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How does the environmental concerns affect the satisfaction of BRT and metro users? A moderator analysis

Iman Farzin[a], Mohammadhossein Abbasi[a], and Alireza Mahpour[b,*]

a. *Faculty of Civil and Environmental Engineering, Department of Transportation Planning, Tarbiat Modares University, Tehran, 14115-111 Iran.*
b. *Faculty of Civil, Water and Environmental Engineering, Shahid Beheshti University, Tehran, Iran.*

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Abstract. The increase in urban population density, car ownership, and car dependency, especially in developing countries highlights the need for sustainable public transportation development. This paper aims to recognize factors affecting people's satisfaction with public transportation services including, Bus Rapid Transit (BRT) and metro with a focus on the moderating effect of environmental concerns. Satisfaction is modeled using the structural equation modeling approach developed on the preferences of 625 respondents in Tehran, Iran in 2020. The results show direct, and significant, with conflicting impacts of the perceived values and service quality on the satisfaction of metro and BRT users. Further, the results indicate that in contrast with BRT, service quality is more crucial affecting satisfaction than the perceived value in metro. The service quality is also more affected by the core service than the physical environment and the infrastructure in metro. While concerning BRT, these two variables have similar impacts. Environmental concern negatively moderates the relationship between service quality and satisfaction while positively moderates the relationship between the perceived value and satisfaction of both transit systems.

1. Introduction

Transport planners in metropolises employ different policies to solve transport problems, including reducing the use of private cars and promoting the use of public transportation to improve air quality, reduce traffic congestion, and air pollution [1–3]. However, factors such as increasing car ownership and dependence on cars, especially in developing countries, have increased the share of private cars and increased the use of online taxi services (such as Uber) over transit [4]. There is potential for increasing public transportation usage by

*. *Corresponding author.*
E-mail addresses: iman.farzin@modares.ac.ir (I. Farzin); a_mohammadhossein@modares.ac.ir (M. Abbasi); a_mahpour@sbu.ac.ir (A. Mahpour)

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retaining existing users and attracting new potential users [5–7]. Taking into account the number of satisfied passengers who use the transit service and who intend to continue to use it in the near future can be used to measure a transit service's success [8]. It is therefore common practice in the industry to collect customer satisfaction surveys on a regular basis in order to capture your customers' perceptions of Service Quality (SQ) directly [9]. Customer satisfaction is a subjective measure of the quality of service a user experiences and is believed to play a significant role in determining their travel demand [10]. Passengers who are satisfied with the service are more likely to continue using it, and improvements in passenger satisfaction usually led to improved consumer loyalty.

Accordingly, to increase the modal share of transit, we aimed at identifying key factors that contribute to satisfaction with public transportation. Psychological factors play a significant role in influencing behavior, and by understanding the factors that influence behavior, numerous strategies can be adopted to encourage people to use public transportation in place of private cars. Previously, many of the research studies analyzed the factors influencing satisfaction with Bus Rapid Transit (BRT) and metros as a whole. However, since these two travel modes have different features, there might also be different factors affecting satisfaction with them [11]. Thus, the purpose of this study is to examine the latent constructs affecting satisfaction with public transportation, separately for BRT and metro, in Tehran, Iran. Previous studies [5,12–14] indicated that satisfaction is influenced by SQ (core service and physical environment), and Perceived Value (PV) factors. Moreover, we have also taken Environmental Concerns (EC) into account to better explain satisfaction with transit since previous studies indicate that EC may affect individuals' intention to use mass transportation [15]. Researchers have studied the effect of EC on a wide range of subjects in transportation, such as mode choice [16 and 17], loyalty to metro systems [18], using buses [19], congestion pricing acceptance [20–23], and public acceptance of autonomous electric vehicles [24]. The moderating effect of EC on transit satisfaction, however, has not been investigated to the best of our knowledge. A moderator is defined as a qualitative or quantitative variable that influences the direction and/or strength of the relationship between an IV and DV. Thus, by using a moderator variable, it is possible to determine whether there is heterogeneity in the effect of an Independent Variable (IV) on a DV [25]. Therefore, after analyzing the direction and significant effect of each variable, EC will be considered as a moderating variable, and it will be examined whether the relationship between IV (SQ and perceived value) and DV (satisfaction) can be strengthened or weakened.

