. Nevertheless, the first three age groups (in ascending order of age) also consider PC5, the absence of driveways, to be unimportant. For the older respondents, however, this factor is a source of excitement. This result is consistent with the findings of a study by Ref. [64], which reported that older pedestrians are more affected by accidents at driveways. Furthermore, older pedestrians represent the user category for whom elements related to the physical characteristics of pedestrian paths have the greatest influence on their willingness to walk.

Based on the results shown by the Importance Grid for the physical characteristics of sidewalks, it can be concluded that urban street managers need to plan measures to improve the physical characteristics of sidewalks, especially on paths used by older pedestrians, i.e., near parks or community centers for older people.

4.2. Comfort

Of the factors in this category, four out of seven are considered significantly influential on their willingness to walk by all subgroups of respondents. In addition, for the total sample and the subgroups represented by women, elderly, and young people aged 21 to 35, C1 (absence of obstacles on the pedestrian path) is ranked as an excitement factor.

It is noteworthy that older pedestrians do not rank any of the comfort factors as unimportant to performance and do not consider any as a fundamental factor. For this user category, five of the comfort factors are considered important to performance and two serve as excitement factors. This indicates that this user category has the highest needs in terms of pedestrian mobility. This result is consistent with numerous studies in the literature. Ref [63] concludes that a senior-friendly city should be characterized primarily by obstacle-free sidewalks with flat, non-slip surfaces, sufficient width, and well-maintained public benches at regular intervals. While the presence of obstacles or obstructions on the pedestrian path is considered irrelevant for younger respondents, as they usually have better physical abilities than older people and can overcome obstacles more easily.

This means that if a route is frequently used by older people, all aspects of comfort must be guaranteed. Therefore, road management authorities must consider measures such as the installation of seats and benches, the removal of fixed obstacles and the installation of deterrents to illegal parking on the sidewalk.

4.3. Safety

Regarding the factors that belong to the Safety category, we note that half of the factors in this category (S1, S4, S5, S6) are considered unimportant by both the total sample and both gender groups (Figures 2 and 3). Factors that positively influence willingness to walk include ease of crossing at intersections (S7) and low flows of vehicular traffic (S2). Women also consider the convenience of crossing out of intersections (S8) to be an influential factor. The statement by respondents in this survey that safety issues have little influence on their willingness to walk seems to contradict numerous studies that cite pedestrian safety as one of the most important factors for walkability [65]. This can be explained in line with a study by Ref. [66], which assumes that the road environment in which pedestrians experience walking influences their judgments. In the city where this survey was conducted, the frequency of walking in daily life is low, the road safety culture is poor, and attitudes that protect or prioritize pedestrians are lacking.

The presence of speed limits for vehicular traffic (S3) is considered to be a factor that would increase the willingness to walk unconsciously, both for the total sample and separately for men and women. However, this result is not obtained when the age group analyses are considered individually; only respondents between the ages of 50 and 65 rank S3 as an Excitement Factor (EF).

When looking at the results for age-based subgroups, it is noticeable that there are five factors that are rated as irrelevant. For younger respondents, S3 is actually considered an unimportant factor. The presence of speed limits on the roadway adjacent to the pedestrian path is only consciously viewed as a positive factor influencing willingness to walk by older respondents. Due to their increased susceptibility to road accidents, older people attribute greater importance and awareness to such safety measures. In contrast, younger road users (first and second age groups) do not attach much importance to the presence of legally imposed speed limits on vehicular traffic when they decide to walk. This observation is significant because it may reflect greater confidence in their ability to safely cross streets with fast-moving traffic.

The above considerations should lead urban road managers to plan measures to improve the safety of pedestrians during the crossing phases, both at and outside intersections. Measures such as raised crosswalks or lane narrowing can be considered useful as they are traffic calming measures designed to improve the safety of pedestrians crossing the road.

