



## Article

# Sustainability Understanding and Behaviors across Urban Areas: A Case Study on Istanbul City

Hasan Fehmi Topal , Dexter V. L. Hunt and Christopher D. F. Rogers 

Department of Civil Engineering, School of Engineering, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK; d.hunt@bham.ac.uk (D.V.L.H.); c.d.f.rogers@bham.ac.uk (C.D.F.R.)

\* Correspondence: HFT718@bham.ac.uk

**Abstract:** The success of urban sustainability is very much dependent on a number of human factors. Therefore, it becomes even more important to explore how people understand urban sustainability and how they behave accordingly. Based on a formerly developed conceptual framework and on specified influencing factors, this study aimed to evaluate and elucidate the urban sustainability understanding and behavior of individuals in the city of Istanbul. This was assessed through the use of a quantitative questionnaire survey of 535 respondents. Therein, socio-psychological processes of sustainability understanding (i.e., determinants of awareness, perception, and attitude) and sustainability behaviors along with personality traits and influential factors were assessed and analyzed through the use of bivariate and multivariate methods (i.e., correlation tests, ANOVA, *t*-tests, and multiple linear regression). The results showed that sustainability awareness was more strongly correlated with attitude than perception, whereas behavior was found to be strongly correlated with both awareness and attitude and was (significantly) predicted by all determinants. The associations/influences of personality traits with determinants were found to be mostly insignificant. Conversely, for behavior, they were significant. The most influential factors found (in hierarchical ordering) were awareness of consequences, trust in society, social appraisal, world-mindedness, willingness to pay, trust in science and technology, ascription of responsibility, age and gender.

**Keywords:** urban sustainability; sustainable behavior; sustainability understanding; awareness; perception; attitude; pro-environmental behavior; influencing factors; Turkey; Istanbul



**Citation:** Topal, H.F.; Hunt, D.V.L.; Rogers, C.D.F. Sustainability Understanding and Behaviors across Urban Areas: A Case Study on Istanbul City. *Sustainability* **2021**, *13*, 7711. <https://doi.org/10.3390/su13147711>

Academic Editor: Tan Yigitcanlar

Received: 2 June 2021

Accepted: 25 June 2021

Published: 9 July 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**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/>).

## 1. Introduction

Over the last 35 years, sustainability studies have featured prominently within research agendas around the world. Starting with the Brundtland Report in 1987 [1], sustainability's prominence has increased with time. In its early approaches, it was understood as the balance between nature and humans that provides continuous development [2]. Early interpretations of sustainable development were defined by the three pillars approach, which includes economic development, social equity, and environmental protection [3].

Sustainability in urban areas plays a critical role for sustainable development, since the planet is facing critical challenges that have arisen as a result of unsustainable urbanization. These problems require precautions such as using natural resources efficiently and balancing the human–nature relationship at both micro- and macro-levels. According to the United Nations, by 2050, while the world population is expected to surpass nine billion [4], urbanization rates are anticipated to reach 66% [5]. Therefore, urban living areas emerge as one of the most critical elements of sustainability studies. In line with this, the United Nations has addressed the importance of urban areas within the Sustainable Development Goals (SDGs) under the heading of “Sustainable cities and communities” [6].

In line with the Sustainable Development Goals, Istanbul, being the largest city in Turkey (with the population reaching 15.5 million by 2020) [7], aims to integrate sustainability into its urbanization and development strategies [8,9]. This rapid urbanization,

together with a rapidly developing economy, has prompted Istanbul's Urban Regeneration Law, commonly referred to as "Transformation of Areas Under the Disaster Risk" [10], making sustainability even more prominent for the case of Turkey in the city of Istanbul. Adopting development aspirations for 2023 in Istanbul [11], Istanbul's master plan has been redesigned according to 2023 goals, including new headings such as sustainable urban development, spatial quality, sustainable transportation, sustainable environment, and environmentally friendly energy [12]. Considering all of this, it is obvious that sustainability is becoming a very prominent topic for Istanbul. However, the development of sustainable behavior needs the support of local and central authorities in order that any sustainability targets are met.

The overall success of sustainability policies within cities is subject to their acceptance by the people who reside therein. Therefore, individual and social behaviors are of critical importance for sustainable living areas. Moreover, combatting the global challenges is immensely reliant on the sustainable practices of individuals. In light of this, it is of prominent importance to study the sustainability understanding and behavior of people in the urban context.

Numerous studies have attempted to explore pro-environmental or sustainable behavior [13–17] from various perspectives such as ecological economics [18], environmental policy [13], household energy conservation [19], waste management [20], and climate change [21]. However, earlier research has mainly adopted either environmental [22] or psychological approaches [23]. On the other hand, a synthesized approach that puts urban sustainability at the very core is required, and, more importantly, this approach was adopted within the current research paper. Moreover, in a Turkish context, studies within this field have, until recently, been relatively unobserved. While there are increasing numbers of studies investigating sustainability from several perspectives, such as transportation [24], climate change [25], energy [26], natural resources [27], and urbanization [28,29], very few studies have concentrated on the understanding and behaviors of urban sustainability [30]. Therefore, this research aimed to fill an important gap within the literature.

## 2. Methodology

### 2.1. Conceptual Approach

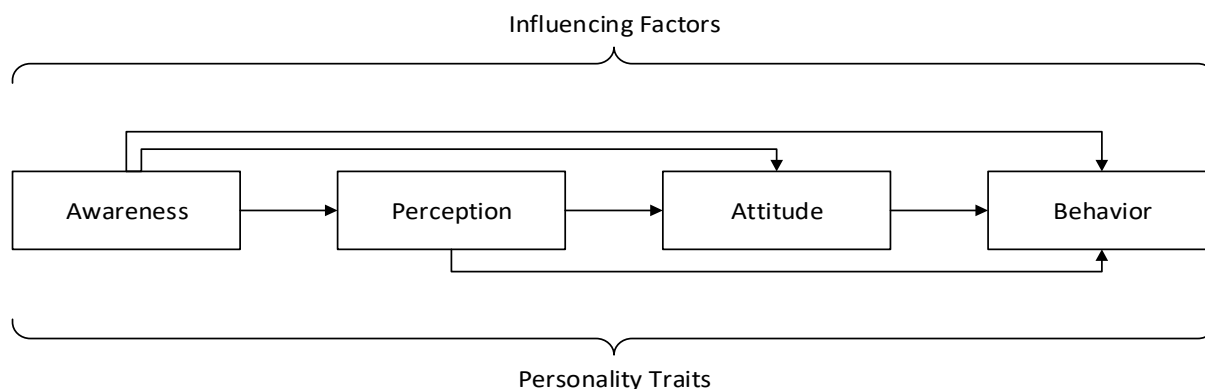
Based on the literature review conducted previously by Topal et al. [31], it was revealed that the complexity of the urban sustainability behavior context required specification of variables that influence sustainability understanding and behavior. Moreover, it was necessary to specify the relationship between socio-psychological determinants of urban behavior in order to evaluate and analyze the individual practices (a determinant is defined herein as a factor that decisively affects the nature or outcome of something).

It is obvious that methodological approaches to sustainability assessment studies require deliberate efforts. In this manner, Sharifi et al. [32] have described critical methodological shortcomings in sustainability assessment tools. Some of the critical ones are:

- Limitations and the lack of harmony about sustainability dimensions;
- Lack of lucidity and the dominance of top-down approaches;
- Insufficient consideration of context-sensitive subjects;
- Lack of flexibility in design stages;
- Lack of compliance among various methodologies; and
- The complexity of the instrument.

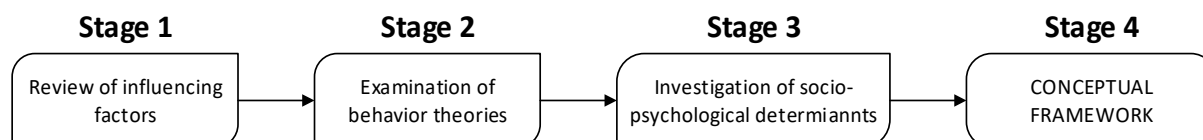
On the other hand, the importance of the balance of the complementary relationship between nature-based recipes and urban-wilding approaches should be kept in mind and needs to be considered in urban sustainability studies [33]. For instance, as stated by Morano et al. [34], the inherent contradiction between the precedence of real estate developers and public authorities defines the natural limits of urban sustainability approaches. While the former has mainly focused on profit maximization, the latter has prioritized the quality of and livability within the city.

Considering the above requirements, a novel conceptual framework was proposed in Topal et al. [35] based on an in-depth literature search. A simplified version of the proposed conceptual framework is shown in Figure 1, which outlines the multiple linkages between awareness, perception, attitude, and behavior. Moreover, the associations between these socio-psychological processes and a range of influencing factors and personality traits have been specified [35].



**Figure 1.** Conceptual framework used in the study.

The development process of the conceptual framework consists of four stages, which are presented in Figure 2. Topal et al. [31] provided a systematic review of the influencing factors of urban sustainability behavior(s), fulfilling the requirements of stage 1. Topal et al. [35] thereafter examined prominent environmental and sustainability behavior theories (stage 2), investigated socio-psychological determinants of urban sustainability understanding and behavior (stage 3), and synthesized these findings into a newly developed conceptual framework (stage 4), which has formed the basis for this current study.



**Figure 2.** Methodological stages of the conceptual framework development.

## 2.2. Research Aim and Objectives

The research aim was to develop a holistic approach to evaluate and elucidate the urban sustainability understanding and behavior of individuals through the application of a developed conceptual framework. In so doing the formation of sustainable urban behavior through socio-psychological processes (i.e., determinants of awareness, perception, and attitude) and the effect of influential factors and personality traits on urban sustainability understanding and behavior were investigated.

In order to meet the research aim, the following objectives were defined:

- To assess the urban sustainability understanding and behavior of individuals, and determine how they are related
- To analyze the relationship between this urban sustainability understanding and behavior and both influencing factors and personality traits
- To develop policies that can improve urban sustainability understanding and the behavior of individuals

### 2.3. Methods

#### 2.3.1. Study Location and Sample

The focus of the project was the sustainable behaviors of the people living in urban areas; therefore, the two main elements were the urban built environment and people. Accepting that sustainability is a highly local context-dependent subject [36], a specific urban area has to be selected. Istanbul was chosen for this study since it is the largest city in Turkey and well-known around the world.

Istanbul is located in the north-west of Turkey in the Marmara region. It had a population of 15.5 million by 2020 [7], and consists of 39 counties. Given its logistically advantageous geography, its strong history and the fact it hosts several crucial economic activities, Istanbul is expected to reach a population of 17 billion by 2030 [6].

Following ethical approval from the University of Birmingham (reference number ERN\_19-0513A), 20 pilot questionnaire surveys were conducted with colleagues at The University of Birmingham and colleagues who were resident in Istanbul. Based on the results of and feedback from the pilot study, the final questionnaire was formulated and administered between 1 December 2020 and 20 January 2021. The survey was undertaken on all days of the week between early morning (7 a.m.) and late in the evening (9 p.m.), in order to minimize sampling bias. Survey respondents were randomly selected from various counties of Istanbul in order to best represent the socio-demographic distribution of the population.

A professional survey company was employed to collect the data. Trained surveyors were involved in the data collection process, armed with tablets to provide people with the option to fill web-surveys. In total, 535 initial responses were obtained.

#### 2.3.2. Measures

Quantitative data were obtained through a comprehensive questionnaire, mainly using a five-point Likert scale [37]. The question wording was designed to be as concise as possible, while the structure was designed to be understandable by grouping questions according to the elements of the conceptual framework.

Respondents were presented with a cover letter, which gave a brief introduction about the survey, and a participant information sheet, which presented the purpose of the study, targeted audiences, confidentiality issues, and contact details. A short explanation of urban sustainability and sustainable behavior was given at the beginning of the survey in order to prevent any misunderstanding or misinterpretation of the terms. In total, the questionnaire consisted of five sections:

1. General socio-demographic information (12 questions)
2. Understanding, i.e., determinants of awareness, perception, and attitudes (14 questions)
3. Behavior (18 questions)
4. Influencing factors (19 questions)
5. Personality traits (5 questions)

As stated earlier, the questions were based on the findings of an in-depth literature review [31] and conceptual framework [35] created by the current authors. The details of the questionnaire are given in Appendix A.

#### 2.3.3. Data Analysis

All statistical analyses for the data collected from the questionnaire survey were performed using Python 3.8 software. In all statistical analysis,  $\alpha = 0.05$  was used as the significance level since it has become the most commonly used threshold by researchers [38]. Three stages of analysis have been conducted:

Firstly, in the preliminary analysis, descriptive statistics including frequency, mean, standard deviation, and scale construction have been performed on each element of the conceptual framework: determinants of understanding (i.e., awareness, perception, and attitude), behavior, personality traits, and influencing factors.

Secondly, bivariate analysis was conducted between the elements of the conceptual framework. Thereafter, correlation tests, *t*-tests, and ANOVA tests were conducted.

In the third stage, multivariate analysis was carried out on the elements of the conceptual framework. A series of multiple linear regression tests were performed on the outcome variables specified in the framework.

### 3. Descriptive Analyses and Results

#### 3.1. Understanding

##### 3.1.1. Determinants of Understanding

##### Determinant 1: Awareness

Awareness was assessed by five different questions (Aw1 to Aw5). The fifth question (Aw 5.1 to Aw 5.9) was about familiarity level and consisted of nine sub-questions (Figure 3).

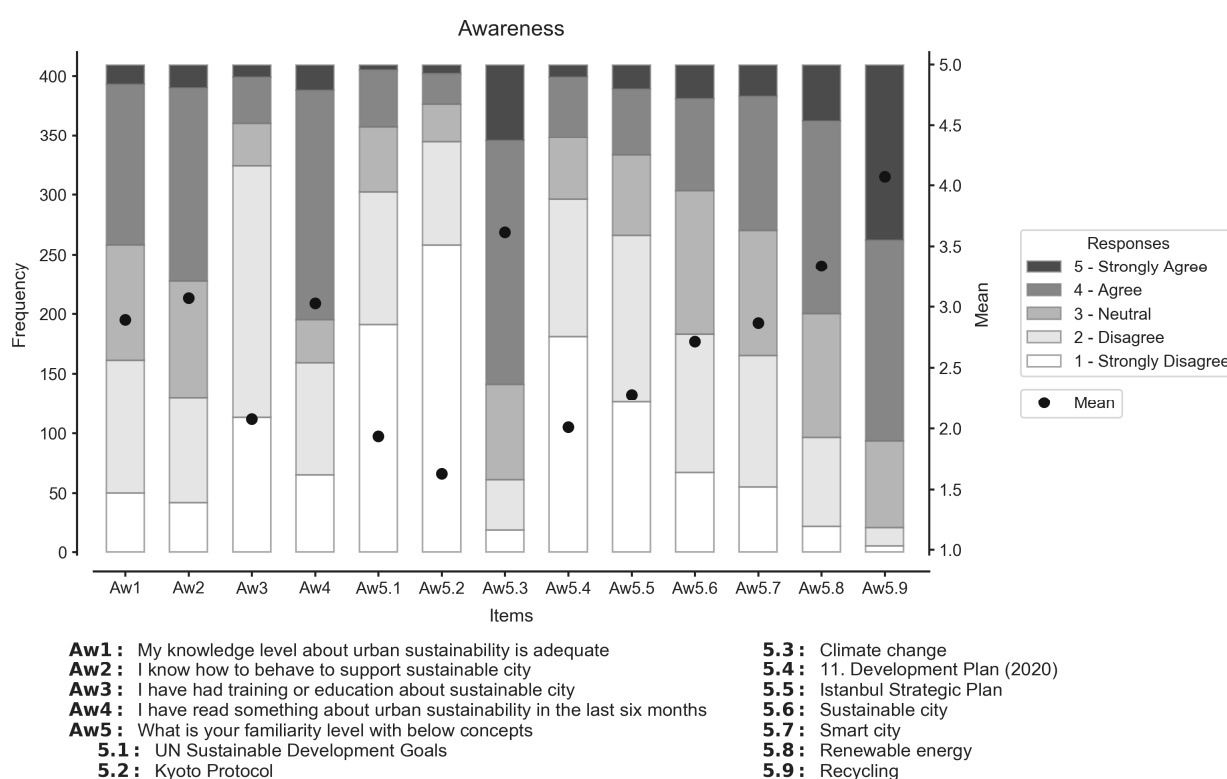


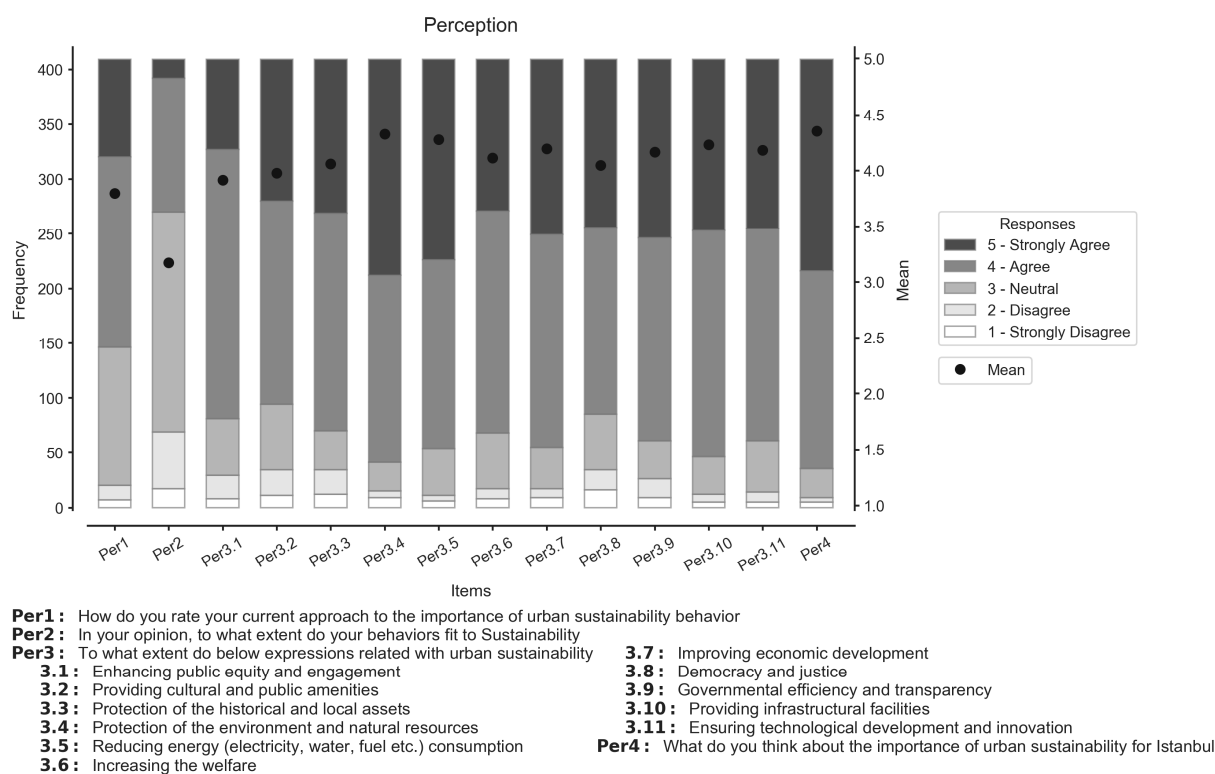
Figure 3. Awareness questions.

