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USER PROFILE-BASED COMPARISON OF IMPROVEMENT EXPECTATIONS IN SHARED E-SCOOTER SYSTEMS

İlknur Türker[1], Yalçın Alver[1], Derya Azik Özkan[2]
[1]*Ege University, Department of Civil Engineering, Turkey*
[2]*Turkish National Police Academy, Department of Traffic and Transportation Psychology, Turkey*

Abstract

Demand for shared e-scooter systems has increased. However, despite their rapid expansion, these systems are still used primarily for recreational purposes rather than as a full transportation mode. Insufficient legal regulations and deficiencies in infrastructure and equipment contribute to safety-related concerns, and e-scooter accidents are increasing. Understanding the expectations of different user profiles from the system is important both for enhancing system reliability and reducing accident risk. The present study aimed to evaluate the expectations of both current and potential users regarding system improvements across demographic characteristics, using the "Willingness to Use Shared E-Scooter Systems Following Improvements Scale", which was developed and psychometrically validated by the authors. Data were collected from 486 participants (208 users, 278 non-users) in İzmir, Turkey, through a face-to-face survey using a convenience sampling approach. Findings revealed that different user profiles have distinct priorities within the scale's two-factor structure. Current system users scored significantly higher on the first factor, which includes incentives for infrastructure, accessibility, and cost, while potential users scored significantly higher on the second factor, which includes incentives for safety and institutional regulations. Demographic analyses showed that women placed greater importance on the safety factor than men did, while younger individuals placed greater emphasis on the infrastructure factor. Education level did not show significant differences between factors. Notably, 78.4% of potential users reported that they would consider using the system if the proposed improvements were implemented. In conclusion, improving safety standards, equipment quality, and legal regulations is necessary to attract women and older individuals to the system, while solving infrastructure and accessibility problems is required to increase usage among the existing young and male user profile. Addressing these differentiated expectations may facilitate the transformation of shared e-scooter systems from predominantly recreational options into integral components of sustainable urban transportation systems.

Keywords: shared e-scooter, sustainable transportation, demographic differences, user expectations

1 Introduction

The growing emphasis on sustainability-oriented policies in urban transportation has led to a rapid expansion of shared mobility systems in recent years. Initially limited to bicycle and car-sharing services, this field has significantly expanded with the introduction of shared e-scooters [1]. Shared e-scooters serve as a complementary component of public transport systems by providing flexible first- and last-mile connections and offer considerable po-

tential for reducing carbon emissions, thereby positioning them as an increasingly prominent element of sustainable urban mobility strategies [2-4]. The rapid expansion of shared e-scooter systems has also given rise to a range of challenges, most notably safety concerns, inadequate infrastructure, and divergent user expectations. Existing research consistently highlights infrastructure deficiencies as one of the most significant barriers to widespread e-scooter use. Large-scale surveys conducted in France and Brussels indicate that the absence of dedicated e-scooter or bicycle lanes and the necessity to operate within motorized traffic are perceived as the most critical problems, followed by high rental costs [5, 6]. Similar findings have been reported in Turkey, where insufficient dedicated infrastructure, high usage costs, regulatory gaps, and inadequate protective equipment have been highlighted as major concerns [7, 8]. The literature further demonstrates a clear divergence in expectations between active users and non-users of shared e-scooter systems. Active users predominantly prioritize operational and accessibility-related improvements, such as the expansion of dedicated lanes, increased vehicle availability, reduced pricing, expanded parking areas, and regular maintenance. In contrast, non-users and less experienced individuals tend to emphasize safety-oriented measures, including mandatory protective equipment, user education programs, and stricter regulatory enforcement [9-12]. For instance, a survey conducted in France with 4, 382 participants revealed that 71% believed mandatory helmet use would reduce usage frequency [5], while a study in Istanbul found that 40% of users experienced technical issues, underscoring the importance of regular maintenance [13]. That study also showed that experienced users perceive lower risk levels compared to new users, who exhibit greater sensitivity to environmental and traffic-related conditions.

Demographic characteristics further shape these differences in expectations. Previous research indicates that shared e-scooter users are predominantly young, male, and relatively well-educated [14, 15]. Younger users are primarily motivated by time and cost efficiency, whereas increasing age is associated with reduced emphasis on operational and financial improvements and heightened safety concerns [12]. Gender-based analyses reveal that women place greater importance on traffic safety, balance, fall risk, and the use of protective equipment, while men tend to focus more on system availability, technical reliability, and vehicle accessibility [9]. These findings suggest that uniform regulatory and planning approaches may be insufficient for the effective and safe integration of shared e-scooter systems into urban transportation networks. Understanding the heterogeneous expectations of different age groups, genders, and user experience levels requires a systematic and measurable analytical framework. Although the literature offers various improvement recommendations, studies that systematically evaluate these expectations using a structured measurement scale across both users and non-users remain limited. Addressing this gap, the present study aims to assess improvement expectations for shared e-scooter systems in the case of İzmir by employing a previously developed 15-item scale designed by the same authors [16] and to identify priority areas for system enhancement across different demographic and user groups.