The aforementioned research gaps motivated the authors to examine how the explanatory variables affect satisfaction with metro and BRT as separate cases. Therefore, this study contributes to the existing body of literature through:

1. Two separate models are developed to determine the predictors of satisfaction in BRT and metro exclusively;
2. EC is used as a moderator variable in order to analyze how it moderates the relationship between each latent variable and satisfaction with both BRT and metro services.

This study is presented in five sections. After the introduction, the next section will discuss the research background, considered variables and their effects on satisfaction. The descriptive analysis of examined variables and the results and interpretation of modeling will be studied in the third and fourth sections, respectively. In the last part, the conclusion is presented, and future research and implications for practice and policy will be suggested.

2. Factors affecting satisfaction with public transport and supported hypotheses

Many researchers have studied the factors affecting the public transportation users' satisfaction. Table 1 shows a selection of researches conducted in this field. In this part, the former studies on satisfaction with public transport will be discussed and the supported hypotheses and conceptual model will be presented. In many studies, perceived value, accessibility, reliability, safety and comfort of the vehicles and stations, costs, and frequency are considered as factors affecting the satisfaction with public transport [5,13,14,26,27]. In the context of urban and metropolitan transit, De Oña [5] examines the mediation effect exerted by satisfaction on behavior intention. A Structural Equation Modeling (SEM) has been used to compare two models that are based on data obtained from a single survey of transit users in five European cities. One model examines satisfaction as a partial mediator, while the other assesses satisfaction as a full mediator. In the context of urban and metropolitan public transportation, the results suggest that the SQ is positively associated with satisfaction and behavioral intention. To investigate how commuter satisfaction is influenced by different characteristics of public transportation journeys, Lunke evaluates commuters' satisfaction with their last trip to work [28]. ANOVA results based on 7630 responses in Oslo, Norway suggest that efficient transport routes with short waiting times and reliable time play a key role compare with short distances to stations and direct routes. A SEM approach has been

Table 1. Selected satisfaction in public transportation studies.

Author(s)	Construct						Location	Sample size	Method
	Service quality	Perceived value	Satisfaction	Behavioral intention/ Loyalty	Involvement	Other			
Fellesson and Friman [31]			✓			✓	Nine European cities	9,542	Factor analysis
Sumaedi et al. [30]		✓	✓			✓	Jakarta	292	SEM
Irtema et al. [12]	✓	✓	✓	✓	✓		Kuala Lumpur	412	SEM
Li [29]			✓			✓	San Francisco	257	SEM
Ingvardson and Nielsen [13]			✓			✓	Six European countries	38,537	SEM
Ha et al. [1]		✓	✓	✓		✓	Kuching	179	SEM
De Oña [14]	✓		✓	✓	✓		Five European cities	2,579	SEM-MIMIC
Lunke [28]			✓			✓	Oslo, Norway	7,630	ANOVA
De Oña [5]	✓		✓	✓			Five European cities	2,579	SEM-MIMIC