By looking at the results, it became apparent that while respondents tended to report themselves knowledgeable about urban sustainability (Aw1) and they know how to behave sustainably (Aw2), they admitted to having a lack of education or training on these issues (Aw3). However, they reported also that they have read something about sustainable cities in various news channels (Aw4), which is slightly contradictory. The answers to Aw1, Aw2, and Aw4, therefore, appear to provide a coherent narrative, explaining that although there are some opportunities for individuals to gain ideas about urban sustainability behavior through media or via the internet, education or training opportunities are insufficient and need improvement. The items in the fifth question (Aw5) present an important trend. Regarding the first three items (Aw5.1 to 5.3), it is possible to deduce that people within Turkey are relatively unfamiliar with more technical and global topics such as The United Nations Sustainable Development Goals (Aw5.1) or the Kyoto Protocol (Aw5.2), but most of them have heard about popular topics such as climate change (Aw5.3). However, it was surprising to find that familiarity with the Kyoto Protocol was lacking, as it could also be

viewed as a hot debate topic. When it comes to the last six items (Aw5.4 to 5.9), respondents were asked to grade their familiarity level regarding the 11th Development Plan of the Turkish Government (2019–2023) [11] (Aw5.4), Istanbul strategic plan [12] (Aw5.5), the sustainable city concept [8] (Aw5.6), the smart city concept (Aw5.7), renewable energy (Aw5.8), and recycling (Aw5.9). It can be seen that as the specificity and locality of the item increase, the familiarity level increases as well. It is also noteworthy that people are slightly more familiar with the term ‘smart city’ than the term ‘sustainable city’. One of the reasons for this could be the increase in popularity of smart city as a term in recent years as a result of rapid technological developments. Moreover, it is slightly difficult to pronounce the Turkish translation of sustainability, which is written as “sürdürülebilirlik”. Therefore, it is possible to surmise that an alternative, catchy keyword with higher advertising value would preferentially be used alongside the sustainability term in the Turkish context. Moreover, the general public is more likely to be concerned by local sustainability issues.

### Determinant 2: Perception

Regarding the perception determinant, less variance and higher scores were observed within the questions (Figure 4).



**Figure 4.** Perception questions.

It was found that 73% of the respondents believe in the importance of urban sustainability behavior (Per1). However, they admit that their behaviors do not conform to sustainability principles (Per2). It is important that people become good at distinguishing their perceptions about the importance of sustainability from their perceptions about their individual performances in behaving accordingly.

In question three (Per3.1 to Per3.11), a comprehensive list of urban sustainability related sub-areas were given and people were asked to grade the strength of their relationship with urban sustainability. Respondents appear to have a holistic perception about urban sustainability since they scored all items highly, although a higher score was observed for environmental aspects (Per3.4 and Per3.5) than social aspects (Per3.1 and Per3.2). It is therefore possible to state that people were more inclined to see sustainability more



as an environmental issue than a social issue. The responses to the last question (Per4) showed there to be an overall consensus among the respondents on the importance of sustainability for Istanbul, which is expected to increase the chance of public participation in urban sustainability actions.

### Determinant 3: Attitude

In terms of attitudes (Figure 5), although the overall attitude was found to be significantly high, it is possible to notice from the responses to questions Att1 and Att4 that a considerable proportion of the respondents still hold some remnants of an anthropocentric approach.

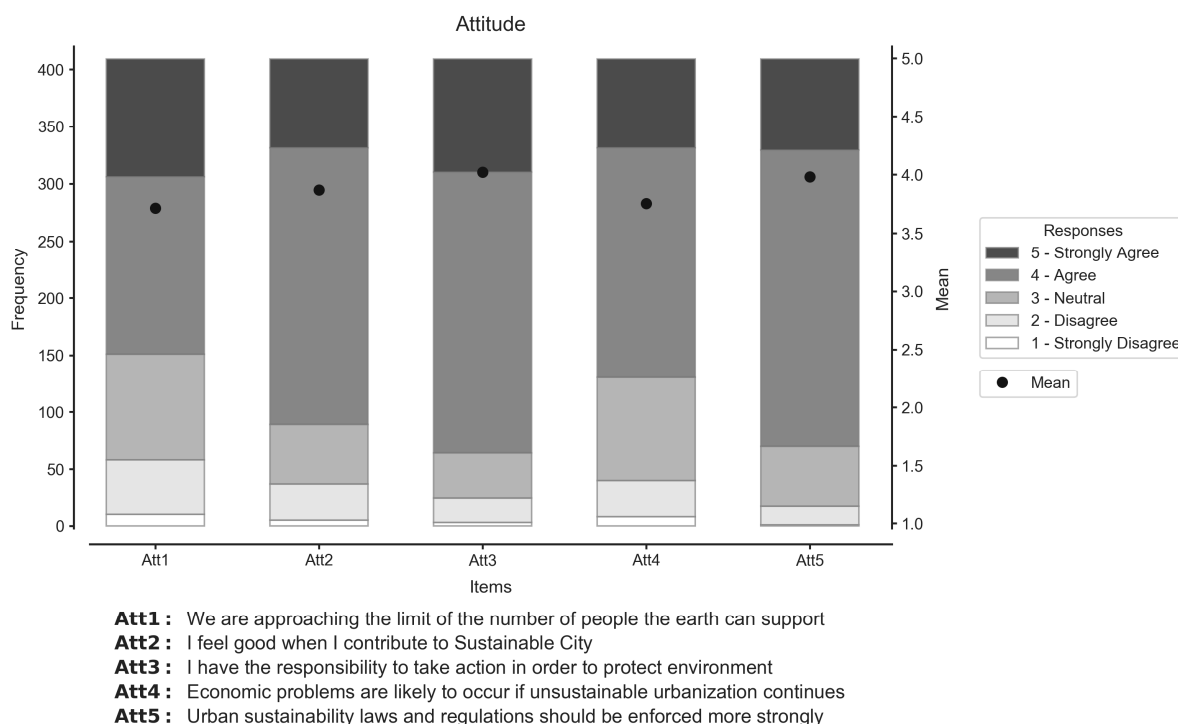


Figure 5. Attitude questions.

They cared somewhat less about the limits of the planet (Att1) and possible economic outcomes of unsustainability (Att4) when compared with other scores. On the other hand, they had a good sense of contributing to sustainability (Att2) and saw themselves as responsible for taking necessary actions (Att3). Moreover, they also thought that public authorities should enforce regulations more strongly (Att5). Their strong emphasis in this question was found to be a result of unsustainable urbanization policy and actions undertaken in Istanbul in recent years. It also showed a general discomfort with the actions that have been implemented. However, it is promising that they hold themselves responsible for urban sustainability actions and feel good about making contributions since it indicates that there are strong attitudes about pro-sustainability issues. Moreover, the consensus among the respondents on the importance of sustainability has the potential to be used in both supporting sustainable policy and actions and changing unsustainable practices, even if they act against the comfort of individuals or benefit specific power groups.

### 3.1.2. Data Preparation

#### Factor Analysis

All determinant questions were subjected to a factor analysis with varimax rotation. This helped to provide confirmation of the appropriateness of the questionnaire structure by deriving latent variables. Moreover, it was useful for providing empirical robustness for aggregate scales [39].

The results indicated that Bartlett's test coefficient was equal to 1943, which, along with a  $p$ -value of  $<0.05$ , showed that the data was suitable for factor analysis. Similarly, a KMO value of 0.867 (higher than the adequacy limit of 0.600) confirmed suitability of the data for factor analysis. In addition, a Scree plot method was used to choose the number of factors that could/should be considered. As a result, three factors with eigenvalues larger than 1.0 were retained [39].

In the final step, the three factors were rotated using varimax orthogonal rotation; the corresponding factor loadings are shown in Table 1.

**Table 1.** Factor loadings for all determinant items.

Variable	Factor 1	Factor 2	Factor 3	Communality	Cronbach's Alpha
Aw1	<b>0.804</b>	0.112	0.280	0.738	0.87
Aw2	<b>0.784</b>	0.068	0.314	0.718	
Aw3	<b>0.659</b>	0.240	−0.016	0.492	
Aw4	<b>0.694</b>	0.070	0.294	0.573	
Aw5	<b>0.671</b>	0.306	0.175	0.574	
Per1	0.186	<b>0.427</b>	0.098	0.227	0.62
Per2	0.302	<b>0.464</b>	−0.067	0.311	
Per3	0.032	<b>0.606</b>	0.231	0.421	
Per4	0.064	<b>0.558</b>	0.126	0.331	
Att1	0.092	−0.098	<b>0.451</b>	0.222	0.68
Att2	0.334	0.328	<b>0.520</b>	0.489	
Att3	0.243	0.269	<b>0.460</b>	0.343	
Att4	0.188	0.179	<b>0.585</b>	0.409	
Att5	0.057	0.288	<b>0.501</b>	0.337	
% Variance	0.213	0.118	0.111	0.442	

Note: Bold ones indicate the corresponding factor loadings.

The chosen three factors confirmed the exact grouping used in the questionnaire (i.e., awareness, perception, and attitude). As can be seen from Table 1, awareness items are grouped under factor 1, perception items are grouped under factor 2, and attitude items are grouped under factor 3. Cronbach's alpha statistics show that all scales were internally consistent, with the internal consistency score of the perception scale being the lowest. As a result, it is possible to state that the questionnaire used in this survey formed a reliable set of scales and provided a valid empirical base [40,41].

### Scale Construction

Although the three separate groups of determinant questions (i.e., awareness, perception, and attitude) were created based on the insights provided from the existing literature, it was important to specify their distinct features empirically. This consisted of two steps.

In the first step, the questions that consisted of several expressions were converted into a scale. In other words, for Aw5 (which consisted of nine statements) and Per3 (which consisted of 11 statements), all statements were considered as equally weighted. Therefore, all answers were summed (from 1—strongly disagree to 5—strongly agree) and the sums were divided by the total number of statements (9 and 11, respectively) in order to obtain an overall score for these particular questions.

In the second step, all questions under each determinant groups—awareness (five questions), perception (four questions), and attitude (five questions)—were summed and the sums were divided by the total number of questions (i.e., 5, 4, and 5, respectively). By doing so, an overall average score for each of the awareness, perception, and attitude determinants were obtained.



### 3.2. Behavior

#### 3.2.1. Items of Behavior

Behavior is the outcome of the socio-psychological processes that feature in the conceptual framework (Figure 1). While exploring urban sustainability understanding and behavior, the number of discrete questions under behavior were more numerous than the individual socio-psychological determinant scales since behavior was the central focus of this research. Similar to the process adopted for awareness, perception, and attitude, reported levels of behavior were measured and analyzed (Figure 6). Therein, 18 different aspects of behavior were considered within seven groups:

1. Personal (Q1.1 to 1.3)
2. Social (Q2.1 to 2.3)
3. Environmental (Q3.1 to 3.3)
4. Economic (Q4.1 to 4.3)
5. Governance (Q5.1 to 5.2)
6. Infrastructural (Q6.1 to 6.2)
7. Technological (Q7.1 to 7.2)

The results presented in Figure 6 show that respondents tended to report their efforts within their personal (Bh1.1) and social environments (Bh1.3) and admit that they were not able to attend informative activities frequently (Bh1.2). The reason behind this could be a lack of time and/or lack of informative activities related to urban sustainability.

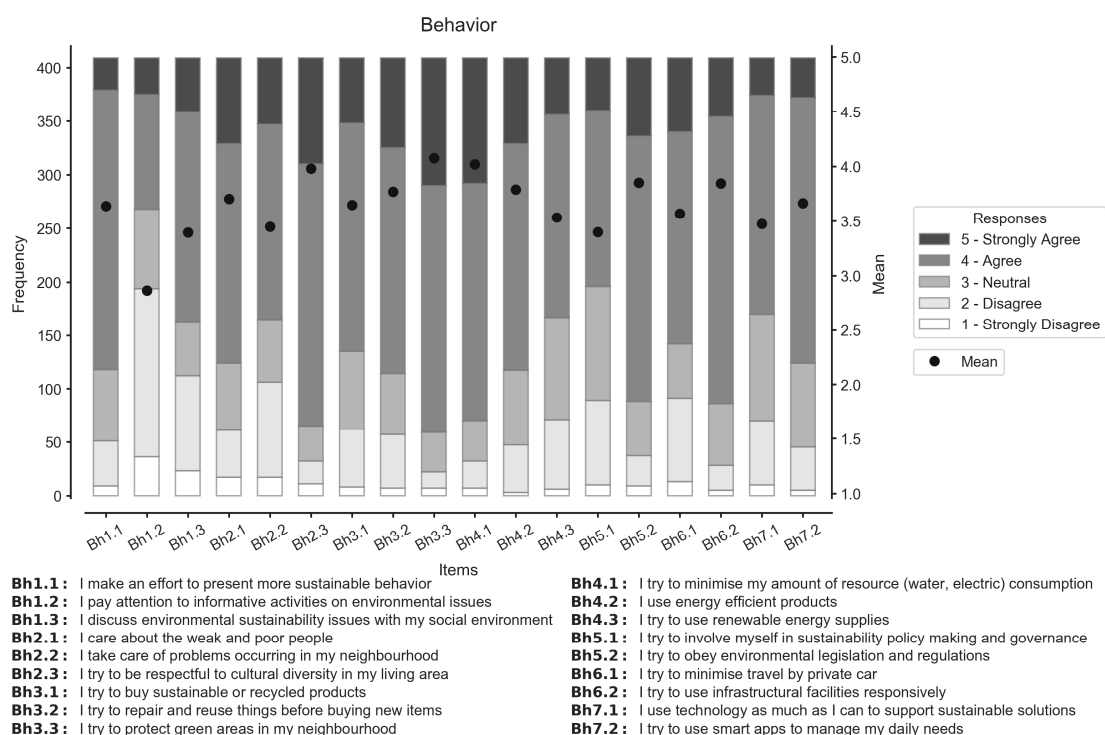


Figure 6. Behavior questions.

Regarding the social behavior items (Bh2.1 to Bh2.3), higher scores were observed. The connection between social behavior items and cultural–moral values provided them with a strong basis. This indicates, therefore, that the advantage of these established cultural codes should be utilized in sustainability policies. A similar high trend in environmental behavior items (Bh3.1 to Bh3.3) was observed. Although the statement of “buying sustainable or recycled products” (Bh3.1) gained lower scores than other environmental behavior items, this aspect of sustainability behavior could be enhanced by providing better labelling and informative ‘sustainability’ signage on products. The responses about repairing and reusing things (Bh3.2) might also be related with cultural codes as well as economic benefits.