4.4. Attractiveness

The attractiveness of pedestrian paths has a positive influence on respondents' willingness to walk for almost all factors. For women and younger people, the presence of other pedestrians (A3) is a subconscious factor that positively influences their willingness. However, for men and older people, this factor is considered unimportant. These results can be justified by the fact that women and younger people associate the presence of other pedestrians with a higher level of security around walking.

High perception of security is considered a relevant performance factor by all subgroups in the sample, which is consistent with many studies in the literature showing that this factor is more important for women [67,68].

In contrast, older people indicate that the presence of other pedestrians does not influence their decision to walk, while they consider all other factors related to the attractiveness of the path to be relevant [11,69]. This may be due to several factors. First, older people may have different priorities and considerations when it comes to walking. They may place more importance on factors such as the quality of the path, its maintenance, and amenities such as seating and shade, which directly affect their comfort and overall walking experience. Second, older people may have more experience and confidence in navigating pedestrian environments, which could lead them to pay less attention to the presence of other pedestrians. They may rely on their own judgment and confidence when it comes to managing potential safety risks because they have developed increased awareness and personal safety practices over the years. In addition, older people may have a more structured and predictable daily routine, which means they are less influenced by the variable factor of encountering other pedestrians along the way. They may have set times for their walks or specific routes they prefer, which may reduce the importance of the presence of others in their decision-making process.

In light of these findings, local administrations should prioritize enhancing various aspects contributing to the appeal of pedestrian paths. A strategic focus on implementing land use policies to promote the establishment of shops, bars, and other activities along the path can have multifaceted benefits. Firstly, such vibrant activities foster a lively and dynamic environment, encouraging community engagement and social interaction. Additionally, the increased human presence naturally contributes to a sense of safety, creating a self-regulating surveillance effect.

Moreover, improving street lighting along the pedestrian path is pivotal for several reasons. Well-lit areas not only enhance visibility and reduce the likelihood of accidents but also play a significant role in enhancing overall safety perceptions. Adequate lighting contributes to a welcoming and secure atmosphere, making the pedestrian path more inviting for residents and visitors alike.

While these strategies form the primary focus, it is acknowledged that alternative measures, such as video surveillance systems and increased police controls, may be considered as a last resort. However, their potential for controversy necessitates careful consideration and community input before any decision is made regarding their implementation.

5. Conclusions

In the context of sustainable urban mobility, this study contributes valuable insights into the factors that influence the willingness of pedestrians to walk. Applying the three-factor theory of user satisfaction, a structured framework is presented to assess the importance of different factors, categorizing them as basic, performance, and excitement categories. This systematic approach provides urban planners and policy makers with a rational understanding that allows prioritized actions to be taken that are tailored to the varying needs of different demographic groups.

The main findings of this study are as follows:

➢ In the realm of Physical Characteristics, factors such as sidewalk width and surface condition are considered "Basic Factors". They are expected and do not significantly boost willingness to walk. However, sidewalk continuity, although not a dominant influence, does affect willingness. Gender-based differences in judgments are notably absent in this regard;

➢ Comfort factors, on the other hand, assume significance. Among them, the absence of obstacles on pedestrian paths stands out as an excitement factor. This is especially pronounced among older pedestrians, highlighting their higher mobility needs;

➢ When it comes to Safety, it is intriguing to note that half of the factors in this category are perceived as factors of irrelevant importance by both the total sample and gender-based subgroups. Yet, ease of intersection crossing and low vehicular traffic flow are positively linked to willingness to walk. The significance of pedestrian safety varies, influenced by the walking culture and road safety attitudes prevalent in the survey location.

➢ The Attractiveness of pedestrian paths, in general, amplifies willingness to walk. For women and younger individuals, the presence of other pedestrians contributes positively, as it is associated with heightened security. Contrarily, this factor is deemed unimportant by men and older pedestrians, who emphasize the relevance of other attractiveness factors.