suggested by De ona [14] as a means of gaining a deeper understanding of the role of involvement in public transportation, using data from a survey conducted in five European cities. In addition, the study examines the effects of heterogeneity within the four constructs (SQ, satisfaction, involvement, and behavioral intentions) using a SEM approach involving multiple indicators and multiple causes. His findings indicate that involvement is the factor most associated with behavioral intentions or loyalty, followed by SQ and satisfaction. In another study in Malaysa, Ha et al. [1] examined the relationship between satisfaction and loyalty in public transport and five factors including accessibility, reliability, perceived value, comfort, and safety and security. Their study involved the estimation of a Partial Least Squares Structural Equation Model (PLS-SEM) using 179 users of public transportation in Kuching city. It was found that safety and security, as well as reliability, significantly influenced the satisfaction and loyalty of public transportation users. The relationship between accessibility, satisfaction, and loyalty, however, was not statistically significant. The study by Ingvardson and Nielsen [13] investigates the key factors associated with satisfaction with public transportation, and their relationship to the frequency of travel and the likelihood of recommending public transportation to others. In order to validate the framework, a comprehensive passenger satisfaction survey was conducted in six European cities, and SEM was utilized to develop a model that is applicable across a variety of travel cultures. They found that travel satisfaction is positively associated to (i) accessibility measures, including network coverage, speed, and frequency of services, (ii) perceived costs, such as reasonably priced tickets, and (iii) norms, such as perceptions regarding public transportation's importance to society and the environment. Li [29] explored how transit customer loyalty is influenced by satisfaction with transit services. Using explanatory factor analysis, he found the underlying latent contructs. He found that low levels of satisfaction with service reliability were associated with a decrease in transit use in San Francisco as a result of analyzing survey data collected across multiple points. As a result of the survey, four latent variables can be identified that summarize the set of satisfaction variables - satisfaction with reliability, travel environment, comfort, and schedule. In the study of Irtema et al. [12], public transport passengers in Kuala Lumpur have been examined in terms of their behavioral intentions. A number of other underlying factors have also been investigated, including quality of service, PV, involvement, and satisfaction of passengers. Results from SEM estimation suggest that SQ, PV, involvement, and satisfaction have positive effects on the behavioural intentions of public transportation users. In the study of Sumaedi et al. [30], PV, image, perceived ease of use, and perceived usefulness were all considered simultaneously when determining

passenger satisfaction. A SEM model has been estimated based on 292 responses. Their findings show that PV, perceived usefulness, and image all have a significant impact on public transportation passengers' satisfaction, whereas perceived ease of use does not.

This research considered latent variables of satisfaction, SQ, PV, and EC. According to the previous studies, PV affects satisfaction, and SQ affects satisfaction and PV [12]. In the following subsection, we discussed the supported hypothese more deeply.

2.1. Service Quality (SQ)

There is no clear and exact definition of SQ, and researchers have defined these variables from various perspectives. For instance, Grönroos [32] has defined SQ as the comparison between customer expectations and perceptions of service. It was also defined as the customer's comprehensive assessment of the superiority of the service over similar services with significant advantages [33]. SQ in the current study is divided into two components: core service (general information facilities, service hours, fare, regulation, handling complaints, ticket sales network, and staff behavior) and physical environment (including restrooms, vehicle hygiene, vehicle safety, safety in stations and terminals, sustainability of the vehicle, and information on display screens) [34]. A number of studies have found that higher SQ is associated with greater customer satisfaction [5,12,14,28,35]. Therefore following hypotheses are formulated:

H_1: SQ is positively related to BRT users' satisfaction;

H_2: SQ is positively related to metro users' satisfaction.

2.2. Perceived Value (PV)

The PV of services is used as a criterion for comparing their quality from two different points of view. According to one viewpoint, higher prices are associated with better quality. On the other hand, high quality is perceived as being more expensive [36]. Generally, PV refers to a customer's perception of a product's merit or desirability, compared to a competitor's product [33]. In more specific terms, PV arises from the trade-off between perceived benefit and cost. Former studies suggest PV may be a better predictor of repurchase than satisfaction or quality [30]. Moreover, previous studies show that SQ affects PV positively [8,37]. Therefore the following hypotheses are formulated:

H_3: PV is positively related to BRT users' satisfaction;

H_4: PV is positively related to metro users' satisfaction;

H_5: SQ is positively related to PV in BRT;

H_6: SQ is positively related to PV in Metro.