A higher score was observed in protecting the green areas (Bh3.3). This score is important since it denotes a need for value to be attached to green areas in urban living.

Economic behavior items (Bh4.1 to Bh4.3) achieved generally high scores, the lowest of the three using renewable energy supplies (Bh4.3). This might be due to either inadequate supply of, or respondents being insufficiently informed about, renewable energy sources. This indicates that the sources of energy supplies used in household energy consumption could be presented more visibly. Under governance behavior items (Bh5.1 and Bh5.2), it was observed that participating in sustainability policy and governance (Bh5.1) achieved low scores. Therefore, it could be argued that the channels for participatory government should be enhanced, which would eventually be expected to result in a positive impact on overall sustainability behavior. On the other hand, people demonstrated a willingness to obey environmental regulations (Bh5.2). For infrastructural (Bh6.1 and Bh6.2) and technological (Bh7.1 and Bh7.2) items, a coherent response characteristic was observed with high mean values.

### 3.2.2. Data Preparation Factor Analysis

In order to prepare the behavior data for inferential analysis, factor analysis with varimax rotation was once again conducted. By doing so, a reduction in the dimension was provided and empirically sound implicit factors were extracted. Bartlett's test coefficient of 3369 along with a  $p$ -value of  $<0.05$  indicated that the data was suitable for factor analysis. Similarly, a KMO value of 0.938 (higher than adequacy limit of 0.600) confirmed the suitability of factor analysis. The Scree plot method was again used to choose the number of factors. Although three eigenvalues were above 1.0, initial analysis using three factors did not give a meaningful outcome. Factor loadings were closely distributed among three factors; therefore, it was not possible to place them under distinct groupings. Moreover, the cumulative variance score was lower than required. Hence, as the eigenvalue of the fourth factor (0.93) was very close to the threshold of 1.0 and the three-factor analysis did not give appropriate results, four factors were used for the second iteration. This proved successful: four factors rotated with varimax orthogonal rotation resulted in a meaningful outcome, the corresponding factor loadings being recorded in Table 2.

Table 2. Factor loadings for behavior items.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Communality	Cronbach's Alpha
Behavior 2.1	<b>0.550</b>	0.412	0.128	0.162	0.515	0.83
Behavior 2.3	<b>0.698</b>	0.314	0.187	0.064	0.625	
Behavior 3.3	<b>0.730</b>	0.097	0.152	0.289	0.649	
Behavior 4.1	<b>0.527</b>	0.022	0.428	0.278	0.538	
Behavior 5.2	<b>0.524</b>	0.177	0.318	0.321	0.510	
Behavior 1.1	0.304	<b>0.537</b>	0.245	0.289	0.525	0.80
Behavior 1.2	0.048	<b>0.671</b>	0.130	0.240	0.526	
Behavior 1.3	0.246	<b>0.718</b>	0.149	0.187	0.632	
Behavior 2.2	0.432	<b>0.491</b>	0.252	0.158	0.516	
Behavior 3.1	0.292	0.500	<b>0.518</b>	0.151	0.627	0.80
Behavior 3.2	0.289	0.054	<b>0.367</b>	0.191	0.258	
Behavior 4.2	0.258	0.287	<b>0.694</b>	0.195	0.669	
Behavior 4.3	0.129	0.333	<b>0.474</b>	0.394	0.507	
Behavior 5.1	0.124	0.461	<b>0.473</b>	0.236	0.507	
Behavior 6.1	0.171	0.248	0.192	<b>0.475</b>	0.353	0.75
Behavior 6.2	0.361	0.227	0.236	<b>0.467</b>	0.456	
Behavior 7.1	0.216	0.305	0.216	<b>0.482</b>	0.418	
Behavior 7.2	0.415	0.242	0.177	<b>0.445</b>	0.460	
% Variance	0.159	0.152	0.112	0.093	0.516	

Note: Bold ones indicate the corresponding factor loadings.

The factors that emerged based on the corresponding questions can be interpreted as:

- Factor 1: Socio-Environmental (Responsibility)—Behavior I
- Factor 2: Personal (Effort)—Behavior II
- Factor 3: Economic-Policy (Concerns)—Behavior III
- Factor 4: Infrastructural and Technological (Endeavors)—Behavior IV

Cronbach's alpha statistics showed that all scales were internally consistent [40,41]. Therefore, these factor groupings formed a reliable set of scales and provided good empirical bases. Moreover, it meant that multivariate analysis could be based on these scales.

### Scale Construction

Based on the factor analysis findings, scales for four behavior groups and an overall behavior scale were required. All statements were treated as equally weighted; therefore, the scores for each question under the corresponding factor were summed (from 1—strongly disagree to 5—strongly agree) and divided by the total number of questions. By doing so, an average score for each of the factor groups was determined. In the next step, these four factor scores were summed and divided by four, assuming all factors had equal weights, to generate an overall behavior score for individuals.

### 3.3. Personality Traits

Based on the conceptual framework used in the study, personality traits were considered as one of the two main influencer groups on urban sustainability understanding and behavior. As explained in Topal et al. [35], the big five personality traits approach of Goldberg [42] was adopted in the conceptual framework, the traits being:

- Surgency (P1)
- Agreeableness (P2)
- Conscientiousness (P3)
- Emotional Stability (P4)
- Intellect (P5)

Five questions were used for the scale of each personality trait groups and each question was treated as equally weighted. Negatively framed questions were recoded for scaling purposes. The scores for each question under the corresponding trait group were summed (from 1—strongly disagree to 5—strongly agree) and divided by five (the total number of questions). Thus, the average score for each personality trait group was created.

### 3.4. Influencing Factors

As described in the conceptual framework, external influencing factors were the main variable group expected to have an impact on urban sustainability understanding and behavior. In accordance with the conceptual framework, influencing factors may vary according to different contexts and conditions, which provide the model with flexibility. For this research, 19 influencing factors that were considered to be critical to the current analysis were specified as a result of the systematic literature review performed by Topal et al. [31]. Figure 7 presents a general overview of the responses given to influencing factors, which will be discussed in detail in Section 6.3.2. It is important to note that six questions (i.e., IF2, IF13, and IF15 to IF18) are by design negatively framed with respect to favorable urban sustainability behavior.

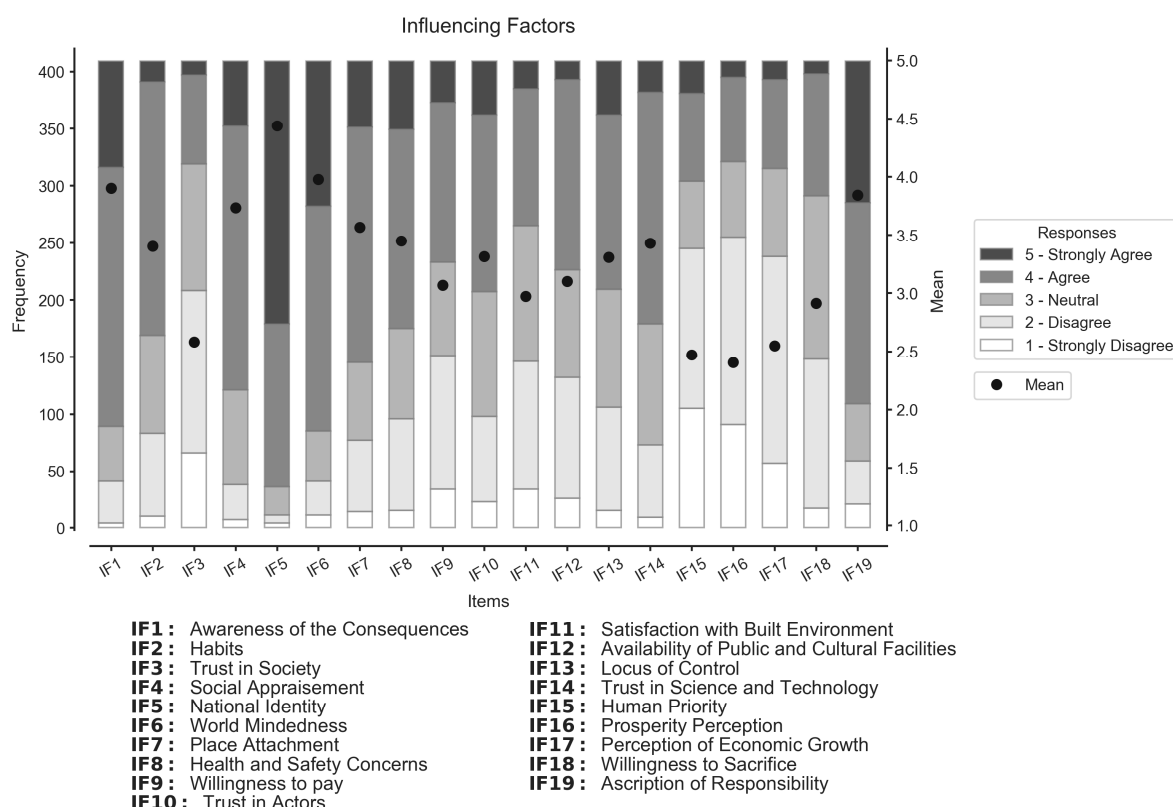


Figure 7. Influencing factor questions.

#### 4. Bivariate Analyses and Results

##### 4.1. Determinants of Understanding

Pearson's  $r$  correlation coefficients for each scale are given in Table 3. The correlation coefficients indicate that awareness, perception, and attitude were all positively correlated with each other. While the correlation between awareness–perception and perception–attitude were approximately equal (i.e., 0.37 and 0.35, respectively), the correlation between awareness–attitude was higher (0.49). Although the former finding was in line with what was expected, the latter finding was unexpected since it can be argued that as the distance between the socio-psychological determinants increase, the correlation value would be expected to decrease. However, that was not the case.

Table 3. Pearson correlation coefficients of determinants.

	Awareness	Perception
Awareness	1	
Perception	0.37 *	1
Attitude	0.49 *	0.35 *

\*  $p < 0.05$ .

##### 4.2. Determinants and Behavior

Pearson's  $r$  correlation test was used to analyze the relationship between behavior and determinants. The correlation coefficients are presented in Table 4, which shows that the correlations were statistically significant.

**Table 4.** Pearson correlation coefficients between determinants and behavior.

	Awareness	Perception	Attitude
Behavior	0.57 *	0.44 *	0.57 *

\*  $p < 0.05$ .

The correlation coefficients of determinants with behavior were anticipated from the conceptual model to be high and the values from this research (0.57 for awareness, 0.44 for perception, 0.57 for attitude) confirmed this expectation to be valid. However, it can be argued that the effects of determinants are variable across behavior, behavior having a higher correlation coefficient value (0.57) with both awareness and attitude, whereas the correlation value with perception (0.44) is significantly lower.

#### 4.3. Personality Traits

##### 4.3.1. Personality Traits and Determinants

As shown in the conceptual framework, personality traits were expected to have an impact on urban sustainability understanding and behavior. Table 5 presents the Pearson correlation coefficients between personality types and determinants. As can be seen from the table, the bivariate relationships between all variables are significant ( $p < 0.05$ ), except for that between attitude and personality IV.

**Table 5.** Pearson correlation coefficients between personality types and determinants.

	Personality I(P1)	Personality II(P2)	Personality III(P3)	Personality IV(P4)	Personality V(P5)
Awareness	0.33 *	0.33 *	0.31 *	0.16 *	0.43 *
Perception	0.26 *	0.20 *	0.22 *	0.12 *	0.27 *
Attitude	0.21 *	0.33 *	0.29 *	0.03	0.26 *

\*  $p < 0.05$ .

For awareness, all personality types (except personality IV—emotional stability) have a strong correlation. The highest correlation was observed with personality V (intellect, 0.43), while personality I–II–III had broadly similar coefficients (0.31 to 0.33, respectively). In contrast, the coefficient for personality IV was notably lower than the other personality types. Therefore, it can be inferred that while intellect is an important predictor of awareness, emotional stability has limited impact.

For perception, personality I (urgency, which describes characteristics of quickness, cleverness, responsiveness, and spontaneity) and personality V had similar coefficients (0.26–0.27), followed by personality II and III (agreeableness, 0.20, and conscientiousness, 0.22, respectively). However, personality IV again differed from other personality types, with a markedly lower correlation value (0.12). Therefore, it is possible to conclude that people with characteristics of urgency and intellect hold better (i.e., more positive) perceptions about urban sustainability.

Regarding attitude, personality II had the highest significant coefficient (0.33), followed by personality III (0.29), personality V (0.26) and personality I (0.21). However, there was no significant relationship between personality IV and attitude. As a result, it can be said that people with a more agreeable and conscientious nature have better attitudes about urban sustainability.

##### 4.3.2. Personality Traits and Behavior

Correlation values for behavior and personality types are presented in Table 6, in which it can be seen that the Pearson correlation coefficients were encouragingly high, all coefficients having significant positive values ( $p < 0.05$ ).

**Table 6.** Pearson correlation coefficients between personality types and behavior.

	Personality I(P1)	Personality II(P2)	Personality III(P3)	Personality IV(P4)	Personality V(P5)
Behavior	0.30 *	0.43 *	0.46 *	0.20 *	0.43 *

\*  $p < 0.05$ .

Although behavior had mostly strong bivariate relationships with all personality types, there were important differences. Personality III (conscientiousness) had the highest coefficient of 0.46, very closely followed by personality II and V (0.43 for each), while personality I (urgency) was more moderately correlated with behavior (0.30). On the other hand, personality IV proved again to be distinct from the other personality types with a markedly lower correlation coefficient (0.20).

To sum up, the correlational analyses showed that personality types of agreeableness, conscientiousness and intellect were strongly correlated with behavior. Surgency proved to be less of an influence on behavior, while emotional stability did not have a substantial influence on urban sustainability behavior. This is not surprising since sustainable behavior requires intellect to comprehend, agreeableness to obey the rules and conscientious to carry out the necessary actions and perform well.

#### 4.4. Socio-Demographics and Influencing Factors

##### 4.4.1. Socio-Demographics and Determinants and Behavior

In this section, the bivariate relationships between socio-demographic variables and urban sustainability understanding and behavior are explored. Due to the different nature of the data, *t*-test, Spearman correlation analysis and ANOVA tests were conducted.

Gender and residential status were the variables explored in the *t*-tests. For gender, the only significant difference ( $t = 2.51$ ) found between male ( $m = 2.85$ ,  $SD = 0.88$ ) and female ( $m = 2.64$ ,  $SD = 0.82$ ) was with awareness. No other determinants or behavior had a statistically significant outcome. The residential status (i.e., landlord, tenant) did not result in a statistically significant difference in any of the determinants and behavior.

The socio-demographic factors presented in Table 7 were investigated for the Spearman analysis. The results showed that while age had a statistically significant negative relationship with awareness, education had statistically significant positive correlations with all of the variables, the highest correlation being with awareness (0.44). Income resulted in positive correlations with all determinants. The number of people living in a household was found to have a significant negative correlation with behavior. Regarding the years lived in Istanbul, positive relationships with attitude and behavior were found. Finally, it was found that the size of the house that people lived in was positively correlated with awareness and attitude.