The systematic categorization of these factors deepens the understanding of sustainable urban mobility and creates the basis for evidence-based interventions that contribute to the realization of climate-neutral and pedestrian-friendly urban spaces.

However, it is important to recognize certain limitations that may be relevant for future research efforts. The study relies on survey data, which is subject to individual perceptions and biases. The accuracy of the results depends on the ability of participants to accurately express their preferences. In addition, the study is geographically limited and focuses on a specific city or region, which limits the generalizability of the results to other urban contexts. The study relies primarily on self-reporting, and participants' responses may not always match actual behavior, which is a potential source of bias.

One potential limitation is the omission of socioeconomic variables (e.g., employment, income, or similar) from the analysis. While the study provides valuable insights into demographic factors such as age and gender, a more comprehensive study that includes socioeconomic aspects could improve our understanding of the complexity of walking decisions.

Future research efforts could address these limitations and conduct a more comprehensive examination of socioeconomic variables to gain a more holistic understanding of the factors that influence sustainable urban mobility. Despite these potential limitations, this study lays a solid foundation for future investigations and serves as a catalyst for evidence-based interventions that shape inclusive, age-friendly, and environmentally conscious urban spaces.

Author Contributions: Conceptualization, N.D. and S.L.; methodology, N.D. and S.L.; software, N.D. and S.L.; validation, S.L.; formal analysis, N.D.; investigation, N.D. and S.L.; resources, N.D. and S.L.; data curation, S.L.; writing—original draft preparation, N.D. and S.L.; writing—review and

editing, N.D. and S.L.; visualization, N.D.; supervision, S.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable to this study because the effects on humans are essentially non-existent.