2.3. Environmental Concerns (EC)

EC are defined in a wide range of ways, and there is no single definition that encompasses them all [38]. A definition of EC could be "An individual's belief that humans endanger the natural environment simultaneously with the intention to preserve it" [39]. As transportation has a profound effect on emissions, it is expected that EC would moderate the relationship between three latent constructs including PV, SQ, and satisfaction. Therefore, the following hypotheses are formulated:

H_7: EC moderate the SQ and satisfaction relationship in metro;

H_8: EC moderate the PV and satisfaction relationship in metro;

H_9: EC moderate the PV and SQ relationship in metro;

H_{10}: EC moderate the SQ and satisfaction relationship in BRT;

H_{11}: EC moderate the PV and satisfaction relationship in BRT;

H_{12}: EC moderate the PV and SQ relationship in BRT.

2.4. Satisfaction

Satisfaction (SAT) refers to the difference between expectations before use and the perceived efficiency after use of the product [40–42]. Literature typically conceptualizes satisfaction in terms of two methodological approaches: transactional satisfaction (individual) and cumulative satisfaction (the use of customers' experiences over time. According to the definition of customer satisfaction used in the field of public transportation, it refers to the level of satisfaction in meeting the passengers' expectations [43] Several studies have shown that negative experiences using public transportation have a considerable effect on customers' feelings [31].

Upon reviewing the aforementioned studies, it can be concluded that many of them did not make a distinction between different forms of public transportation. With respect to the differences between BRT and metro, we have developed two separate models to identify the factors that contribute to customer satisfaction with BRT and metro. Consequently, a survey has been developed in which transit users will be asked to answer both questions pertaining to BRT and metro. Moreover, there have been studies in the past that examined how variables such as involvement [44], loyalty [45], attitudes [45], and nationality [46] can serve as moderators in the relationship between satisfaction and IV. However, there is still no study that has been conducted to examine the moderating effect of EC on satisfaction. In light of the aforementioned hypothesis

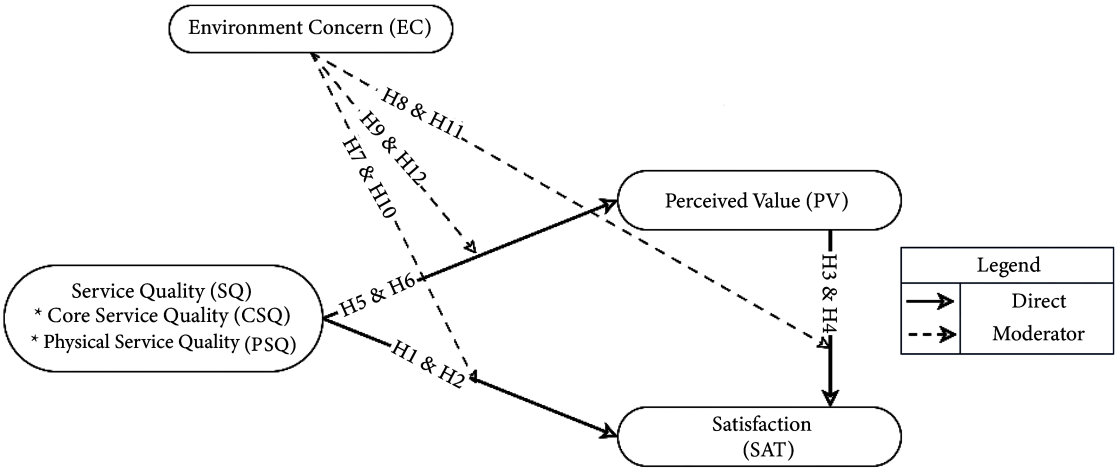

Figure 1. Research's conceptual model and hypotheses.