**Table 7.** Spearman correlation coefficients between socio-demographics and determinants and behavior.

Social Demographics (SD)	Awareness	Perception	Attitude	Behavior
SD1—Age	−0.14 *	−0.06	−0.02	0.07
SD2—Education	0.44 *	0.21 *	0.16 *	0.22 *
SD3—Income	0.21 *	0.13 *	0.24 *	0.09
SD4—Household	0.04	0.04	−0.06	−0.15 *
SD5—Year living in Istanbul	0.00	0.03	0.18 *	0.17 *
SD6—Size of home	0.10 *	0.06	0.20 *	0.03

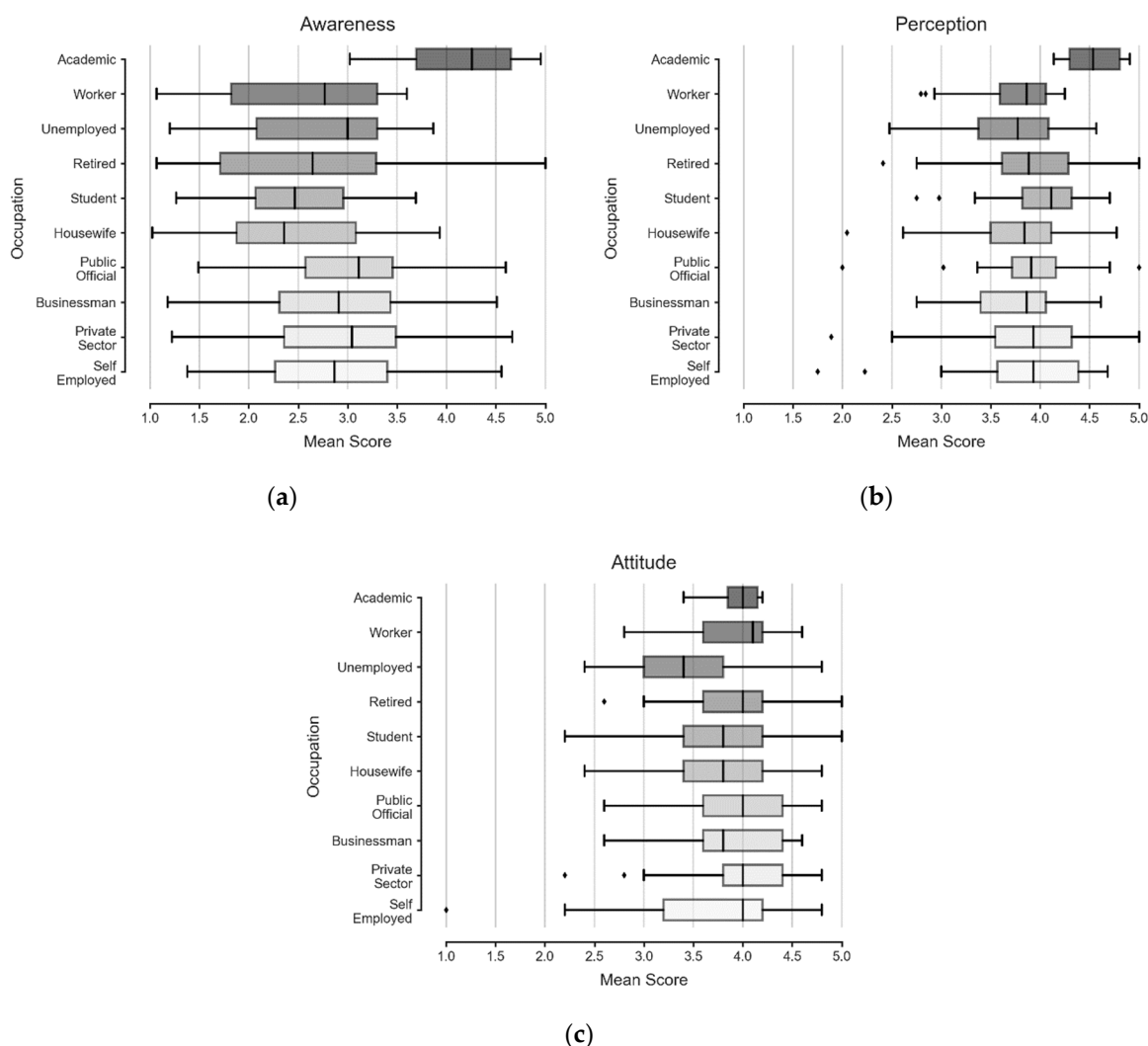
\*  $p < 0.05$ .

For the other socio-demographic factors (occupation, the county that people live in, probable future residency, and political orientation) one-way ANOVA tests were performed to examine the relationships with determinants and behavior. Furthermore, a Tukey post-hoc test was conducted for each factor to specify the group differences.



In terms of occupation, statistically significant differences were found in awareness ( $f(9) = 5.88$ ), perception ( $f(9) = 1.93$ ), and attitude ( $f(9) = 2.97$ ); these are shown in Figure 8.

For awareness, academics were found to have higher scores than students (1.58), workers (1.57), private sector employees (1.18), the self-employed (1.21), businessmen (1.28), the unemployed (1.40), housewives (1.72), and those who were retired (1.58). Moreover, housewives showed lower degrees of awareness than public servants (0.68) and private sector employees (0.54). For perception, academics obtained higher scores than workers (0.75), housewives (0.75), and unemployed people (0.84). Regarding attitude, private sector employees showed higher scores than housewives (0.29) and unemployed people (0.58).



**Figure 8.** Box plots for occupation and determinants: (a) awareness; (b) perception; (c) attitude.

In terms of the county of residence, statistically significant differences were found in awareness ( $f(32) = 2.13$ ), perception ( $f(32) = 2.40$ ), attitude ( $f(32) = 5.53$ ; see Table 8), and behavior ( $f(32) = 4.42$ ; see Table 9). For awareness, Sariyer had a lower score than Beykoz (1.00), Gaziosmanpasa (0.99), and Umraniye (0.95). While Sisli district showed lower levels of perception than Bagcilar (0.53) and Kagithane (0.81), differences in attitude scores are noticeable in Table 8. For example, it is noticeable that Bahcelievler, Gaziosmanpasa, Kucukcekmece, Sultanbeyli, and Uskudar scored significantly higher in attitude than other counties.

**Table 8.** ANOVA mean differences between counties of residence for attitude.

	Bahcelievler	G.Pasa	K.Cekmece	Sultanbeyli	Umraniye	Uskudar
Avcilar	−0.95	−0.90	−0.94	−1.50		−0.71
Bakirkoy				−1.37		
Bagcilar	−0.80	−0.74	−0.78	−1.35	−0.51	−0.56
Beykoz	−0.82			−1.03		
Beyoglu		−0.76	−0.80	−1.37		−0.58
Besiktas	−0.91	−0.85	−0.89	−1.46		−0.67
Cekmekoy				−1.28		
Esenler	−0.88	−0.82	−0.86	−1.43		
Fatih	−0.95	−0.90	−0.94	−1.50	−0.67	−0.71
Gungoren				−1.36		
Sariyer	−0.79	0.74	−0.78	−1.34		−0.55
Sisli	−0.68		−0.66	−1.23		

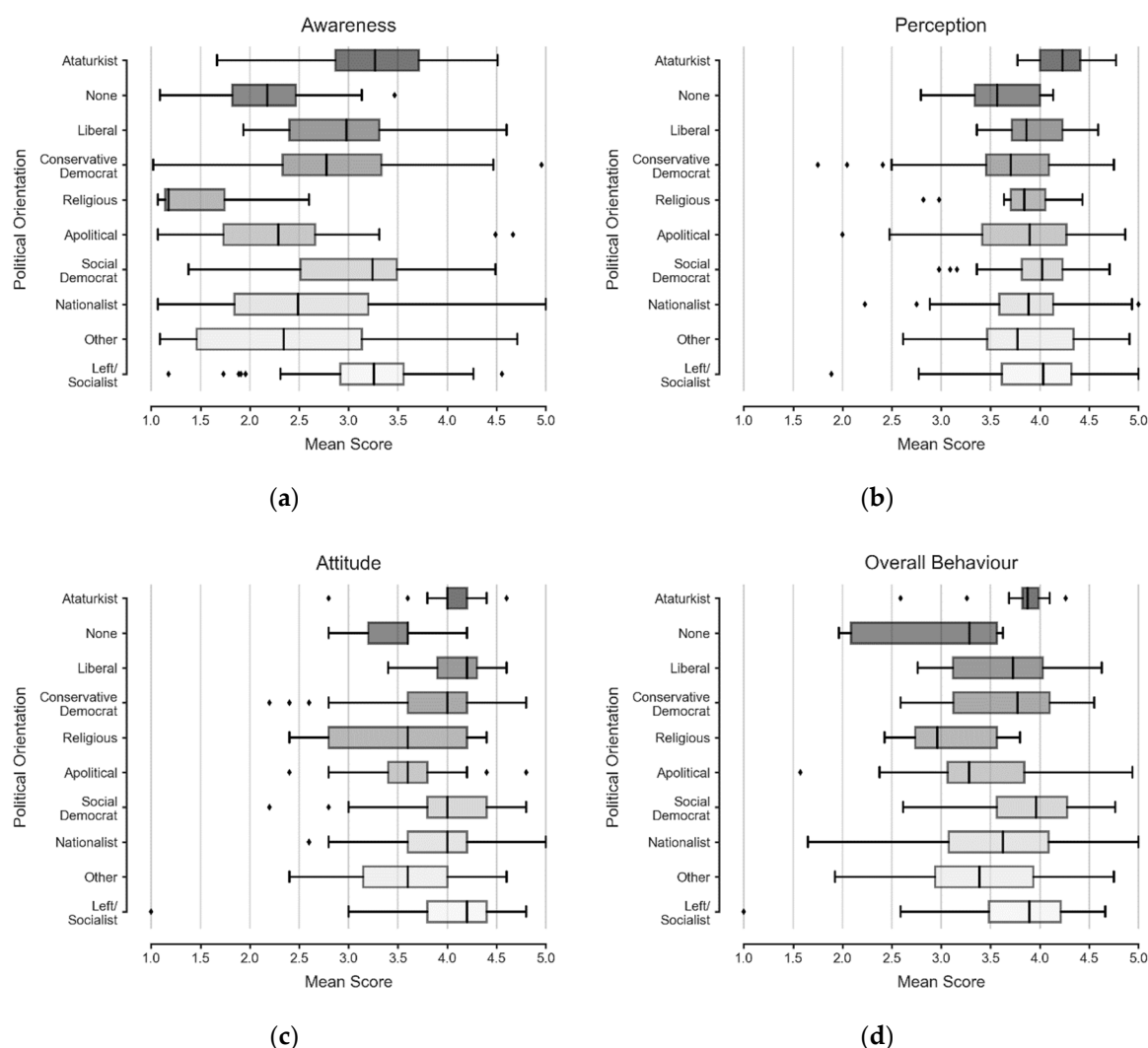
Finally, for behavior, as seen in Table 9, Fatih and Sariyer had significantly lower scores than many other counties.

**Table 9.** ANOVA mean differences between counties of residence for behavior.

	Fatih	Sariyer	Sultanbeyli
Avcilar			−1.30
Bahcelievler	1.02	0.91	
Bakirkoy			
Bagcilar	0.67	0.56	
Beykoz		0.56	
Beyoglu			−1.21
Besiktas			−1.27
Esenler	0.91	0.80	
G.Pasa	0.96	0.85	
Gungoren	0.99	0.88	
K.cekmece	0.97	0.86	
Sultanbeyli	1.75	1.64	
Umraniye	1.06		
Uskudar	0.72	0.61	
Zeytinburnu	0.99	0.88	

In terms of future probable residency, no significant differences were found in any of the determinants and behavior. However, for political orientation, statistically significant differences were found in awareness ( $f(9) = 9.77$ ), perception ( $f(9) = 3.65$ ), attitude ( $f(9) = 3.78$ ), and behavior ( $f(9) = 5.93$ ), these being presented in Figure 9.

For awareness, the apolitical group resulted in lower scores than Atatürkist (0.96), left/socialist (0.86), and social democrat (0.77). What is more, the respondents who identified themselves as religious showed lower awareness than the groups of respondents who identified as liberal (1.51), nationalist (1.06), conservative democrat (1.31), left/socialist (1.65), and social democrat (1.55).



**Figure 9.** Box plots for political orientation and determinants and behavior: (a) awareness; (b) perception; (c) attitude; (d) behavior.

In terms of perception, the responses from the conservative democrat group resulted in lower scores than left/socialist (0.28), Ataturkists (0.54), and social democrats (0.33). On the other hand, the Ataturkist group had higher perception than the group without any ideology (0.70). Regarding attitude, the 'other ideology' group recorded lower scores than left/socialists (0.52) and social democrats (0.45). Similarly, the apolitical group had lower attitude scores than left/socialists (0.40).

Finally, for behavior, it was noticeable that people who do not prefer to be identified by a political ideology recorded lower scores than Ataturkists (0.89), left/socialists (0.90), social democrats (0.96), and conservative democrats (0.73). Left-socialist and social democrats were found to have higher behavior scores than most of the other ideologies, especially for the apolitical (0.45) and religious (0.68) groups.

#### 4.4.2. Influencing Factors (IF) and Determinants

The Spearman correlation analysis (Table 10) shows the correlation between influencing factors (IF) and determinants. Therein, it can be seen that the awareness determinant was significantly correlated with the 12 influencing factors (IF 1-2-4-5-6-7-9-11-12-14-17-18) while perception had significant but comparatively lower correlation coefficients with the 11 influencing factors (IF 1-4-5-6-7-9-10-13-14-18-19). In contrast, attitude showed significant correlation with almost all of the influencing factors (only IF 13-19 were not).

It should be kept in mind that questions related to IF 2-13-15-16-17-18 were by design negatively framed.

**Table 10.** Spearman correlation coefficients between influencing factors and determinants.

Influencing Factors (IF)	Awareness	Perception	Attitude
IF 1—Awareness of Consequences	0.30 *	0.22 *	0.51 *
IF 2—Habit	0.10 *	0.09	0.13 *
IF 3—Trust in Society	0.08	−0.03	−0.12 *
IF 4—Social Appraisal	0.42 *	0.29 *	0.54 *
IF 5—National Identity	0.18 *	0.21 *	0.39 *
IF 6—World Mindedness	0.28 *	0.33 *	0.37 *
IF 7—Place Attachment	0.12 *	0.10 *	0.29 *
IF 8—Health and Safety Concerns	0.07	−0.04	0.15 *
IF 9—Willingness to Pay	0.33 *	0.20 *	0.31 *
IF 10—Trust in Actors	−0.04	−0.16 *	0.11 *
IF 11—Satisfaction with Built Environment	0.12 *	−0.04	0.11 *
IF 12—Availability of Public Facilities	0.11 *	−0.01	0.16 *
IF 13—Locus of Control	−0.03	−0.22 *	−0.01
IF 14—Trust in Science and Technology	0.25 *	0.27 *	0.36 *
IF 15—Human Priority	−0.09	−0.07	−0.40 *
IF 16—Prosperity Perception	−0.07	−0.05	−0.32 *
IF 17—Perception of Economic Growth	−0.11 *	−0.02	−0.38 *
IF 18—Willingness to Sacrifice	−0.13 *	−0.15 *	−0.16 *
IF 19—Ascription of Responsibility	0.00	0.15 *	0.07

\*  $p < 0.05$ .

People who were more aware of the consequences of unsustainable actions often had more awareness and better perception; moreover, they held more positive attitude scores. As social appraisal of a behavior increased, so did the awareness, perception, and attitudes of people. If people had a stronger sense of national identity, they appeared to have reasonably strong awareness and perceptions, but also highly positive attitudes. People who considered themselves as more open-minded appeared to have good awareness, combined with positive perceptions and attitudes. Place attachment was another influencer that exhibited statistically significant positive correlation with awareness and perceptions of individuals, while its positive impact on attitudes was higher. Finally, health and safety concerns were found to have a significant correlation with attitudes of individuals; i.e., the stronger such a concern was felt by individuals, the stronger their attitude towards urban sustainability was likely to be.

Economic approaches of individuals deserve further attention. If, for example, individuals were more ready to pay for sustainability, they were more likely to have good awareness, combined with more developed perceptions and attitudes. On the other hand, if people held a more economically or personal prosperity-centered perspective over sustainability, they were found to have slightly lower awareness scores and considerably more negative attitudes. Similarly, people who were less willing to sacrifice their amenities (in the name of sustainability) resulted in them having negative scores for awareness, perception, and attitude. Finally, people who believed in humans having priority over nature were found to be negatively correlated with urban sustainability attitude.

As trust in a mediator (actor) increased, perceptions and attitudes about urban sustainability were found to become more positive. However, trust in society only resulted in better attitudes. In addition, people who had more trust in science and technology reported higher scores in awareness, perceptions, and attitudes. Counterintuitively, unsustainable habits were positively correlated with awareness and attitudes, albeit marginally. Even though this was an unexpected outcome, it might mean that, in general, the more conscientious people were about their wrong habits, the higher their awareness and attitudes.

The quality of the living environment was another factor to note. It was observed that people who have a greater satisfaction with the quality of the built environment also

had greater awareness and better attitudes towards urban sustainability. Similarly, more cultural facilities in the vicinity of the area in which the respondents lived led to higher awareness and attitude scores. Interestingly, the locus of control factor was found to have a statistically significant correlation only with urban sustainability perceptions of individuals. People who felt they had less control over their sustainable built environment had lower sustainability perception scores. Similarly, ascription of responsibility resulted only in better perceptions.

#### 4.4.3. Influencing Factors (IF) and Behavior

The Spearman correlation values between behavior and influencing factors (IF) are presented in Table 11. Statistically significant correlations therein are marked.

**Table 11.** Spearman correlation coefficients between influencing factors and behavior.

Influencing Factors (IF)	Behavior
IF 1—Awareness of Consequences	0.43 *
IF 2—Habit	0.23 *
IF 3—Trust in Society	0.21 *
IF 4—Social Appraisalment	0.49 *
IF 5—National Identity	0.22 *
IF 6—World Mindedness	0.42 *
IF 7—Place Attachment	0.29 *
IF 8—Health and Safety Concerns	−0.01
IF 9—Willingness to Pay	0.47 *
IF 10—Trust in Actors	0.11 *
IF 11—Satisfaction with Built Environment	0.15 *
IF 12—Availability of Public Facilities	0.15 *
IF 13—Locus of Control	−0.03
IF 14—Trust in Science and Technology	0.29 *
IF 15—Human Priority	−0.16 *
IF 16—Prosperity Perception	−0.16 *
IF 17—Perception of Economic Growth	−0.15 *
IF 18—Willingness to Sacrifice	−0.17 *
IF 19—Ascription of Responsibility	0.17 *

\*  $p < 0.05$ .