Informed Consent Statement: Participants in this study provided informed consent as part of the survey process, ensuring their awareness of the study's purpose, anonymity assurance, and agreement to comply with ethical guidelines, including those outlined in the Declaration of Helsinki.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to confidentiality issues.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. European Union (EU). Regulation (Eu) 2021/1119 of the European Parliament and of the Council of 30 June 2021 Establishing the Framework for Achieving Climate Neutrality and Amending Regulations (EC) N. 401/2009 and (EU) 2018/1999 ('European Climate Law'). 2021. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1119&from=EN (accessed on 10 July 2023).
2. European Commission. The European Green Deal. COM(2019) 640 Final. Bruxelles. 2019. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%253A2019%253A640%253AFIN (accessed on 28 June 2023).
3. Glazener, A.; Wylie, J.; van Waas, W.; Khreis, H. The Impacts of Car-Free Days and Events on the Environment and Human Health. *Curr. Environ. Health Rep.* **2022**, *9*, 165–182. [CrossRef]
4. United Nations. *The UN Sustainable Development Goals*; United Nations: New York, NY, USA, 2015; Available online: http://www.un.org/sustainabledevelopment/summit/ (accessed on 20 June 2023).
5. Anciaes, P.; Jones, P. Transport policy for liveability—Valuing the impacts on movement, place, and society. *Transp. Res. A Policy Pract.* **2020**, *132*, 157–173. [CrossRef]
6. Aldred, R.; Croft, J. Evaluating active travel and health economic impacts of small streetscape schemes: An exploratory study in London. *J. Transp. Health* **2019**, *12*, 86–96. [CrossRef]
7. Larrañaga, A.M.; Rizzi, L.I.; Arellana, J.; Strambi, O.; Cybis, H.B.B. The influence of built environment and travel attitudes on walking: A case study of Porto Alegre, Brazil. *Int. J. Sustain. Transp.* **2016**, *10*, 332–342. [CrossRef]
8. Frank, L.D.; Sallis, J.F.; Saelens, B.E.; Leary, L.; Cain, K.; Conway, T.L.; Hess, P.M. The development of a walkability index: Application to the Neighborhood Quality of Life Study. *Br. J. Sports Med.* **2010**, *44*, 924–933. [CrossRef] [PubMed]
9. Salazar Miranda, A.; Fan, Z.; Duarte, F.; Ratti, C. Desirable streets: Using deviations in pedestrian trajectories to measure the value of the built environment. *Comput. Environ. Urban Syst.* **2021**, *86*, 101563. [CrossRef]
10. Montella, A.; Chiaradonna, S.; Mihiel, A.C.d.S.; Lovegrove, G.; Nunziante, P.; Rella Riccardi, M. Sustainable Complete Streets Design Criteria and Case Study in Naples, Italy. *Sustainability* **2022**, *14*, 13142. [CrossRef]
11. Distefano, N.; Pulvirenti, G.; Leonardi, S. Neighbourhood walkability: Elderly's priorities. *Res. Transp. Bus. Manag.* **2021**, *40*, 100547. [CrossRef]
12. Bentley, R.; Blakely, T.; Kavanagh, A.; Aitken, Z.; King, T.; McElwee, P.; Giles-Corti, B.; Turrell, G. A Longitudinal Study Examining Changes in Street Connectivity, Land Use, and Density of Dwellings and Walking for Transport in Brisbane, Australia. *Environ. Health Persp.* **2018**, *126*, 057003. [CrossRef]
13. Nosal Hoy, K.; Puławska-Obiedowska, S. The Travel Behaviour of Polish Women and Adaptation of Transport Systems to Their Needs. *Sustainability* **2021**, *13*, 2693. [CrossRef]
14. Montoya-Robledo, V.; Escovar-Álvarez, G. Domestic workers' commutes in Bogotá: Transportation, gender and social exclusion. *Transp. Res. A Policy Pract.* **2020**, *139*, 400–411. [CrossRef]
15. Hillnhütter, H. Stimulating urban walking environments—Can we measure the effect? *Environ. Plan. B Urban Anal. City Sci.* **2022**, *49*, 275–289. [CrossRef]
16. Ribeiro, A.I.; Hoffimann, E. Development of a Neighbourhood Walkability Index for Porto Metropolitan Area. How Strongly Is Walkability Associated with Walking for Transport? *Int. J. Environ. Res. Public Health* **2018**, *15*, 2767. [CrossRef]
17. Wey, W.; Huang, J. Urban sustainable transportation planning strategies for livable City's quality of life. *Habitat Int.* **2018**, *82*, 9–27. [CrossRef]
18. Almatar, K.M. Towards sustainable green mobility in the future of Saudi Arabia cities: Implication for reducing carbon emissions and increasing renewable energy capacity. *Heliyon* **2023**, *9*, e13977. [CrossRef]
19. Wang, H.; Yang, Y. Neighbourhood walkability: A review and bibliometric analysis. *Cities* **2019**, *93*, 43–61. [CrossRef]
20. Van Dyck, D.; Veitch, J.; De Bourdeaudhuij, I.; Thornton, L.; Ball, K. Environmental perceptions as mediators of the relationship between the objective built environment and walking among socio-economically disadvantaged women. *Int. J. Behav. Nutr. Phys. Act.* **2013**, *10*, 108. [CrossRef] [PubMed]