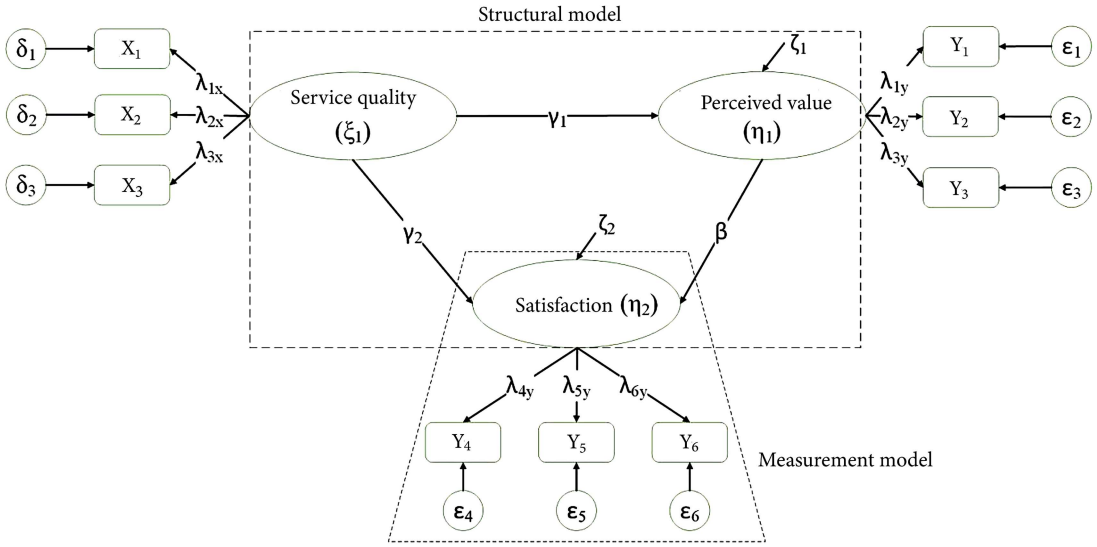

Figure 2. Illustration of the structure of the research SEM conceptual model.

and research objective, the research's conceptual model is illustrated in Figure 1.

3. Methodology

3.1. Structural Equation Modelling (SEM)

A SEM is a set of statistical techniques for examining the relationships between one or more IV, either continuous or discrete, and one or more DV, either continuous or discrete [47]. It is possible to use IVs or DVs as factors or as measured variables. An SEM consists of two submodels, a structural model and a measurement model. The measurement model defines the relationship between the measured variables (X_i or Y_i) and the latent constructs. An analysis of hypothesized relationships among latent constructs is tested in a structural model. The conceptual model containing the symbols in model is presented in Figure 2. As it can be seen, the exogenous and endogenous latent constructs are shown by ζ and η, respectively. The error term in the structural model is shown by ζ. However, in the measurement model, the error terms in measuring the endogenous and exogenous latent constructs are shown by ε and δ. In addition, in a structural model, the factor loadings are shown by γ (relationship between an exogenous variable and an endogenous variable) and β (relationship between endogenous variables). However, in the measurement model, the factor loadings are shown by λs. Eqs. (1) to (3) are used for illustrating the relationship between used variables in an SEM model:

$$\eta = \mathrm{B}\eta + \Gamma\xi + \zeta, \tag{1}$$

$$X = \Lambda_x\xi + \delta, \tag{2}$$

$$Y = \Lambda_y\eta + \varepsilon. \tag{3}$$

3.2. Case study

As the largest metropolis in the Middle East, Tehran is faced with serious public transport problems. There are many factors that contribute to the high usage of private cars in Tehran such as inefficient and unreliable transit services, long waiting and travel times, various incentives for using private cars such as free parking and low fuel costs [4].

A low share (26%) of urban trips in Tehran are undertaken by bus (both BRTs and regular buses) and metro, while taxis and private cars account for a significant portion (66%). There are 121 stations in the Tehran metro system, which is 228 kilometers long, and there are 728 million trips made by the metro system in a year. The BRT lines in Tehran cover 183.6 kilometers, and there are 347 stations. The number of trips made by BRT is 560 million per year. Hence, the significant use of BRT and metro necessitates an analysis of the factors affecting people's satisfaction. Figure 3 illustrates the urban transit system in Tehran and its coverage.