Sustainability behavior was significantly correlated with all factors, except two: health and safety concerns (IF8) and locus of control IF13. However, it can be seen that the factors of awareness of consequences (IF1), social appraisalment (IF4), world mindedness (IF6), place attachment (IF7), willingness to pay (IF9), and trust in science and technology (IF14) had encouragingly high correlation coefficients with urban sustainability behavior.

## 5. Multivariate Analyses and Results

In this section, multivariate analyses based on the conceptual framework are reported. A series of multiple regression analyses were used to investigate the associations between the main variables of interest (i.e., socio-psychological determinants of awareness, perception, and attitude) and behavior.

### 5.1. Preparation for the Analysis

Variables that were either numerical or continuous were directly included in the analysis. Ordered categorical socio-demographic variables (age, education level, income level, number of people living in the household, length of time lived in Istanbul, and approximate size of houses) were also directly included in the analyses by converting them to numerical codes. Unordered categorical variables were converted into dummy variables for inclusion in the analysis. Probable future residency was recoded as 1 for ‘continue to live in Istanbul’ and 0 for ‘continue to live elsewhere’. For gender, women were coded as 1 and men were coded as 0. Finally, for residential status, the landlord option was

coded as 1 and the tenant option was coded as 0. Consequently, it was possible to include all predictor variables in the multiple linear regression tests, which are reported in the following sections.

## 5.2. Determinants and Behavior

Based on the conceptual framework, outcome variables for linear regression tests were specified as awareness, perception, attitude, and behavior. All influencing factors, personality types, and prepared socio-demographic questions were included as predictor variables. However, in accordance with the framework, each previous outcome variable was included in the following tests as a predictor variable. In other words:

- Awareness was included in the linear regression test of perception;
- Awareness and perception were included in the linear regression test of attitude; and
- Awareness, perception, and attitude were included in the linear regression test of behavior.

Table 12 shows the results of the series of multiple linear regression tests, including regression coefficients,  $R^2$  values, and F statistics.

**Table 12.** Standardized linear regression coefficients for determinants and behavior.

	Awareness	Perception	Attitude	Behavior
<b>Awareness</b>		<b>0.176 *</b>	<b>0.153 *</b>	<b>0.218 *</b>
<b>Perception</b>			0.060	<b>0.128 *</b>
<b>Attitude</b>				<b>0.190 *</b>
<b>Influencing Factors (IF)</b>				
IF 1—Awareness of Consequences	<b>0.164 *</b>	0.002	<b>0.209 *</b>	0.079
IF 2—Habit	0.029	0.053	0.028	0.017
IF 3—Trust in Society	0.040	−0.061	<b>−0.102 *</b>	<b>0.111 *</b>
IF 4—Social Appraisalment	<b>0.172 *</b>	0.082	<b>0.167 *</b>	<b>0.092 *</b>
IF 5—National Identity	0.031	0.089	<b>0.181 *</b>	0.063
IF 6—World Mindedness	0.005	<b>0.171 *</b>	<b>0.136 *</b>	<b>0.087 *</b>
IF 7—Place Attachment	−0.042	0.052	0.047	−0.023
IF 8—Health and Safety Concerns	0.035	<b>−0.091 *</b>	<b>0.083 *</b>	−0.031
IF 9—Willingness to Pay	<b>0.144 *</b>	0.085	<b>0.141 *</b>	<b>0.144 *</b>
IF 10—Trust in Actors	−0.075	−0.062	<b>0.094 *</b>	0.066
IF 11—Satisfaction with Built Environment	0.085	−0.057	−0.015	−0.003
IF 12—Availability of Public Facilities	0.051	−0.042	−0.016	−0.025
IF 13—Locus of Control	0.028	<b>−0.151 *</b>	<b>0.101 *</b>	−0.001
IF 14—Trust in Science and Technology	0.071	<b>0.173 *</b>	<b>0.081 *</b>	−0.073
IF 15—Human Priority	−0.020	0.009	−0.051	0.065
IF 16—Prosperity Perception	0.044	0.109	0.025	−0.027
IF 17—Perception of Economic Growth	−0.017	0.060	<b>−0.116 *</b>	0.014
IF 18—Willingness to Sacrifice	<b>−0.119 *</b>	<b>−0.151 *</b>	−0.040	−0.012
IF 19—Ascription of Responsibility	<b>−0.105 *</b>	<b>0.167 *</b>	<b>0.077 *</b>	0.059
<b>Personality Traits (P)</b>				
P1—Surgency	0.022	0.037	0.035	−0.020
P2—Agreeableness	0.078	−0.032	0.000	<b>0.085 *</b>
P3—Conscientiousness	0.022	0.067	−0.006	<b>0.131 *</b>
P4—Emotional Stability	0.021	0.014	−0.050	0.048
P5—Intellect	<b>0.149 *</b>	−0.042	−0.017	<b>0.084 *</b>
<b>Social Demographics (SD)</b>				
SD 1—Age	<b>−0.086 *</b>	0.014	−0.062	<b>0.095 *</b>
SD 2—Gender	<b>−0.074 *</b>	<b>0.101 *</b>	−0.034	0.001
SD 4—Education	<b>0.323 *</b>	0.038	−0.033	0.023
SD 6—Income	0.000	0.028	0.046	−0.045



Table 12. Cont.

	Awareness	Perception	Attitude	Behavior
SD 8—Household number	0.047	<b>0.110 *</b>	−0.011	−0.069
SD 9—Year living in Istanbul	−0.088	−0.051	0.063	0.012
SD 10—Future residency	−0.006	0.020	0.024	−0.001
SD 12—Residential Status	<b>0.127 *</b>	0.043	−0.031	0.006
SD 13—Size of House	0.006	−0.010	<b>0.090 *</b>	−0.014
<b>R<sup>2</sup>—Model Fit</b>	<b>0.539</b>	<b>0.369</b>	<b>0.669</b>	<b>0.650</b>
<b>F</b>	<b>13.31</b>	<b>6.428</b>	<b>21.58</b>	<b>19.19</b>
<b>Error</b>	<b>0.67</b>	<b>0.79</b>	<b>0.57</b>	<b>0.59</b>
<b>Model Significance</b>	<b><i>p</i> &lt; 0.01</b>	<b><i>p</i> &lt; 0.01</b>	<b><i>p</i> &lt; 0.01</b>	<b><i>p</i> &lt; 0.01</b>

Note: \*  $p < 0.05$ . Bold ones indicate the statistically significant results.

Based on the results, it was observed that all models were significant, meaning that the outcome variables were successfully predicted (by predictor variables). Therein, perception had a weaker fit of 37%, awareness had a moderate fit (54%), whilst both attitude (67%) and behavior (65%) had good fits. Despite considerable error terms, which means that a substantial amount of unobserved variance existed the model, these findings can be considered valuable for theoretical purposes. Moreover, it can be observed that all determinants and behavior were influenced by several different factors while some factors were found to have an effect on more than one determinant. For example, awareness significantly predicted perception and attitude, yet no significant association was found between perception and attitude. Moreover, awareness, perception, and attitude were found to have significant positive associations with behavior in isolation. This relationship was in line with the theoretical premise proposed by the conceptual framework (see Topal et al. [35]).

#### 5.2.1. Awareness

When exploring the awareness outcome variable, it can be seen that five influencing factors, one personality type, and four socio-demographic parameters, as predictor variables, were found to have significant predictive power. As expected, people who were more aware of the consequences of their behaviors (IF1) had higher urban sustainability awareness. Similarly, the effect of social appraisalment (IF4) on awareness was considerable, which emphasized the importance of the social environment in sustainability policies. In addition, people who were found to be more willing to pay (IF9) or willing to sacrifice (IF18) were also found to have higher awareness. Therefore, people with altruistic characteristics might be more inclined to be aware of sustainability. Interestingly, ascription of responsibility (IF19) resulted in a negative effect on awareness. In terms of personality types, people with higher intellect (P5) were associated with higher levels of awareness. In this respect, it goes without saying that awareness requires a certain level of intellectual capacity, so this overall outcome seems reasonable. Regarding socio-demographics, age (SD1) was found to have a negative impact, which means the younger people are, the more aware they are. Since sustainability is a novel topic and the information channels to awareness require adaptation to technological developments, the finding that the younger generation tends to have more awareness is again reasonable. When it comes to gender (SD2), it was observed that males had greater awareness than females on average. In the Turkish context, where a more male-dominated culture is prevalent and males have better educational opportunities, this is understandable. As expected, there was a strongly positive influence of education (SD4) on awareness. Finally, it was found that people who live in their own house (SD12) had greater awareness than people who live in a rented property.

#### 5.2.2. Perception

With regard to the perception outcome variable, the awareness determinant, six influencing factors, and two socio-demographic parameters as predictor variables were found

to have significant predictive power. Among the other variables, awareness was found to have a strongly positive impact upon perception, which supports the theoretical conceptualization of the model. In terms of the influencing factors, world mindedness (IF6) was positively associated with perception, meaning that, in general, people who have a more global vision have a stronger urban sustainability perception. Health and safety concerns (IF8) also had a positive impact on perception, while a negative coefficient indicated that perception was negatively associated with those having less locus of control (IF13). Trust in science and technology (IF14) to solve environmental problems, on the other hand, was associated with a positive influence on perception. This highlights the critical role of science and technology within the field of urban sustainability. While willingness to sacrifice (IF18) and ascription of responsibility (IF19) were shown to positively affect perception, there was no significant predictive power of any personality type, meaning that urban sustainability perception of the individuals is independent from an individuals' personality. Regarding socio-demographics, it was found that the number of people living in the household (SD8) was positively associated with perception and females had higher perception than males (SD2) on average, which was contrary to the effect observed on awareness.

### 5.2.3. Attitude

Regarding the attitude outcome variable, a combination of the awareness determinant, 12 influencing factors and one socio-demographic parameter (as predictor variables) were found to have significant predictive power. However, neither perception nor the personality types were found to have any significant impact on attitude. In line with the conceptual model, awareness was found to have a positive (significant) association with attitude. In terms of influencing factors, awareness of the consequences (IF1), social appraisalment (IF4), trust in actors (IF10), and trust in science and technology (IF14) were found to have a positive effect on the attitude of individuals. However, trust in society (IF3) resulted in a negative influence on attitude, which means that people who considered their society unsuccessful held better attitudes towards behavior. For national identity (IF5) and world mindedness (IF6), a positive association with attitude was observed. Therefore, it is possible to claim that having a global environmental approach and caring about the nation's future positively contributes to attitude. Health and safety concerns (IF8), willingness to pay (IF9), and ascription of responsibility (IF19) had a positive effect on attitude. However, it was observed that favoring economic development over urban sustainability (IF17) resulted in an individual holding a negative association with attitude. On the contrary, the thought of not having locus of control (IF13) resulted in a positive association with attitude. This result was counterintuitive and might be related to people's positive view of their attitudes, even though they think themselves unable to influence the sustainability of their built environment.

### 5.2.4. Behavior

Considering the behavior outcome variable, which is the final output of the socio-psychological processes presented in the conceptual model, awareness, perception and attitude determinants as predictor variables resulted in positive associations. Moreover, four influencing factors, three personality types, and one socio-demographic parameter were found to have significant predictive power as predictor variables. Of the influencing factors, trust in society (IF3) along with social appraisalment (IF4) were found to have a positive association with urban sustainability behavior. This indicates the importance of society and the social environment. As a result, the success of any policy was deemed to be highly dependent on its acceptance by the society as a whole, which in turn has the potential of improving individual's actions. In addition, willingness to pay (IF9) and world mindedness (IF6) had positive significant impacts on behavior. This shows that having a world-minded approach contributes positively to sustainable behavior. In terms of personality types, agreeableness (P2), conscientiousness (P3), and intellect (P5) were positively associated with behavior. In other words, people who are more agreeable, more

conscientious, or have a greater intellect were observed to have better (urban) sustainability behavior. Finally, age (SD1) was found to have a positive effect on behavior. Therefore, it can be concluded that older generations perform better when it comes to urban sustainability behavior, even though they tend to be less aware of the issues (see Section 5.2.1).

Taking into account this large number of influencing factors, it can be argued that urban sustainability behavior is a highly complex phenomenon. However, the explanatory power of 65% shows that the framework presented here has promising results.

## 6. Discussion

### 6.1. Urban Sustainability Understanding and Behavior

#### 6.1.1. Determinants of Understanding

Urban sustainability understanding consisted of three individual determinant scales: awareness, perception, and attitude. While the perception and attitude scales resulted in very close mean values (3.86 and 3.87, respectively), the mean value of awareness was considerably lower (2.75). It is therefore possible to deduce that although people have a lower level of awareness about urban sustainability, their perceptions and attitudes are comparatively more positive. Since perception and attitude are assumed to be preceded by awareness, this points to the fact that there are other factors that have direct influence on each determinant. Correlation coefficients showed that awareness was better correlated with attitude (0.49) than perception (0.37). Finding a significant correlation between each determinant was an expected outcome from the previous studies of Guo et al. [43] and Tran [44]. When it comes to understanding, awareness had the highest correlation (0.86), followed by attitude (0.76) and perception (0.68). This finding highlights that awareness is the key factor for achieving a better urban sustainability understanding.

Looking at standardized regression coefficients based on the conceptual framework, awareness was found to have more predictive power on perception (0.173) than attitude (0.153), yet no significant relationship was found between perception and attitude. Whilst the former finding confirms the linear sequence of determinants given in the conceptual framework, the latter finding points out the highly intertwined relationship between perception and attitude determinants. Consequently, it is possible to deduce that increasing the awareness level of individuals should have a high potential impact on perception and attitudes (of urban sustainability).

#### 6.1.2. Determinants and Behavior

The results for behavior indicated that both awareness and attitude have the same correlation coefficients (0.57), followed by perception (0.44). Regarding the standardized regression coefficients, awareness resulted in the highest predictive power (0.218), followed by attitude (0.190) and perception (0.128). These results showed that urban sustainability behavior is mainly predicted by awareness and attitude. This resonates with the findings of Barr [20], Buerke et al. [45], Cagañová et al. [46], Guagnano et al. [47], and Peng et al. [48]. In order to enhance sustainability behavior, there should be a stronger focus on increasing the awareness of people by informative activities, training opportunities, public campaigns and advertisements, and social media [49]. Moreover, their attitude towards urban sustainability behavior needs to be enriched by encouraging sustainable practices, providing necessary laws and regulations, revealing the adverse environmental, economic, and social effects of unsustainability, stressing the criticality of the current situation for themselves and future generations, and reminding them of the responsibility of each and every individual to achieve a more sustainable future.

To sum up, behavior requires respective efforts in terms of socio-psychological determinants to achieve sustainable practices. Therefore, it is of the utmost importance to provide customized approaches based on the nature and type of the determinants and behavior. Lastly, it can be concluded that perception acts as a mediator between awareness and attitude and could be assumed as an intermediate determinant. Due to its intertwined

meaning with awareness and attitude, it is more difficult to specify its individual impact (or contribution) on urban sustainability behavior.

## 6.2. Personality Traits

### 6.2.1. Personality Traits and Determinants

It was observed that the mean value of P3 and P2 (conscientiousness and agreeableness, 3.88 and 3.85, respectively) are the highest, followed by P5 (intellect, 3.51) and P1 (urgency, 3.30), while P4 (emotional stability) holds the lowest mean value (3.09). Therefore, it can be concluded that the characteristic traits of the respondents are that they had an agreeable and conscientious nature with high intellect. This can be seen as a positive aspect since sustainable behavior is expected to be related with having (a) an agreeable nature, (b) a certain level of intellect, and (c) performed conscientious actions [50].

Considering the results of the regression test, it was found that only P5 (intellect) had a significant predictive power on the awareness determinant. This shows that although personality types have significant correlations with urban sustainability understanding, they have weaker predictive associations.

P1 (urgency) resulted in the highest correlation with awareness (0.33), followed by perception (0.26) and attitude (0.21). It is therefore evident that 'extroversion', quick-wittedness and confident sociability of the individuals have a strongly positive correlation with awareness. It would not be inappropriate to assume that this might be due to respondents' openness to new sources of information and innovation. Therefore, the informative channels for urban sustainability should be designed accordingly in order to attract those people who exhibit less urgency. P2 (agreeableness) resulted in exactly the same correlation with awareness (0.33) and attitude (0.33), followed by perception (0.20). Similarly, agreeable people were found to have more positive attitudes to, along with greater awareness of, urban sustainability. Similar results were found for P3 (conscientiousness) personality trait. However, it was found that P4 (emotional stability) had low degrees of correlation with awareness (0.16) and perception (0.12), while no significant correlation could be found with attitude. This striking finding suggests that the emotional stability trait of individuals has little or no relationship with their urban sustainability understanding. Finally, P5 (intellect) was found to have the highest correlation with Awareness (0.43), followed by perception (0.27) and attitude (0.26). From this, it can be further deduced that urban sustainability understanding of individuals increases with their intellectual capacity.