21. Forsyth, A. What is a walkable place? The walkability debate in urban design. *Urban Des. Int.* **2015**, *20*, 274–292. [CrossRef]
22. Sisiopiku, V.P.; Akin, D. Pedestrian behaviors at and perceptions towards various pedestrian facilities: An examination based on observation and survey data. *Transp. Res. F Traffic Psychol.* **2003**, *6*, 249–274. [CrossRef]
23. Bornioli, A.; Parkhurs, G.; Morgan, P.L. Affective experiences of built environments and the promotion of urban walking. *Transp. Res. Part A Policy Pract.* **2019**, *123*, 200–215. [CrossRef]
24. Julio, R.; Monzon, A.; Susilo, Y.O. Identifying key elements for user satisfaction of bike-sharing systems: A combination of direct and indirect evaluations. *Transportation* **2022**. [CrossRef]
25. Alfonzo, M.A. To Walk or Not to Walk? The Hierarchy of Walking Needs. *Environ. Behav.* **2005**, *37*, 808–836. [CrossRef]
26. Echaniz Beneitez, E.; Ho, C.Q.; Dell´Olio, L.; Rodríguez Gutiérrez, A. Universidad de Cantabria Comparing best-worst and ordered logit approaches for user satisfaction in transit services. *Transp. Res. Part A Policy Pract.* **2019**, *130*, 752–769. [CrossRef]
27. Fang, D.; Xue, Y.; Cao, J.; Sun, S. Exploring satisfaction of choice and captive bus riders: An impact asymmetry analysis. *Transp. Res. D Transp. Environ.* **2021**, *93*, 102798. [CrossRef]
28. Martilla, J.A.; James, J.C. Importance-Performance Analysis. *J. Mark.* **1977**, *41*, 77–79. [CrossRef]
29. Kano, N.; Seraku, N.; Takahashi, F.; Tsuji, S. Attractive Quality and Must-Be Quality. *Qual. Eng. J. Jpn. Soc. Qual. Control.* **1984**, *14*, 147–156. [CrossRef]
30. Danioni, F.; Coen, S.; Rosnati, R.; Barni, D. The relationship between direct and indirect measures of values: Is social desirability a significant moderator? *Rev. Eur. Psychol. Appl.* **2020**, *70*, 100524. [CrossRef]
31. Wu, X.; Cao, J.; Huting, J. Using three-factor theory to identify improvement priorities for express and local bus services: An application of regression with dummy variables in the Twin Cities. *Transp. Res. Part A Policy. Pract.* **2018**, *113*, 184–196. [CrossRef]
32. Zhang, C.; Cao, X.; Nagpure, A.; Agarwal, S. Exploring rider satisfaction with transit service in Indore, India: An application of the three-factor theory. *Transp. Lett.* **2019**, *11*, 469–477. [CrossRef]
33. Cao, J.; Cao, X. Comparing importance-performance analysis and three-factor theory in assessing rider satisfaction with transit. *J. Transp. Land Use* **2017**, *10*, 837–854. [CrossRef]
34. Obregón-Biosca, S.A. Choice of transport in urban and periurban zones in metropolitan area. *J. Transp. Geogr.* **2022**, *100*, 103331. [CrossRef]
35. Tatum, K.; Parnell, K.; Cekic, T.I.; Knieling, J. Driving factors of sustainable transportation: Satisfaction with mode choices and mobility challenges in oxfordshire and hamburg. *Int. J. Transp. Dev. Integr.* **2019**, *3*, 55–66. [CrossRef]
36. Sampson, S.E.; Showalter, M.J. The Performance-Importance Response Function: Observations and Implications. *Serv. Ind. J.* **1999**, *19*, 1–25. [CrossRef]