3.3. Questionnaire

In order to meet our research objectives, only travelers who utilize BRT and metro were surveyed. In order to identify the factors affecting the satisfaction of people with public transportation (including BRT and metro), a face-to-face survey was developed and distributed from January until March 2020. The questionnaire includes three sections. There is a brief explanation of the purpose of the questionnaire in the first section. In the second section, attitudinal questions were asked pertaining to satisfaction, PV, EC, and SQ. It is of note that respondents answered questions both related to BRT and metro simultaneously. In other words, each respondent answered each question twice, once for the subway and once for the BRT. On a five-point Likert scale (ranging from strongly disagree: 1 to strongly agree: 5) respondents were asked to provide responses to each question separately for both BRT and metro. In the last part of the survey, people were asked about their socioeconomic status including gender, marital status, age, education, driver's license, monthly income (individual), household car ownership, and household size. After omitting the invalid responses, 625 complete questionnaires were used for the further analysis. Results of the statistical analysis (Table 2) demonstrate that men, married respondents, 25 to 44 years old, bachelor education level, an income between 10 and 30 million Iranian Rials (IRR) (40-120 USD), households without a private car, 4-member households, and respondents possessing a driving license have the highest frequency among other groups.

4. Results and discussion

In our study, we used SEM to test the proposed hypotheses. It consists of two main parts, the measurement model and the structural model. The relationship between the latent variables and their indicators is

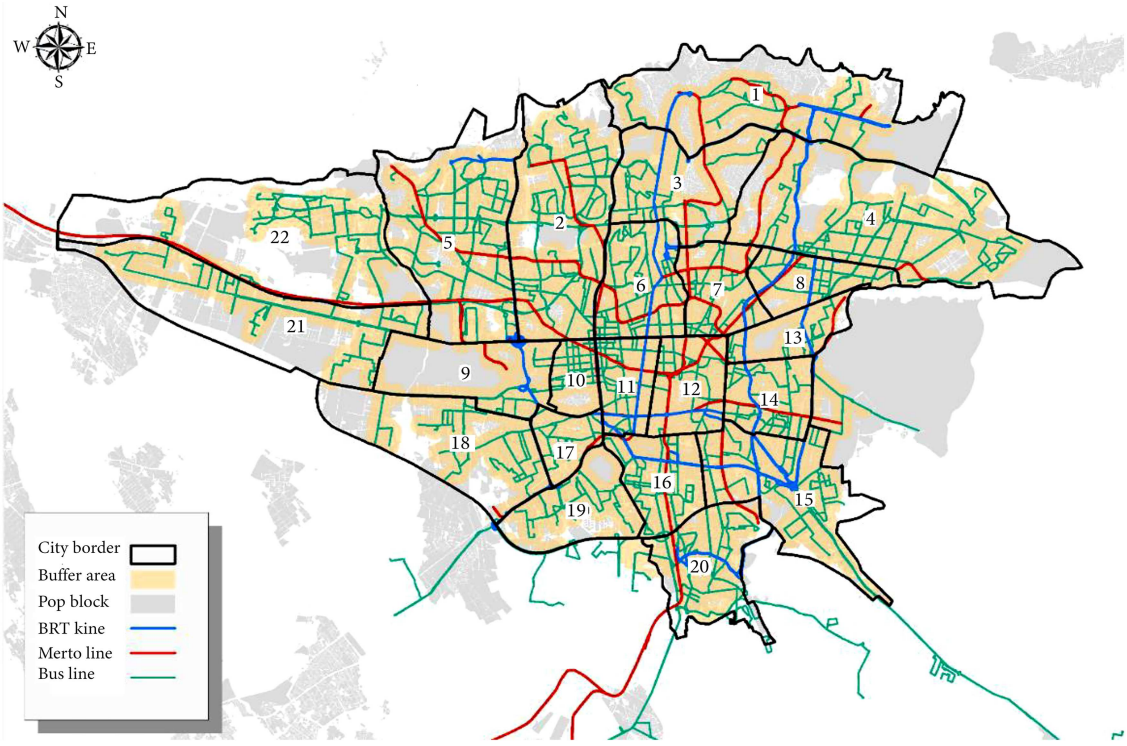

Figure 3. Tehran's urban transit network.