The results also indicated that all personality types, except P4 (emotional stability), have considerable positive correlations with socio-psychological determinants of urban sustainability understanding. Moreover, only P5 (intellect) had significant predictive power on the awareness determinant. This is logical since abstract thinking could facilitate the process of both gaining and interpreting the knowledge. However, this points to the additional need that informative policies should be designed in such a way that requires less intellectual effort in order to attract the attention and adherence of most citizens [51]. Keeping in mind the high mean values of the P2 (agreeableness) (3.85) and P3 (conscientiousness) (3.88) among respondents, the chance of successfully achieving urban sustainability behavior seems promising. To sum up, it is seen that although urban sustainability understanding is correlated with personality types of individuals [52], it is, on the whole, not predicted by them.

### 6.2.2. Personality Traits and Behavior

Contrary to determinants, personality traits of individuals were found to have higher correlations and more predictive power on urban sustainability behavior.

The Behavior results showed that the strongest correlations exist with P2 (agreeableness) (0.43), P3 (conscientiousness) (0.46), and P5 (intellect) (0.43). In line with the correlation coefficients, standardized regression coefficients revealed that P2 (agreeableness) (0.085), P3 (conscientiousness) (0.131) and P5 (intellect) (0.084) had significant predictive power on urban sustainability behavior. Based on these findings, it is possible to say that

sustainability behavior is closely associated with an agreeable nature, conscientious practice, and intellectual effort. Moreover, it could be claimed that corresponding policies and regulations have more chance of success if they specifically target these key characteristics of individuals.

To conclude, it was observed in this research, but also elsewhere within the literature, that certain personality types have a close relationship with urban sustainability behavior [17,53–55]. This finding reveals the fact that political decisions as well as regulatory instruments need to take into consideration the differing personalities of the public. Moreover, it can be deduced that successful urban sustainability behavior could be achieved if these practices are adhered to. Finally, these political decisions and regulatory instruments should be shaped to be synergistic with conscientious traits in the public and provide an adequate intellectual background.

### 6.3. Socio-Demographics and Influencing Factors

#### 6.3.1. Socio-Demographics and Determinants and Behavior

##### Age

Age has very little negative correlation with awareness and understanding, yet it is a significant predictor of awareness and behavior. While age has negative association with awareness, meaning that the younger generation has better awareness about urban sustainability, it has a positive relationship with behavior. It is therefore possible to conclude that although the younger generation is more aware of the sustainability as a result of having better access to digital informative channels [56,57], the formation of behavior and responsibility improves with the age of an individual [58,59]. In essence, this finding implies that the older generation needs more informative interventions while specific attention should be given to behavior formation of the younger generation in Turkey.

##### Gender

Gender had significant correlation with all determinants and behavior, the strongest correlation occurring with awareness. On the other hand, gender had predictive power only on awareness and perception. While male respondents had greater awareness than females [43], female respondents scored better in perception than males [60]. Contrary to the findings of several studies reporting the association between gender and sustainable behavior [58,61], the results of this study did not indicate any significant relationship. That said, the findings of the current study did reveal that females need to have more access to informative activities and specific actions are required to increase their knowledge and awareness level. Moreover, since the impact of women on the purchasing habits of the household is considerable, their positive perceptions could be an advantage for sustainability practices of the family unit in Turkey.

##### Education

Education had the strongest correlation with awareness (0.44) and resulted in significant association with awareness alone. The relationship between awareness and education echoes the findings of previous studies (for example, [43,62]) and is understandable considering the close relationship it holds also with gaining knowledge. On the other hand, the insignificant association of education with perception [60], attitude [63], and behavior [64,65] is contrary to the findings within the literature. Therefore, it could be inferred that current educational content in Turkey is inadequate to improve urban sustainability understanding and behavior. This includes better access to information tools, where the findings suggest that curricula of high schools and higher education should be improved and amended in order to enhance sustainability understanding and behavior.

##### Occupation

Considering the ANOVA test results along with the Tukey post-hoc test, it was found that statistically significant differences occurred among occupation types. The most no-

ticeable differences were housewives having a weaker degree of awareness than public servants and private sector employees. Likewise, private sector employees had higher attitude scores than housewives, unemployed people, and academics, thereby showing higher levels of awareness and perception. These differences may simply be the result of people in certain occupations simply not having much time to pay attention to sustainability issues, as suggested by Barau [66].

#### Income

Income had moderate positive correlations with awareness and attitude, yet no apparent correlation was found with behavior (see Table 7). On the other hand, there was no significant association between income and any of the determinants and behavior presented in Table 12. Although income has been found to be both positively [43,63,64] or negatively [60,67] associated with urban sustainability understanding and behavior within the literature, it is evident from the findings of this research that there is no significant association within the Turkish context. This emphasizes the context-sensitive nature of sustainability behavior.

#### County of Residence

The ANOVA test results showed that the county of residence resulted in a statistically significant difference for determinants and behavior. It was observed that counties which contain residents from lower socio-economic groups had higher levels of awareness, perception, attitude, and behavior. For instance, Sariyer had lower awareness levels than Gaziosmanpasa (0.99) and Umraniye (0.95); Sisli had a lower perception score than Bagcilar (0.53); and finally, Kagithane (0.81), Sultanbeyli, and Gaziosmanpasa had better attitude scores than many other counties. Although income alone did not present any association, socio-economic condition seems to have an impact on sustainability understanding and behavior. While better perception, attitude, and behavior in these areas can be as a result of being exposed to the adverse effects of unsustainable urbanization, in line with the work of Maiello et al. [68], the better awareness results were unexpected. The widespread use of social media in all socio-economic spheres of Turkey may have been influential here.

#### Household Number

While the household number (i.e., occupancy rate) was not significantly correlated with any of the determinants, it did have a moderately negative correlation with behavior. On the other hand, the household number was positively associated with perception (0.110). It was found that large families have better perceptions, which means that they care more about urban sustainability. Therefore, it is important to reach the large family units to encourage them to engage in improved behavior. Moreover, these families could provide an opportunity to build upon the positive perceptions about sustainability—i.e., to engage individuals in the wider population. This finding resonates with the findings of Waitt et al. [61], which stresses the importance of household number in successfully advancing urban sustainability.

#### Length of Residency in Istanbul

Considering the length of residency, it was observed that positive correlations exist with attitude and behavior. However, no predictive power was found as a result of linear regression. As Rogers and Bragg [69] suggest, the length of residency is one of the major contributors to an individual forming a place attachment. Subsequently, this may also result in better urban sustainability understanding (and motivation), leading to responsible environmental behavior for people in Turkey.

#### Political Orientation

The ANOVA test results demonstrated that there were significant differences among different political orientations in relation to all determinants and behavior. However,



perhaps remarkably, religious [43] and apolitical people were found to have lower scores (on determinants and behavior) than left/socialists, social democrats, and Atatürkist people. This is in line with the findings of Drews and van den Bergh [63], who reported that religiosity and political orientation have a direct relationship with sustainability understanding and behavior, not least in a Turkey context.

#### Residential Status

According to *t*-test results, no significant differences were found when considering residential status. However, when applying standardized regression coefficients, it could be seen that residential status had a significant impact on awareness. Additionally, landlords were found to have greater awareness (0.127) than tenants. This is contrary to the findings of Kang [51]. It is reasonable to suggest that investing in the purchase of a house increases the awareness of individuals about the sustainability of the property—not least in terms of the cost to run the property. Therefore, it might be a good idea to promote urban sustainability with real estate advertisements since it is likely to be the best time for people to engage with the subject, i.e., people are likely to be open to the receipt of information due to their financial investment.

#### Size of House

The size of house that people live in has a significant positive correlation with awareness and attitude. Similarly for linear regression results, the size of house has a predictive power on attitude (0.90). While larger houses are mentioned within the literature as the cause of unsustainable behavior, as a result of increased resource consumption [67], it was found within this study to have a positive impact on the attitude of an individual towards urban sustainability. This could be related to the socio-economic conditions of the individuals, since a larger income (allied with a larger surplus income) also had a positive correlation with attitude. However, it is possible to deduce that physical living conditions of the individuals have a positive impact on attitudes of individuals. In other words, improvement therein can enhance an individual's urban sustainability understanding and behavior. This should be carefully considered for urban planning policies in Turkey—not least when it comes to urban regeneration and sustainable retrofitting. Exemplar projects in terms of sustainability could make a step-change in this respect.

#### 6.3.2. Influencing Factors and Determinants and Behavior

While the majority of the influencing factors have significant correlation with determinants and behavior, their predictive power varies. Details for each influencing factors will be given in the following sub-sections.

##### Awareness of Consequences

Awareness of consequences has been shown within this research to have strong positive correlations with all the determinants and behavior. It was found to be one of the most powerful influencing factors. Regarding the regression coefficients, it was found to have strong impacts on awareness and attitude. As stated in norm-activation theory by Schwartz and Howard [70], awareness of consequences leads to feeling of guilt. Moreover, it also appeals to the rational thinking of individuals. Therefore, making people aware of the consequences of unsustainable actions seems to have a huge impact on making them aware of urban sustainability, forming an appropriate attitude and behaving accordingly [14,44,47,57,71,72].

##### Habit

While unsustainable habits resulted in weak correlations with determinants, they have a moderate correlation with behavior. However, no significant associations were found. Therefore, habits may require consideration in terms of specific behavior types to determine whether there are further associations. While unsustainable habits can be

accepted as a threat for sustainable practices, they could also be seen as opportunities if they are turned (nudged) into sustainable ones [17,57,58,73]. In so doing, it is important to specify what types of urban behavior are related with habits of the people and how they can they be channeled into sustainable forms through incentives and interventions.

#### Trust in Society

Trust in society had a moderate positive correlation with behavior, while in terms of the regression coefficients, it was found that it has a negative association with attitude and a positive relationship with behavior. It was observed that having confidence and trust in the sustainability performance of the society that people live in could have a considerable positive impact on their sustainability behavior. It is important to improve the overall performance of society in terms of an individual sustainable behavior, but this requires a significant level of trust being placed upon individuals. That said, there will always be people who do not take their civic duties and social responsibilities seriously—these individuals will behave badly, whatever the status quo [64,74].

#### Social Appraisalment

Social appraisalment (alongside trust in society) was found to be the other most influential factor due to its very high correlations with all determinants and behavior. Similarly, it was found to have predictive power on awareness, attitude, and behavior. It can be argued that if people believe that behaving in a sustainable manner is good for their social identity and their social environment approves of this behavior, they perform well in terms of sustainable behavior [66,72]. Moreover, social appraisalment increases the awareness of individuals by their interaction within the society and in so doing this helps the formation of highly positive attitudes [66,75]. Consequently, society as a whole should be convinced of the importance of sustainability and likewise should be encouraged to behave sustainably, modifying the existing (and sometimes entrenched) social norms. In other words, sustainable behavior should become a new norm for Turkish society to ensure the success of sustainability policies. For example, only 15 years ago, the UK made it illegal for anyone to smoke in an enclosed public place and within the workplace; this is now widely accepted as the new norm and has brought with it substantial health benefits to individuals. Perhaps zero-emission cars and car-free neighborhoods/cities will be the new norm of the future for sustainable urban areas—time will tell.

#### National Identity

National identity had positive correlations with determinants, especially attitude and behavior. According to standardized regression coefficients, national identity was found to have predictive power on attitude. As presented in Section 3.1, most of the respondents identify themselves as nationalist, followed by conservative democrats, thus demonstrating the importance of national identity. Therefore, announcing (national) macro-sustainability strategies with emphasis on the national interest of Turkey could improve attitudes, which in turn could encourage people to participate [51,76].

#### World Mindedness

The high correlation coefficients with all determinants and behavior, along with the predictive power on perception, attitude, and behavior, indicates that having a world-minded approach is very important for achieving urban sustainability, understanding and behavior. It is therefore of the utmost importance to reference the international policy and practices of sustainability when making and announcing sustainability policies (and associated interventions). This echoes the work of Der-Karabetian et al. [77] who suggested that the simple act of letting people know about what international standards exist (for sustainability) and how they manifest into expected sustainability actions can lead to a positive impact—the same is true for improving people's urban sustainability understanding and behavior.

### Place Attachment

While place attachment was found to have moderate positive correlations with determinants and behavior, no significant association was found as a result of the regression analysis. Although it is stated to have positive impact on sustainable lifestyles within the literature [66,69], no significant impact was found in the Turkey context. That said, it might also imply that the sense of belonging to the area people live in is low in many places internationally. Therefore, by providing a better urban landscape, i.e., high-quality built environment with more urban greenery, it would not be inappropriate to assume there would be a stronger place attachment resulting in more sustainable behavior.

### Health and Safety Concerns

Health and Safety concerns had a significant correlation only with attitude, while the regression analysis demonstrated a significant negative association with perception and a positive association with attitude. In other words it can be seen that people who are worried about their health and safety mostly hold unfavorable perceptions about urban sustainability—this is a finding shared by Noonan et al. [78]. On the other hand, their attitudes also seem to be influenced positively from this concern [74]. Therefore, it might be deduced that health and safety concerns could be beneficial to urban sustainability (ultimately perhaps influencing behavior) as long as an attitude of self-preservation did not ensue.

### Willingness to Pay

It was found that willingness to pay had strong positive correlations with urban sustainability understanding, i.e., all three determinants, and behavior. Similarly, regression results illustrate that it had a positive impact on awareness, attitude, and behavior. Thus, the more people improve their sustainability understanding and behavior, the more they are ready to pay, and vice-versa [49,67]. Sustainability policies should therefore be presented in a way that attracts people's attention and persuades them that it is necessary for the benefit of people and the planet to spend more in this arena. This requires the sustainability benefits (to Turkish society as a whole) to be identified. For example, this highlights the need for those who have the money to invest in more sustainable technologies, such as electric cars, in order to reduce carbon emissions and other greenhouse gas and meet international targets. This could be accompanied by a reduction in road tax for those who adhere to the change and an increase in car tax for those who keep their older (more polluting) vehicles. Likewise, sustainability grants, subsidies and loans would need to be brought in to help those who need it (i.e., those who are willing but unable to pay).

### Trust in Actors

While trust in actors (such as public authorities, academics, NGOs) had a weak correlation with perception, attitude, and behavior, the regression analysis showed it had a significant positive impact on attitude. Therefore, in order to improve the attitudes of individuals and increase the success of policies, it is important that citizens should be confident with and trust in the actors [74,79]. Transparency and the public communication can be key factors for public authorities in Turkey to gain the trust of individuals.

### Satisfaction with Built Environment

Satisfaction with the built environment had a weak to moderate correlation with awareness, attitude, and behavior, yet no significant relationship was found as a result of the linear regression tests. Although it was reported in the literature to have an impact on sustainability behavior [46,80,81], this was not the case for the Turkey context. The comments above made in relation to place attachment might therefore be echoed here.

### Availability of Public Facilities

With very similar responses to satisfaction with the built environment, the availability of public facilities was also found to have a weak to moderate correlation with awareness, attitude, and behavior, and no significant association with the linear regression tests. However, this is contrary to what was previously reported in the literature, in which the availability of public facilities was highlighted as having an impact on the perceptions and behavior of individuals [46,74]. This could once again be related to the local context and conditions of the areas surveyed.

### Locus of Control

The locus of control (defined as being determined by one's own behavior—internal control—as opposed to outside forces such as other people or fate—external control) was found to have a significant correlation only with urban sustainability perception, and importantly, not behavior, while the linear regression analysis showed it to have a significant association with perception and attitude. Within the literature, it is suggested that people who perceive themselves as having little or no control over the built environment (in which they live) tend to have a more negative sustainability perception [17,43,44,61,71]. In other words, it was expected that people living in Turkey would tend to behave more sustainability if they had an internal locus of control; however, this was not borne out strongly by the results.

### Trust in Science and Technology

Trust in science and technology was found to have a strong correlation with all determinants and behavior. Moreover, it had significant positive association with perception and attitude [63]. Therefore, it is possible to deduce that when people have confidence in science and technology to solve environmental problems, they have more positive perceptions and attitudes. However, this confidence may result in reluctance to take actions and behave accordingly. Therefore, while technology should be utilized to improve the sustainability understanding of individuals, it is important to stress both its limits and the significance of individual practices towards the sustainability agenda. People should know also that technology only helps to improve sustainability as long as they collaborate; hence, its direct links with sustainable behavior cannot be ignored.

### Human Priority

Having a human priority mindset holds negative correlations, especially with attitude and behavior. On the other hand, no significant associations were found with any of the determinants and behavior. Therefore, it can be assumed to be beneficial to convince people about the importance and priority of nature and its balance with humanity [60,75].

### Prosperity Perception

Favoring personal prosperity over urban sustainability was found to be negatively correlated with attitude and behavior. On the other hand, it did not result in any predictive power on any of the determinants and behavior. The strongest correlation was found with attitude, which means that a person who prioritizes his/her own interests has strongly negative attitudes towards urban sustainability [63]. Keeping in mind the self-centered nature of some people within society, it is therefore important to stress both the short- and long-term benefits (and prosperity) of making sustainable choices rather than the short-term impacts alone.