2 Material and method

2.1 Data collection instrument

Data were collected using a structured questionnaire consisting of two sections. The first section included demographic variables (gender, age, education level) and shared e-scooter usage experience, operationalized as having used the system at least once; participants were classified as users or non-users accordingly. The second section comprised the “Willingness to Use Shared E-Scooter Systems Following Improvements Scale, ” a 15-item, two-factor scale previously developed by the same authors as part of a master’s thesis using Exploratory

Factor Analysis (EFA) [16], designed to assess the extent to which proposed system improvements influence individuals' intention to use shared e-scooters. The scale items and corresponding factor loadings are presented in table 1.

Table 1 Items of the willingness to use shared e-scooter systems following improvements scale

Items	Factor 1	Factor 2
Increasing the number of shared e-scooters to improve the likelihood of finding one in my vicinity	0.80	
Building more bicycle and e-scooter lanes that are physically separated from motor vehicle traffic	0.80	
Establishing designated parking areas near public transportation systems	0.79	
Ensuring fare integration with the public transport system	0.78	
Reducing e-scooter usage fees	0.73	
Building more shared bicycle and e-scooter lanes that can be used together with motor vehicles	0.73	
Providing monthly subscription options for e-scooter use	0.68	
Increasing the number of designated e-scooter parking areas	0.65	
Ensuring regular maintenance and repair of e-scooters	0.55	
Increasing the legal speed limits for e-scooters	0.51	
Making the use of safety equipment (e.g. helmet, knee pads, reflectors) legally mandatory while using e-scooters		0.93
Offering free training programs for e-scooter use		0.86
Increasing the prevalence of enforcement in line with e-scooter regulations		0.75
Making the use of signaling and visibility devices (e.g. signals, horns, rear-view mirrors) legally mandatory while using e-scooters		0.72
Providing more information on proper e-scooter use		0.53
Factor 1: infrastructure, accessibility and cost Incentives Factor 2: safety and institutional regulation Incentives		

All items were measured using a 5-point Likert-type scale, ranging from 1 = strongly discourages to 5 = strongly encourages. The first factor, "infrastructure, accessibility and cost incentives", consists of 10 items, while the second factor, "safety and institutional regulation incentives", consists of 5 items. All items loaded on their respective factors with factor loadings of 0.40 or above, indicating acceptable construct validity. No reverse-coded items were included in the scale. The internal consistency coefficients (Cronbach's alpha) reported in the original scale development study were 0.91 for the first factor and 0.86 for the second factor, demonstrating high internal reliability. In addition, non-user participants were asked the question "Would you consider using an e-scooter in the future if improvements are implemented?" in order to assess potential future usage intentions.

2.2 Data collection process and procedure

Data were collected from 486 participants aged between 18-65 in İzmir through face-to-face surveys using convenience sampling. Survey locations included shopping malls, university campuses, coastal areas, and public transportation hubs between January 2024 and May 2025. Prior to data collection, ethical approval for the use and administration of the questionnaire was obtained from the Ege University Scientific Research and Publication Ethics Committee.

2.3 Study sample

The study sample consisted of 42.8% shared e-scooter users (n = 208) and 57.2% non-users (n = 278). The mean age of all participants was 33.08 years (SD = 11.17). The gender distribution of the sample was 53.1% male (n = 258) and 46.9% female (n = 228). Regarding education level, 7.2% of the participants had completed primary education (n = 35), 35.8% were high school graduates (n = 174), 47.9% held a bachelor's degree (n = 233), and 9.1% had a postgraduate degree (n = 44). Among shared e-scooter users, 61.1% were male (n = 127) and 38.9% were female (n = 81), whereas among non-users, 47.1% were male (n = 131) and 52.9% were female (n = 147). The mean age of shared e-scooter users was 28.79 years (SD = 7.83), while the mean age of non-users was 36.29 years (SD = 12.18). The mean factor score was 38.93 for Infrastructure, Accessibility, and Cost Incentives and 18.66 for Safety and Institutional Regulation Incentives.

2.4 Analysis plan

All data were transferred to IBM SPSS Statistics version 25.0, and preliminary checks indicated no missing values or data entry errors. To address the research objectives:

- independent samples t-tests were conducted to assess differences in total factor scores between gender groups (male/female)
- linear regression analysis was conducted to assess the relationship between age and total factor scores
- one-way analysis of variance (ANOVA) was conducted to assess whether total factor scores differed significantly across education levels
- independent samples t-tests were conducted to assess differences in total factor scores based on shared e-scooter usage experience (user vs. non-user).

These analyses enabled the evaluation of whether perceptions of system improvement incentives differed in a statistically significant manner across gender, age, education level, and shared e-scooter usage experience.

3 Findings

3.1 Comparisons based on gender and usage experience

Independent samples t-tests were conducted to compare gender and shared e-scooter usage experience-based factor scores. The analysis revealed that gender had a significant effect only on Factor 2 scores, with females (M = 19.78) scoring significantly higher than males (M =1 7.67, t = 4.448, $p < 0.001$). Regarding usage experience, significant differences were observed across both factors. Users (M = 40.97) reported higher Factor 1 scores compared to non-users (M = 37.41, t = -4.444, $p < 0.001$). Conversely, non-users (M = 19.11) had significantly higher Factor 2 scores than users (M = 18.06, t = 2.160, p = 0.031). The results are summarized in table 2.