Table 2. Statistical analysis of socioeconomic characteristics of respondents.

Variables	Values	Count	Frequency (%)
Gender	Female	301	48.2
	Male	324	51.8
Marital status	Married	340	54.4
	Single	285	45.6
Age	< 18	59	9.5
	$18 - 24$	157	25.1
	$25 - 44$	286	45.8
	$45 - 64$	101	16.2
	65+	22	3.4
Education	Under high school diploma	163	26.1
	High school diploma	173	27.6
	Associate degree and bachelor	209	33.4
	Masters and PhD	80	12.9
Driving license status	Owning a driving license	399	63.8
	Not owning a driving license	226	36.2
Monthly income	$<$ 10 Million IRR*	182	29.2
	10 q $-<$ 30 Million IRR	204	32.6
	30 q $-<$ 60 Million IRR	143	23.0
	60 q $-<$ 90 Million IRR	68	10.9
	$\geq$ 90 Million IRR	28	4.3
Household car ownership	0	413	66.1
	1	134	21.4
	2+	78	12.5
Household size	1	10	1.6
	2	109	17.6
	3	170	27.2
	4	197	31.5
	5+	139	22.1

* 1 USD equivalent to 130,000 IRR at the date of survey.

examined by the measurement model while the simultaneous relationship between constructs and hypotheses is examined by structural model analysis.

Using AMOS 26 and the Maximum Likelihood Estimation (MLE) approach, the best fit model was calibrated after excluding items that were insignificant or had a standard regression coefficient below the acceptable range (lower than 0.5). Because of the use of MLE, it is important to note that the normality assumption was checked by using the D'agostino-Pearson test [48], and the values of Skewness and Kurtosis (ranging from -2 to 2) indicate that the data are normally distributed.

4.1. Measurement model analysis

Two measurement models are proposed as a means to examine the relationships between indicators and constructs of BRT and metro. Different criteria are examined for each part of the model in order to evaluate the model goodness of fit. Tables 3 and 4 present the standardized regression coefficients and their significant level, Average Variance Expected (AVE), Cronbach's alpha and Construct Reliability (CR). Cronbach's alpha is used to assess the internal consistency of the questionnaire, and in the measurement model, reliability is evaluated by CR. Accordingly, the threshold for both of these indicators should be greater than 0.7 and 0.6, respectively [49]. The evaluation criteria for both indexes are satisfied in both Tables 3 and 4. To determine whether a reflective construct is convergently valid, the indicator loadings and AVE must be evaluated. The majority of the factor loadings of BRT and metro are higher than 0.6, respectively, which is higher than the acceptable threshold of 0.5 proposed by Hair et al. [49]. All values in the AVE analysis exceed the necessary threshold of

Table 3. Estimation results of metro measurement model.

Constructs	Items	λ	*P*-value	AVE	Cronbach's alpha	CR
PV	The fare is reasonable	0.897	–	0.529	0.834	0.868
	Service quality received reasonable	0.764	***			
	It is cheap	0.647	***			
	I feel that this vehicle meets my needs with high quality and low price	0.594	***			
	I feel that this vehicle meets my needs at a reasonable price	0.796	***			
	This vehicle is a comfortable means of transportation for me.	0.617	***			
CSQ	Service regularity	0.780	***	0.525	0.714	0.767
	Deals with complaint	0.758	***			
	Staffs behavior	0.627	–			
PSQ	Vehicle hygiene	0.670	–	0.570	0.830	0.839
	Vehicle security	0.859	***			
	Security at terminals and stops	0.828	***			
	Vehicle stability	0.639	***			
SQ	CSQ	0.996	–	0.805	0.859	0.891
	PSQ	0.786	***			
SAT	Feeling cosines while waiting at station stops	0.680	–	0.536	0.748	0.761
	The staff performs very well according to my expectations.	0.664	***			
	In this vehicle, it tries to satisfy the passengers.	0.759	***			

0.5, indicating that the construct describes more than half of the variance of its indicators.