### Perception of Economic Growth

Similar to prosperity, the perception of economic growth (in relation to urban sustainability) was found to have strong negative correlations with attitude, alongside weaker negative correlations with awareness and behavior. Moreover, standardized regression showed it to have a negative association with attitude. Therefore, it can be deduced that

people who favor economic development generally hold negative attitudes towards sustainability [63]. In order to overcome this, the economic benefits of urban sustainability need to be explicitly addressed in the relevant policies and interventions.

#### Willingness to Sacrifice

Willingness to sacrifice was found to have significant moderate correlations with all three determinants and behavior. Moreover, standardized regression coefficients showed that it had strong predictive power on awareness and perception. People who are not ready to forego certain actions associated with their patterns of living are therefore expected to have lower levels of awareness and perception, and accordingly, are not expected to perform well in terms of their behavior. Along with the other factors, it is important to encourage people to make sacrifices willingly, rather than reluctantly (by force) [61]. In order to persuade them, other positive perspectives and future benefits of creating sustainable urban areas should once again be emphasized.

#### Ascription of Responsibility

Although the ascription of responsibility was found to have a significant (weak) correlation only with perception and a weak correlation with behavior, it was found to have strong predictive power on awareness, perception, and attitude [16,47,82]. However, unlike other determinants, the impact of the ascription of responsibility was negative on awareness. This result means that although people who take responsibility may hold relatively low awareness, they are likely to have better sustainability perceptions and attitudes.

#### 6.3.3. Summary

It can be concluded that sustainability understanding and behaviors have a very complex and context-sensitive relationships with a wide range of influencing factors. As stated in Topal et al. [35], this context-related nature of urban sustainability behavior requires distinctive efforts with a flexible method to understand, which is implemented in this study. According to the findings, while socio-demographic variables were found to be mostly influential on the awareness and perception of individuals, other influencing factors had a considerable impact on all determinants (i.e., awareness, perception, and attitude) and behavior. Amongst the many influences, the most influential factors on determinants of urban sustainability were identified to be education, age and gender, awareness of consequences, social appraisal, world mindedness, willingness to pay, locus of control, trust in science and technology, willingness to sacrifice, and ascription of responsibility. On the other hand, for behavior, it was found that factors of age, habit, trust in society, social appraisal, world mindedness, and willingness to pay and trust in science and technology had the most significant associations.

#### 6.4. Recommendations

The findings of the study could have significant policy implications. By providing a systematic and organized approach, the framework has proved capable of evaluating the sustainability understanding and behavior in an urban context.

The fundamental outcome of the research is that each of the determinants of urban sustainability understanding must be treated separately, and customized approaches should be developed in order to improve sustainability behavior. Moreover, political decisions and corresponding regulative instruments must consider the impact of personality types within society and individual personality traits on their likely efficacy. Importantly, the wide range of different and distinct factors have intertwined effects (i.e., they are interdependent in different and complex ways), meaning that all should be specifically identified and assessed diligently, both individually and in combination, via a holistic approach based on the local context and conditions.

Regarding policy implications, those responsible for governance must treat each and every element of urban sustainability understanding and behavior as equally important. People's awareness about sustainability should be targeted as a precursor for improving their perceptions and attitudes in relation to general and specific sustainability issues. It is of crucial importance to target the awareness of individuals by improving their knowledge via: (i) educational content in schools and universities, and (ii) advertisements and training opportunities with the help of institutional tools. Based on the findings of the impact of personality types on sustainability understanding and behavior, it is possible to deduce that the content of these efforts should not be intellectually demanding if they are to resonate with the public. However, subjects should be prepared conscientiously, and provided with necessary justifications, in order to result in positive behavioral outcomes.

As noted within the literature, many variables are important in the prediction of urban sustainability awareness, perception, attitude, and behavior. However, particular situations need specific approaches. In the Turkish context studied herein, while females and older generations require more informative interventions, younger generations need encouragement to improve their behavior. Therefore, inclusive activities that target the youth have better chances of success if they result in practical outcomes such as: (i) public contests (or challenges), either in physical or digital world, and (ii) sustainability projects in high school and university curricula. Since people who are exposed to unsustainable outcomes and negative consequences in their living environment have better understanding and behaviors, municipalities should clearly indicate the connections between these outcomes and unsustainable practices in order to direct people towards desired actions.

In terms of the social environment at the micro- and macro-level, cultural codes, trust, social appraisal, and identity were found to be distinctive variables. In order to gain the trust of individuals, governmental actors have to provide transparent and inclusive policy-making procedures. With the help of district municipalities and digital tools, such as social media, participation of the public in decision-making processes about sustainability issues needs to be enabled. Similarly, up-to-date conditions and achievements can be shared to gain the trust about the ongoing practices. By doing so, individuals can be encouraged to participate in sustainable behaviors in their private spheres. Moreover, in order to improve trust in society, neighborhood-based sustainability activities organized by local authorities should be organized. With the help of these micro efforts, it would be possible to change the socio-cultural norms in favor of sustainability, which in turn could boost social appraisal mechanisms in relation to sustainability issues. It is of the utmost importance to provide an effort–reward system to support such micro social improvements.

## 7. Conclusions

### 7.1. Key Findings

The main aim of this research was to explore the urban sustainability understanding and behavior of the public. This study is unique since it has adapted a novel conceptual framework and applied it to the context and local conditions of Istanbul in Turkey. The influencing factors considered constitute a comprehensive list with an urban focus. Contrary to earlier research (which adopts either environmental or psychological approaches), this research has adopted a synthesized approach that puts urban sustainability at the very core. Overall, the conceptual framework proposed was found to be promising in terms of its ability to identify urban sustainability understanding and behavior, while also being able to cast light on the impact of a range of personality traits and influencing factors. The main findings of the research can be summarized as follows:

- **Determinants:** the statistical analysis on the 535 responses to sets of detailed questions on urban sustainability showed that the average awareness score of respondents was lower than perception and attitude scores. While respondents were found to be more aware of local sustainability issues than anticipated, they readily identified that educational opportunities needed improvement. Although sustainability was perceived as more of an environmental issue, respondents were able to distinguish between the



importance of sustainability and the appropriateness of their behavior to advancing the cause of sustainability. Respondents were also found to hold positive attitudes in relation to taking responsibility for and contributing to urban sustainability. Bivariate analysis showed that although the correlations between awareness–perception and perception–attitude were broadly similar, the correlation between awareness–attitude was found to be stronger. Regarding the predictive power revealed by the multivariate linear regression analysis, awareness was found to impact upon both perception and attitude, yet there was no significant association between perception and attitude.

- Behavior: the overall behavior scores of the respondents produced a promising mean value (3.63). Furthermore, the bivariate analysis showed strong correlations with both awareness and attitude. The multivariate linear regression analysis demonstrated that all three determinants (awareness, perception, and attitude) had significant predictive power on behavior.
- Personality traits: the respondents as a whole were found to have both agreeable and conscientious natures. Surgency and intellect personality types were found to be highly correlated with awareness, while agreeableness and conscientiousness had strong correlations with awareness and perception. Similarly, behavior was found to have the strongest correlation with conscientiousness, closely followed by agreeableness and intellect. Additionally, people who had more intellectual personality traits resulted in them having better (sustainability) awareness and behavior. Likewise, an agreeable and conscientious personality was found to have positive impacts on sustainability behavior.
- Influencing factors: it was noticeable that while the factors of awareness of consequences, social appraisalment, national identity, world mindedness, willingness to pay and trust in science and technology had the strongest correlations with the three determinants and behavior, having a human priority mindset and favoring personal prosperity resulted in strong negative correlations with attitude. Additionally, place attachment was strongly correlated with behavior. In terms of predictive associations, awareness of consequences, social appraisalment, world mindedness, willingness to pay, locus of control, trust in science and technology, willingness to sacrifice, and ascription of responsibility were observed to be the most influential factors on the determinants of awareness, perception, and attitude. Furthermore, attitude was the most easily predicted determinant by influencing factors. In terms of behavior, it was found that habit, trust in society, social appraisalment, world mindedness, willingness to pay, and trust in science and technology had the most predictive power.
- Socio-demographic factors: while males were more aware of urban sustainability, age was negatively correlated with awareness. Interestingly, education and income were positively correlated with all of the determinants, yet behavior had no correlation with income and a positive correlation with education. In terms of occupation, housewives and unemployed people had weaker awareness and attitudes than those in other occupations. Moreover, people who live in socio-economically more deprived areas produced higher scores for the determinants and behavior. Similarly, both apolitical and religious people were found to have weaker urban sustainability understanding and behavior than Atatürkist, left/socialist, and social democrats. In terms of predictive power, older ages and being female were found to have negative impact on awareness. However, while age had a positive impact on behavior, being female had a positive impact on perception. Moreover, landlords were found to be more aware while inhabitants of bigger houses had better attitudes.

## 7.2. Recommendations for Future Research

As a result of this study, some potential avenues for future research on urban sustainability understanding and behavior have been identified. These are:

- The understanding and behavior of urban sustainability have been explored according to the main determinants specified in the conceptual framework. However, there

are several sub-determinants that could be considered for deeper investigation, such as knowledge, concern, value–belief, and personal norms [35]. Moreover, further investigation into the different urban sustainability behavior types (such as economic, environmental, and social urban sustainability behaviors) would provide valuable insights and a customized approach.

- Although quantitative approaches provide ease, accuracy, and generalizability of analysis, it can be valuable to explore urban sustainability understanding and behavior of individuals in qualitative ways. For instance, in-depth interviews, focus group discussions, or even observations, could provide alternative insights.
- The scope of the current study was the macro-scale, which concentrates on the whole city. However, the conceptual framework could be applied to local contexts and at micro-scales, such as the district, county, or even neighborhood level. This would have the potential to enable local authorities to better identify local needs and problems.
- There would be a benefit in conducting further intra- and international comparisons among urban areas in order to identify different urban characteristics and particular differences among various geographical regions and cultures. Therein, it would be interesting to see how developed and developing countries differ, and to interrogate those distinguishing characteristics that are most influential on urban sustainability behavior within each setting.
- The proposed conceptual framework provides a flexible and adaptable option for different case study areas due to the wide range of influencing factors that interact with determinants and behavior. Although an extensive list of factors has been tested within this research, it is possible to customize the influencing factors for different regions.

**Author Contributions:** Abstract and introduction, H.F.T., D.V.L.H. and C.D.F.R. Methodology, H.F.T. Main body of research with analyses and results, H.F.T. Discussion, H.F.T., D.V.L.H. and C.D.F.R. Conclusions, H.F.T., D.V.L.H. and C.D.F.R. Writing—original draft preparation, H.F.T. Supervision, revision, editing, and proofreading, D.V.L.H. and C.D.F.R. All authors have contributed to the work reported. All authors have read and agreed to the published version of the manuscript.

**Funding:** The first author would also like to thank his sponsor, The Ministry of National Education, Republic of Turkey, for funding his doctoral studies at the University of Birmingham under scholarship of Higher Education. C.D.F.R. and D.V.L.H. received the financial support of the UK EPSRC under grant EP/J017698/1 (Transforming the Engineering of Cities to Deliver Societal and Planetary Wellbeing, known as Liveable Cities) and EP/P002021 (From Citizen to Co-innovator, from City Council to Facilitator: Integrating Urban Systems to Provide Better Outcomes for People, known as Urban Living Birmingham).

**Institutional Review Board Statement:** The study was conducted with ethical approval from the University of Birmingham (reference number ERN\_19-0513A).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Not applicable.

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

## Appendix A.

### Appendix A.1. General Information

The questionnaire starts with a wide range of socio-demographic questions. This helps to better understand the general characteristics, background information and representativeness of the respondents within the study area. Moreover, it was necessary to capture this information in order to subsequently compare and contrast the effects of the demographic characteristics on urban sustainability understanding and behavior. Hence, the questions first looked to identify the most frequently asked characteristics within any questionnaire: age, gender, education level, occupation, and monthly income. Furthermore, since the study was conducted at a city scale, respondents were asked which county they lived in—this facilitated making comparisons between different regions. Household char-

acteristics were also investigated through use of specific questions, such as: (i) number of people living in the household, (ii) residential status, and (iii) approximate size of home. These were followed by questions that identified the length of time resident in Istanbul and probable (or likely) future residency. Finally, political orientations of individuals were solicited.

#### *Appendix A.2. Sustainability Understanding*

Socio-psychological determinants of urban sustainability understanding were investigated using three sub-sections containing individual questions. All questions herein employed the standardized Likert type scale (see [83]). This section started with questions that assess the general ‘awareness’ of respondents of/to sustainability. As such, respondents were asked to rate their knowledge about urban sustainability, sustainable behavior, and familiarity with different sustainability concept(s). In the second sub-section, the ‘perceptions’ of individuals about urban sustainability and sustainable behavior were evaluated. This sub-section consisted of four questions that ask about the respondent’s approach to urban sustainability and sustainable behavior, how they rate the importance of urban sustainability, and the appropriateness of their behavior in terms of sustainability. In the last sub-section, the ‘attitudes’ of the respondents were explored. Respondents were asked to rate five statements relating to: (i) environmental limits; (ii) (contributing to) the sustainable city; (iii) environmental responsibility, (iv) economic problems (related to unsustainable urbanization), and (v) sustainability laws and regulations.

#### *Appendix A.3. Sustainability Behavior*

In this section respondents were asked to rate (using a Likert scale) 18 statements which belong to the different core elements of sustainability of personal, social, environmental, economic, governance, infrastructural, and technological aspects of sustainable behavior. This section started by assessing the individual efforts respondents took in respect to adopting sustainable behavior—in their personal area and also their social environment. Following this, their social behaviors were evaluated by asking about their practices pertaining to social issues within their living areas. Their environmental behaviors were subsequently evaluated by identifying relevant topics, such as ‘repair, reuse, recycle’, and green areas. For economic behavior, both resource efficiency and minimization behavior were assessed. Likewise, governance behaviors were determined by asking whether respondents participate in or are paying due obedience to related policies and regulations. Finally, the actions of individuals were evaluated in terms of both infrastructural and technological sustainability areas.

#### *Appendix A.4. Influencing Factors*

In this section, respondents were asked to rate (using the same Likert scale) 19 influencing factors of urban sustainability understanding and behavior. These questions were again specified based upon the literature review performed by Topal et al. [31]. The influencing factors were: awareness of consequences; habits; concerns for social appraisal, and for health and safety; trust in actors, society, and science and technology; national and global identities; place attachment; willingness to pay and sacrifice; prosperity, economy, and human priority perceptions; availability of public facilities; satisfaction with the built environment; locus of control; and ascription of responsibility.

#### *Appendix A.5. Personality Traits*

Five personality types, also specified according to findings from the literature search, were investigated here. The five major personality types adopted were [84]: surgency, agreeableness, conscientiousness, emotional stability, and intellect. Each group consisted of five statements to be rated in using a five-point Likert scale.