37. Vavra, T.G. *Improving Your Measurement of Customer Satisfaction*; ASQ Quality Press: La Vergne, TN, USA, 2001.
38. Munn, Z.; Peters, M.D.; Stern, C.; Tufanaru, C.; McArthur, A.; Aromataris, E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Med. Res. Methodol.* **2018**, *18*, 143. [CrossRef] [PubMed]
39. Abdulla, K.; Abdelmonem, M.G.; Selim, G. Understanding Walkability in the Libyan Urban Space: Policies, Perceptions and Smart Design for Sustainable Tripoli. *Int. J. Civ. Environ. Struct. Constr. Archit. Eng.* **2016**, *10*, 1624–1632.
40. Abou-Senna, H.; Radwan, E.; Mohamed, A. Investigating the correlation between sidewalks and pedestrian safety. *Accid. Anal. Prev.* **2022**, *166*, 106548. [CrossRef] [PubMed]
41. Aghaabbasi, M.; Moeinaddini, M.; Zaly Shah, M.; Asadi-Shekari, Z. A new assessment model to evaluate the microscale sidewalk design factors at the neighbourhood level. *J. Transp. Health* **2017**, *5*, 97–112. [CrossRef]
42. Kang, L.; Xiong, Y.; Mannering, F.L. Statistical analysis of pedestrian perceptions of sidewalk level of service in the presence of bicycles. *Transp. Res. A Policy Pract.* **2013**, *53*, 10–21. [CrossRef]
43. Asadi-Shekari, Z.; Moeinaddini, M.; Zaly Shah, M. A pedestrian level of service method for evaluating and promoting walking facilities on campus streets. *Land Use Policy* **2014**, *38*, 175–193. [CrossRef]
44. Arellana, J.; Saltarín, M.; Larrañaga, A.M.; Alvarez, V.; Henao, C.A. Urban walkability considering pedestrians' perceptions of the built environment: A 10-year review and a case study in a medium-sized city in Latin America. *Transp. Rev.* **2020**, *40*, 183–203. [CrossRef]
45. Fonseca, F.; Papageorgiou, G.; Tondelli, S.; Ribeiro, P.; Conticelli, E.; Jabbari, M.; Ramos, R. Perceived Walkability and Respective Urban Determinants: Insights from Bologna and Porto. *Sustainability* **2022**, *14*, 9089. [CrossRef]
46. Ferrer, S.; Ruiz, T.; Mars, L. A qualitative study on the role of the built environment for short walking trips. *Transp. Res. F Traffic Psychol.* **2015**, *33*, 141–160. [CrossRef]
47. Zhu, M.; Sze, N.N.; Newnam, S. Effect of urban street trees on pedestrian safety: A micro-level pedestrian casualty model using multivariate Bayesian spatial approach. *Accid. Anal. Prev.* **2022**, *176*, 106818. [CrossRef] [PubMed]
48. Troped, P.J.; Cromley, E.K.; Fragala, M.S.; Melly, S.J.; Hasbrouck, H.H.; Gortmaker, S.L.; Brownson, R.C. Development and Reliability and Validity Testing of an Audit Tool for Trail/Path Characteristics: The Path Environment Audit Tool (PEAT). *J. Phys. Act. Health* **2006**, *3*, S158–S175. [CrossRef] [PubMed]
49. Van Eggermond, M.A.B.; Erath, A. Pedestrian and transit accessibility on a micro level. *J. Transp. Land Use* **2016**, *9*, 127–143. [CrossRef]
50. Barón, L.; Otila da Costa, J.; Soares, F.; Faria, S.; Prudêncio Jacques, M.A.; Fraga de Freitas, E. Effect of Built Environment Factors on Pedestrian Safety in Portuguese Urban Areas. *Appl. Syst. Innov.* **2021**, *4*, 28. [CrossRef]