Table 2 Results of the t-test according to gender and experience status

Variable	Group	N	Mean	SD	t	p
Factor 1 (gender)	Female Male	228 258	39.21 38.68	8.57 9.19	0.652	0.515
Factor 2 (gender)	Female Male	228 258	19.78 17.67	4.71 5.59	4.448	0.000*
Factor 1 (experience)	Non-user User	278 208	37.41 40.97	9.18 8.09	-4.444	0.000*
Factor 2 (experience)	Non-user User	278 208	19.11 18.06	5.22 5.35	2.160	0.031*

*p ‹ 0.05 level of significance
Factor 1: infrastructure, accessibility and cost Incentives
Factor 2: safety and institutional regulation Incentives

3.2 Differences according to educational level

A one-way analysis of variance (ANOVA) was conducted to determine whether factor scores differed significantly across participants' educational levels. The homogeneity of variance was confirmed via Levene's test (p › 0.05). As shown in table 3, the analysis revealed that neither Factor 1 nor Factor 2 scores showed a statistically significant difference across educational levels (p › 0.05).

Table 3 ANOVA results by educational level

Variable	F	p
Factor 1	0.750	0.523
Factor 2	1.775	0.151

Factor 1: infrastructure, accessibility and cost Incentives
Factor 2: safety and institutional regulation Incentives

3.3 The relationship between age and factor scores

A linear regression analysis was performed to evaluate the predictive effect of age on factor scores. The results indicated a significant negative relationship between age and Factor 1 scores (β = -0.174; t=-3, 876; p ‹ 0.001). The model for Factor 1 was statistically significant (R^2 = .03; F = 15.022; p ‹ 0.001). However, age did not significantly predict Factor 2 scores (p › 0.05). Detailed regression coefficients are presented in table 4.

Table 4 Regression results regarding the effect of the age variable on factor scores

Dependent variable	Independent variable	β (standard)	t	p
Factor 1	Age	-0.174	-3.876	0.000*
Factor 2	Age	-0.077	-1.702	0.089

*p ‹ 0.05 level of significance
Factor 1: infrastructure, accessibility and cost Incentives
Factor 2: safety and institutional regulation Incentives

3.4 Usage intention of non-users

As part of the study, 278 participants who had never used a shared e-scooter system were asked whether they would use the system if the proposed improvements (safety, cost, accessibility, etc.) were implemented. 78.4% of non-users (n = 218) stated that they would be willing to use the system following these improvements.

4 Discussion and conclusion

The findings of this study conducted in İzmir provide strong empirical evidence on how proposed system improvements in shared e-scooter services can encourage user adoption and are largely consistent with both international and national literature. The results highlight differentiated expectations of users and non-users across demographic and user experience-related dimensions. Gender-based analysis shows that female participants scored significantly higher on Factor 2 (safety and institutional regulation incentives). This parallels Sanders et al. (2020) [9], revealing that women place greater importance on traffic safety, legal regulations, and protective equipment use, suggesting safety concerns represent a critical barrier to adoption among female users. Comparisons based on usage experience revealed that active users scored significantly higher on Factor 1 (infrastructure, accessibility and cost incentives), while non-users scored higher on Factor 2 (safety and institutional regulation incentives). These results align with studies showing experienced users prioritise operational elements such as cost and accessibility, while inexperienced individuals focus on safety, regulation, and training related concerns [9-12]. This divergence suggests that perceived risk plays a central role during the initial adoption phase, whereas functional efficiency becomes more salient with increased usage experience. Linear regression analysis revealed a significant negative relationship between age and Factor 1 (infrastructure, accessibility and cost incentives) scores, consistent with studies indicating shared e-scooter users are predominantly young and that importance attributed to infrastructure and cost improvements decreases with age [12, 14, 15]. The absence of a significant difference between groups in the ANOVA analysis based on education level indicates that the proposed system improvements are perceived as a shared and universal requirement by individuals, regardless of their education level. Notably, 78.4% of participants who had never used shared e-scooters stated they would start using the system if proposed improvements were implemented. This demonstrates that if fundamental barriers – such as lack of dedicated infrastructure, high usage fees, insufficient information, and legal uncertainties [5, 7, 8] – are removed, the market in İzmir possesses substantial latent demand and significant growth potential.

Based on findings, shared e-scooter policies should be structured around two complementary strategic axes: ‘user acquisition’ and ‘usage continuity’. To facilitate the inclusion of female users and those with no prior experience, safety-oriented measures, such as regulations governing speed limits and parking, mandatory protective equipment, and comprehensive training, should be prioritised as critical thresholds at system entry. For long-term use by young and existing users, focus should be on expanding dedicated infrastructure and developing cost-effective, flexible pricing or subscription models, particularly in high-usage areas like university campuses. Overall, safety and regulatory assurance are decisive for initial engagement, whereas infrastructure quality and accessibility are fundamental to long-term sustainability.

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