## References

- Brundtland, G.H. *Report of the World Commission on Environment and Development: Our Common Future*; United Nations: New York, NY, USA, 1987.
- Mensah, J. Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. *Cogent Soc. Sci.* **2019**, *5*. [CrossRef]
- Morelli, J. Environmental Sustainability: A Definition for Environmental Professionals. *JES* **2011**, *1*. [CrossRef]
- United Nations. *World Population Prospects: The 2017 Revision*; United Nations Department of Economic and Social Affairs: New York, NY, USA, 2017; Volume 33, pp. 1–66.
- United Nations Department of Economic and Social Affairs. *Population Division World Urbanization Prospects: The 2014 Revision*; United Nations Department of Economic and Social Affairs: New York, NY, USA, 2015.
- United Nations Department of Economic and Social Affairs. *Population Division World Urbanization Prospects: The 2018 Revision*; United Nations Department of Economic and Social Affairs: New York, NY, USA, 2019; ISBN 978-92-1-148319-2.
- Türkiye İstatistik Kurumu (TUIK) Adrese Dayalı Nüfus Kayıt Sistemi. Available online: <https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-N%C3%BCfus-Kay%C4%B1t-Sistemi-Sonu%C3%A7lar%C4%B1-2020-37210&dil=1> (accessed on 13 April 2021).
- World Bank. *Turkey—Sustainable Cities Project: Environmental and Social Management Framework (English)*; World Bank Group: Washington, DC, USA, 2016.
- Sari, V.İ.; Kindap, A. *Türkiye’de Kentsel Yaşam Kalitesi Göstergelerinin Analizi*; Ankara University: Ankara, Turkey, 2018.
- Candas, E.; Flacke, J.; Yomralioglu, T. Understanding Urban Regeneration in Turkey. *ISPRS Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci.* **2016**, *XLI-B4*, 669–675. [CrossRef]
- Strateji ve Bütçe Başkanlığı, Türkiye Cumhuriyeti Cumhurbaşkanlığı, National Development Plans. Available online: <https://www.sbb.gov.tr/kalkinma-planlari/> (accessed on 2 June 2021).
- Istanbul Development Agency. *2014–2023 Istanbul Regional Plan*; Istanbul Development Agency: Istanbul, Turkey, 2014; p. 90.
- Blake, J. Overcoming the ‘value-action gap’ in environmental policy: Tensions between national policy and local experience. *Local Environ.* **1999**, *4*, 257–278. [CrossRef]
- Huijts, N.M.A.; Molin, E.J.E.; Steg, L. Psychological factors influencing sustainable energy technology acceptance: A review-based comprehensive framework. *Renew. Sustain. Energy Rev.* **2012**, *16*, 525–531. [CrossRef]
- Steg, L.; Vlek, C. Encouraging pro-environmental behaviour: An integrative review and research agenda. *J. Environ. Psychol.* **2009**, *29*, 309–317. [CrossRef]
- Stern, P.C. New environmental theories: Toward a coherent theory of environmentally significant behavior. *J. Soc. Issues* **2000**, *56*, 407–424. [CrossRef]
- Kollmuss, A.; Agyeman, J. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environ. Educ. Res.* **2002**, *8*, 239–260. [CrossRef]
- Turaga, R.M.R.; Howarth, R.B.; Borsuk, M.E. Pro-environmental behavior: Rational choice meets moral motivation. *Ann. N. Y. Acad. Sci.* **2010**, *1185*, 211–224. [CrossRef]
- Abrahamse, W.; Steg, L.; Vlek, C.; Rothengatter, T. A review of intervention studies aimed at household energy conservation. *J. Environ. Psychol.* **2005**, *25*, 273–291. [CrossRef]
- Barr, S. Factors Influencing Environmental Attitudes and Behaviors: A U.K. Case Study of Household Waste Management. *Environ. Behav.* **2007**, *39*, 435–473. [CrossRef]
- Gifford, R. The Dragons of Inaction: Psychological Barriers That Limit Climate Change Mitigation and Adaptation. *Am. Psychol.* **2011**, *66*, 290–302. [CrossRef]
- Bamberg, S. How does environmental concern influence specific environmentally related behaviors? A new answer to an old question. *J. Environ. Psychol.* **2003**, *23*, 21–32. [CrossRef]
- Stern, P.C.; Dietz, T. The value basis of environmental concern. *J. Soc. Issues* **1994**, *50*, 65–84. [CrossRef]
- Batur, İ.; Koç, M. Travel Demand Management (TDM) case study for social behavioral change towards sustainable urban transportation in Istanbul. *Cities* **2017**, *69*, 20–35. [CrossRef]
- Balaban, O. *A Matter of Capacity: Climate Change and the Urban Challenges for Turkey*; Cambridge University Press: Cambridge, UK, 2017; Volume 56.
- Kaygusuz, K.; Toklu, E. Energy issues and sustainable development in Turkey. *J. Eng. Res. Appl. Sci.* **2012**, *1*, 25.
- Yalçıntaş, M.; Bulu, M.; Küçükvar, M.; Samadi, H. A Framework for Sustainable Urban Water Management through Demand and Supply Forecasting: The Case of Istanbul. *Sustainability* **2015**, *7*, 11050–11067. [CrossRef]
- Egercioğlu, Y. Urban Transformation Processes in Illegal Housing Areas in Turkey. *Procedia Soc. Behav. Sci.* **2016**, *223*, 119–125. [CrossRef]
- Okumuş, G. A Geographical Information System Based Urban Sustainability Evaluation Model Proposal in Neighbourhood Scale. *J. Plan.* **2017**, *27*, 193–204. [CrossRef]
- Yurttaş, A.; Çağlar, A. The attitudes of governmental officialin terms of sustainable environment. *Int. Electron. J. Environ. Educ.* **2019**, *9*, 142–156.
- Topal, H.F.; Hunt, D.V.L.; Rogers, C.D.F. Urban Sustainability and Smartness Understanding (USSU)—Identifying Influencing Factors: A Systematic Review. *Sustainability* **2020**, *12*, 4682. [CrossRef]

32. Sharifi, A.; Dawodu, A.; Cheshmehzangi, A. Limitations in assessment methodologies of neighborhood sustainability assessment tools: A literature review. *Sustain. Cities Soc.* **2021**, *67*, 102739. [\[CrossRef\]](#)
33. Bayulken, B.; Huisingh, D.; Fisher, P.M.J. How are nature based solutions helping in the greening of cities in the context of crises such as climate change and pandemics? A comprehensive review. *J. Clean. Prod.* **2021**, *288*, 125569. [\[CrossRef\]](#)
34. Morano, P.; Tajani, F.; Anelli, D. Urban planning decisions: An evaluation support model for natural soil surface saving policies and the enhancement of properties in disuse. *Prop. Manag.* **2020**, *38*, 699–723. [\[CrossRef\]](#)
35. Topal, H.F.; Hunt, D.V.L.; Rogers, C.D.F. Exploring Urban Sustainability Understanding and Behaviour: A Systematic Review towards a Conceptual Framework. *Sustainability* **2021**, *13*, 1139. [\[CrossRef\]](#)
36. Lynch, A.J.; Mosbah, S.M. Improving local measures of sustainability: A study of built-environment indicators in the United States. *Cities* **2017**, *60*, 301–313. [\[CrossRef\]](#)
37. Wakita, T.; Ueshima, N.; Noguchi, H. Psychological Distance Between Categories in the Likert Scale: Comparing Different Numbers of Options. *Educ. Psychol. Meas.* **2012**, *72*, 533–546. [\[CrossRef\]](#)
38. Johnson, R.B.; Christensen, L. *Educational Research: Quantitative, Qualitative, and Mixed Approaches*; SAGE Publications Inc.: New York, NY, USA, 2019; ISBN 1-5443-3785-X.
39. Field, A.P.; Miles, J.; Field, Z. *Discovering Statistics Using R*; Sage: London, UK; Thousand Oaks, CA, USA, 2012; ISBN 978-1-4462-0046-9.
40. Cordano, M.; Welcomer, S.A.; Scherer, R.F. An analysis of the predictive validity of the new ecological paradigm scale. *J. Environ. Educ.* **2003**, *34*, 22–28. [\[CrossRef\]](#)
41. Hair, J.F. (Ed.) *Multivariate Data Analysis*, 7th ed.; Pearson: Harlow, UK, 2014; ISBN 978-1-292-02190-4.
42. Goldberg, L.R. The development of markers for the Big-Five factor structure. *Psychol. Assess.* **1992**, *4*, 26. [\[CrossRef\]](#)
43. Guo, D.; Cao, Z.; DeFrancia, K.; Yeo, J.W.G.; Hardadi, G.; Chai, S. Awareness, perceptions and determinants of urban sustainable development concerns—Evidence from a central province in China. *Sustain. Dev.* **2018**, *26*, 652–662. [\[CrossRef\]](#)
44. Tran, K.C. Public perception of development issues: Public awareness can contribute to sustainable development of a small island. *Ocean Coast. Manag.* **2006**, *49*, 367–383. [\[CrossRef\]](#)
45. Buerke, A.; Straatmann, T.; Lin-Hi, N.; Müller, K. Consumer awareness and sustainability-focused value orientation as motivating factors of responsible consumer behavior. *Rev. Manag. Sci.* **2017**, *11*, 959–991. [\[CrossRef\]](#)
46. Cagáňová, D.; Stareček, A.; Horňáková, N.; Hlásniková, P. The Analysis of the Slovak Citizens' Awareness about the Smart City Concept. *Mob. Netw. Appl.* **2019**, 2050–2058. [\[CrossRef\]](#)
47. Guagnano, G.A.; Stern, P.C.; Dietz, T. Influences on attitude-behavior relationships: A natural experiment with curbside recycling. *Environ. Behav.* **1995**, *27*, 699–718. [\[CrossRef\]](#)
48. Peng, G.C.A.; Nunes, M.B.; Zheng, L. Impacts of low citizen awareness and usage in smart city services: The case of London's smart parking system. *Inf. Syst. e-Bus. Manag.* **2017**, *15*, 845–876. [\[CrossRef\]](#)
49. Himmel, S.; Zaunbrecher, B.S.; Wilkowska, W.; Ziefle, M. The Youth of Today Designing the Smart City of Tomorrow. In *Human-Computer Interaction. Applications and Services*; Kurosu, M., Ed.; Springer International Publishing: Cham, Switzerland, 2014; Volume 8512, pp. 389–400, ISBN 978-3-319-07226-5.
50. Ajzen, I. *Attitudes, Personality, and Behavior*; McGraw-Hill Education: London, UK, 2005; ISBN 0-335-22400-8.
51. Kang, S. Communicating sustainable development in the digital age: The relationship between citizens' storytelling and engagement intention. *Sustain. Dev.* **2019**, *27*, 337–348. [\[CrossRef\]](#)
52. Pavalache-Ilie, M.; Cazan, A.-M. Personality correlates of pro-environmental attitudes. *Int. J. Environ. Health Res.* **2018**, *28*, 71–78. [\[CrossRef\]](#)
53. Busic-Sontic, A.; Czap, N.V.; Fuerst, F. The role of personality traits in green decision-making. *J. Econ. Psychol.* **2017**, *62*, 313–328. [\[CrossRef\]](#)
54. Grob, A. A structural model of environmental attitudes and behaviour. *J. Environ. Psychol.* **1995**, *15*, 209–220. [\[CrossRef\]](#)
55. Klöckner, C.A. A comprehensive model of the psychology of environmental behaviour—A meta-analysis. *Glob. Environ. Chang.* **2013**, *23*, 1028–1038. [\[CrossRef\]](#)
56. He, G.; Boas, I.; Mol, A.P.J.; Lu, Y. E-participation for environmental sustainability in transitional urban China. *Sustain. Sci.* **2017**, *12*, 187–202. [\[CrossRef\]](#)
57. Tononi, M.; Pietta, A.; Bonati, S. Alternative spaces of urban sustainability: Results of a first integrative approach in the Italian city of Brescia. *Geogr. J.* **2017**, *183*, 187–200. [\[CrossRef\]](#)
58. Hsu, J.L.; Feng, C.-H. Evaluating environmental behaviour of the general public in Taiwan: Implications for environmental education. *IJCED* **2019**, *21*, 179–189. [\[CrossRef\]](#)
59. Rajapaksa, D.; Gifford, R.; Torgler, B.; Garcia-Valiñas, M.; Athukorala, W.; Managi, S.; Wilson, C. Do monetary and non-monetary incentives influence environmental attitudes and behavior? Evidence from an experimental analysis. *Resour. Conserv. Recycl.* **2019**, *149*, 168–176. [\[CrossRef\]](#)
60. Wong, T.K.; Wan, P. Perceptions and determinants of environmental concern: The case of Hong Kong and its implications for sustainable development. *Sustian. Dev.* **2011**, *19*, 235–249. [\[CrossRef\]](#)
61. Waitt, G.; Caputi, P.; Gibson, C.; Farbotko, C.; Head, L.; Gill, N.; Stanes, E. Sustainable Household Capability: Which households are doing the work of environmental sustainability? *Aust. Geogr.* **2012**, *43*, 51–74. [\[CrossRef\]](#)



62. Branchini, S.; Meschini, M.; Covi, C.; Piccinetti, C.; Zaccanti, F.; Goffredo, S. Participating in a Citizen Science Monitoring Program: Implications for Environmental Education. *PLoS ONE* **2015**, *10*, e0131812. [\[CrossRef\]](#)
63. Drews, S.; van den Bergh, J.C.J.M. Public views on economic growth, the environment and prosperity: Results of a questionnaire survey. *Glob. Environ. Chang.* **2016**, *39*. [\[CrossRef\]](#)
64. Newton, P.; Meyer, D. Exploring the Attitudes-Action Gap in Household Resource Consumption: Does “Environmental Lifestyle” Segmentation Align with Consumer Behaviour? *Sustainability* **2013**, *5*, 1211–1233. [\[CrossRef\]](#)
65. Rajapaksa, D.; Islam, M.; Managi, S. Pro-Environmental Behavior: The Role of Public Perception in Infrastructure and the Social Factors for Sustainable Development. *Sustainability* **2018**, *10*, 937. [\[CrossRef\]](#)
66. Barau, A.S. Perceptions and contributions of households towards sustainable urban green infrastructure in Malaysia. *Habitat Int.* **2015**, *47*, 285–297. [\[CrossRef\]](#)
67. Harlan, S.L.; Yabiku, S.T.; Larsen, L.; Brazel, A.J. Household Water Consumption in an Arid City: Affluence, Affordance, and Attitudes. *Soc. Nat. Resour.* **2009**, *22*, 691–709. [\[CrossRef\]](#)
68. Maiello, A.; Battaglia, M.; Daddi, T.; Frey, M. Urban sustainability and knowledge: Theoretical heterogeneity and the need of a transdisciplinary framework. A tale of four towns. *Futures* **2011**, *43*, 1164–1174. [\[CrossRef\]](#)
69. Rogers, Z.; Bragg, E. The Power of Connection: Sustainable Lifestyles and Sense of Place. *Ecopsychology* **2012**, *4*, 307–318. [\[CrossRef\]](#)
70. Schwartz, S.H.; Howard, J.A. A normative decision-making model of altruism. In *Altruism Help. Behav.*; Rushton, J.P., Sorrentino, R.M., Eds.; 1981; pp. 189–211, ISBN-10: 0898591554.
71. Bamberg, S.; Möser, G. Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *J. Environ. Psychol.* **2007**, *27*, 14–25. [\[CrossRef\]](#)
72. Uren, H.V.; Dzidic, P.L.; Roberts, L.D.; Leviston, Z.; Bishop, B.J. Green-Tinted Glasses: How Do Pro-Environmental Citizens Conceptualize Environmental Sustainability? *Environ. Commun.* **2019**, *13*, 395–411. [\[CrossRef\]](#)
73. Fransson, N.; Gärling, T. Environmental concern: Conceptual definitions, measurement methods, and research findings. *J. Environ. Psychol.* **1999**, *19*, 369–382. [\[CrossRef\]](#)
74. Macke, J.; Casagrande, R.M.; Sarate, J.A.R.; Silva, K.A. Smart city and quality of life: Citizens’ perception in a Brazilian case study. *J. Clean. Prod.* **2018**, *182*, 717–726. [\[CrossRef\]](#)
75. Zhang, L.; Chen, L.; Wu, Z.; Xue, H.; Dong, W. Key Factors Affecting Informed Consumers’ Willingness to Pay for Green Housing: A Case Study of Jinan, China. *Sustainability* **2018**, *10*, 1711. [\[CrossRef\]](#)
76. Polese, F.; Barile, S.; Caputo, F.; Carrubbo, L.; Waletzky, L. Determinants for Value Cocreation and Collaborative Paths in Complex Service Systems: A Focus on (Smart) Cities. *Serv. Sci.* **2018**, *10*, 397–407. [\[CrossRef\]](#)
77. Der-Karabetian, A.; Cao, Y.; Alfaro, M. Sustainable Behavior, Perceived Globalization Impact, World-Mindedness, Identity, and Perceived Risk in College Samples from the United States, China, and Taiwan. *Ecopsychology* **2014**, *6*, 218–233. [\[CrossRef\]](#)
78. Noonan, D.; Zhou, S.; Kirkman, R. Making Smart and Sustainable Infrastructure Projects Viable: Private Choices, Public Support, and Systems Constraints. *Urban Plan.* **2017**, *2*, 18–32. [\[CrossRef\]](#)
79. Granier, B.; Kudo, H. How are citizens involved in smart cities? Analysing citizen participation in Japanese “Smart Communities”. *Inf. Polity* **2016**, *21*, 61–76. [\[CrossRef\]](#)
80. Holdsworth, S.; Kenny, D.; Cooke, J.; Matfin, S. Are We Living with Our Heads in the Clouds? Perceptions of Liveability in the Melbourne High-Rise Apartment Market. In *Energy Performance in the Australian Built Environment*; Rajagopalan, P., Andamon, M.M., Moore, T., Eds.; Springer: Singapore, 2019; pp. 181–198, ISBN 978-981-10-7879-8.
81. Norouzian-Maleki, S.; Bell, S.; Hosseini, S.-B.; Faizi, M.; Saleh-Sedghpour, B. A comparison of neighbourhood liveability as perceived by two groups of residents: Tehran, Iran and Tartu, Estonia. *Urban For. Urban Green.* **2018**, *35*, 8–20. [\[CrossRef\]](#)
82. Karp, D.G. Values and their effect on pro-environmental behavior. *Environ. Behav.* **1996**, *28*, 111–133. [\[CrossRef\]](#)
83. Norman, G. Likert scales, levels of measurement and the “laws” of statistics. *Adv. Health Sci. Educ.* **2010**, *15*, 625–632. [\[CrossRef\]](#)
84. Norman, W.T. Toward an adequate taxonomy of personality attributes: Replicated factor structure in peer nomination personality ratings. *J. Abnorm. Soc. Psychol.* **1963**, *66*, 574. [\[CrossRef\]](#) [\[PubMed\]](#)