51. Galanis, A.; Botzoris, G.; Eliou, N. Pedestrian road safety in relation to urban road type and traffic flow. *Transp. Res. Procedia* **2017**, *24*, 220–227. [CrossRef]
52. Distefano, N.; Leonardi, S. Evaluation of the Effectiveness of Traffic Calming Measures by SPEIR Methodology: Framework and Case Studies. *Sustainability* **2022**, *14*, 7325. [CrossRef]
53. Ortega, E.; Martín, B.; De Isidro, Á.; Cuevas-Wizner, R. Street walking quality of the 'Centro' district, Madrid. *J. Maps* **2020**, *16*, 184–194. [CrossRef]
54. Canale, S.; Distefano, N.; Leonardi, S. Comparative analysis of pedestrian accidents risk at unsignalized intersections. *Balt. J. Road Bridge Eng.* **2015**, *10*, 283–292. [CrossRef]
55. Papadimitriou, E.; Lassarre, S.; Yannis, G. Human factors of pedestrian walking and crossing behaviour. *Transp. Res. Procedia* **2017**, *25*, 2002–2015. [CrossRef]
56. Li, X.; Santi, P.; Courtney, T.K.; Verma, S.K.; Ratti, C. Investigating the association between streetscapes and human walking activities using Google Street View and human trajectory data. *Trans. GIS* **2018**, *22*, 1029–1044. [CrossRef]
57. Adams, M.A.; Frank, L.D.; Schipperijn, J.; Smith, G.; Chapman, J.; Christiansen, L.B.; Coffee, N.; Salvo, D.; du Toit, L.; Dygrýn, J.; et al. International variation in neighborhood walkability, transit, and recreation environments using geographic information systems: The IPEN adult study. *Int. J. Health Geogr.* **2014**, *13*, 43. [CrossRef] [PubMed]
58. Salem, D.; Khalifa, S.I.; Tarek, S. Using Landscape Qualities to Enhance Walkability in Two Types of Egyptian Urban Communities. *Civ. Eng. Archit.* **2022**, *10*, 1798–1813. [CrossRef]
59. Taleai, M.; Taheri Amiri, E. Spatial multi-criteria and multi-scale evaluation of walkability potential at street segment level: A case study of tehran. *Sustain. Cities Soc.* **2017**, *31*, 37–50. [CrossRef]
60. Lizárraga, C.; Martín-Blanco, C.; Castillo-Pérez, I.; Chica-Olmo, J. Do University Students' Security Perceptions Influence Their Walking Preferences and Their Walking Activity? A Case Study of Granada (Spain). *Sustainability* **2022**, *14*, 1880. [CrossRef]
61. Lucchesi, S.T.; Larranaga, A.M.; Ochoa, J.A.A.; Samios, A.A.B.; Cybis, H.B.B. The role of security and walkability in subjective wellbeing: A multigroup analysis among different age cohorts. *Res. Transp. Bus. Manag.* **2021**, *40*, 100559. [CrossRef]
62. Pollard, T.M.; Wagnild, J.M. Gender differences in walking (for leisure, transport and in total) across adult life: A systematic review. *BMC Public Health* **2017**, *17*, 341. [CrossRef]
63. Bonatto, D.d.A.M.; Alves, F.B. Application of Walkability Index for Older Adults' Health in the Brazilian Context: The Case of Vitória-ES, Brazil. *Int. J. Environ. Res. Public Health* **2022**, *19*, 1483. [CrossRef] [PubMed]
64. Das, S.; Bibeka, A.; Sun, X.; Zhou, H.; Jalayer, M. Elderly Pedestrian Fatal Crash-Related Contributing Factors: Applying Empirical Bayes Geometric Mean Method. *Transp. Res. Rec.* **2019**, *2673*, 254–263. [CrossRef]
65. Maisel, J.L. Impact of Older Adults' Neighborhood Perceptions on Walking Behavior. *J. Aging Phys. Act.* **2016**, *24*, 247–255. [CrossRef] [PubMed]
66. Yoh, K.; Khaimook, S.; Doi, K.; Yamamoto, T. Study on influence of walking experience on traffic safety attitudes and values among foreign residents in Japan. *IATSS Res.* **2022**, *46*, 161–170. [CrossRef]
67. Basu, N.; Haque, M.M.; King, M.; Kamruzzaman, M.; Oviedo-Trespalacios, O. The unequal gender effects of the suburban built environment on perceptions of security. *J. Transp. Health* **2021**, *23*, 101243. [CrossRef]
68. Paydar, M.; Kamani-Fard, A.; Etminani-Ghasrodashti, R. Perceived security of women in relation to their path choice toward sustainable neighborhood in Santiago, Chile. *Cities* **2017**, *60*, 289–300. [CrossRef]
69. Leonardi, S.; Distefano, N.; Pulvirenti, G. Identification of road safety measures for elderly pedestrians based on K-means clustering and hierarchical cluster analysis. *Arch. Transp.* **2020**, *56*, 107–118. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.