4.2. Goodness of fit indices

In order to analyze the structural model, various criteria are presented in three categories: absolute (such as GFI), comparative (such as CFI and TLI), and parsimonious (such as PNFI). Jaccard et al. [50] assert that if any of the three groups of indicators (absolute, comparative, and parsimonious) are within acceptable thresholds, the model's goodness of fit is satisfactory [50]. The derived values indicate that the data are fitted to the model properly (Table 5).

4.3. Discriminant validity

Table 6 presents the overall discriminant validity of proposed model of BRT and metro. The absolute inter-correlation of the structures in the overall proposed model ranges from 0.551 to 0.837 in metro and from 0.748 to 0.801 in BRT, which is less than the suggested threshold value of 0.85 [49]. Moreover, correlations are lower than the square root of AVE, indicating that these factors have strong discriminant validity.

4.4. Structural models

After examining the validity of measurement models, two structural models (Figures 4 and 5) proposed for BRT and metro to explore the relationship between the IV and the DV. People's satisfaction with both the metro and BRT are influenced by the two significant variables of PV and SQ. It has been determined that the SQ of metro affects satisfaction more than the SQ of BRT (Figures 4 and 5). In light of this, improving metro facilities can result in a much higher level of satisfaction for users. However, this is not true for BRT, where the effect of PV on satisfaction is more influential than SQ. Consequently, improving the factors that increase the PV of BRT (such as a reasonable ticket price) can result in higher customer satisfaction. Because of the large capacity of the metro,

Table 4. Estimation results of BRT measurement model.

Constructs	Items	λ	*P*-value	AVE	Cronbach's alpha	CR
PV	Service quality received reasonable	0.758	–	0.515	0.830	0.809
	I feel that this vehicle meets my needs with high quality and low price	0.734	***			
	I feel that this vehicle meets my needs at a reasonable price	0.668	***			
	This vehicle is a comfortable means of transportation for me	0.707	***			
CSQ	General information facility	0.832	***	0.585	0.716	0.807
	Deals with Complaint	0.790	***			
	Staffs behavior	0.662	–			
PSQ	Vehicle hygiene	0.782	***	0.563	0.884	0.866
	Vehicle security	0.764	***			
	Security at terminals and stops	0.725	***			
	Vehicle stability	0.718	***			
	On board information facility	0.761	–			
SQ	CSQ	0.934	–	0.882	0.891	0.937
	PSQ	0.944	***			
SAT	I can usually sit on a seat in this vehicle on my trips	0.653	–	0.554	0.852	0.861
	Feeling cosines while waiting at station stops	0.765	***			
	Overall, I find satisfaction with this vehicle	0.787	***			
	The staff performs very well according to my expectations	0.711	***			
	In this vehicle, it tries to satisfy the passengers	0.796	***			

Table 5. Structural model's evaluation criteria in proposed models.

Indices	Acceptable range [44]	The value obtained in this study for BRT	The value obtained in this study for metro
GFI	> 0.80	0.891	0.901
TLI	> 0.85	0.919	0.897
CFI	> 0.85	0.938	0.919
PNFI	> 0.50	0.696	0.686
RMSEA	< 0.08	0.076	0.078

Table 6. Discriminant validity of overall models by BRT and metro.

	Metro			BRT		
	SQ	**PV**	**SAT**	**SQ**	**PV**	**SAT**
Service Quality (SQ)	**0.897**			**0.939**		
Perceived Value (PV)	0.551	**0.727**		0.793	**0.718**	
Satisfaction (SAT)	0.837	0.63	**0.732**	0.748	0.801	**0.744**

people care more about SQ than BRT. Therefore, since most people travel by metro more than by BRT for their mandatory trips (e.g., school or work), they value quality more than price [51].

Furthermore, we observe that SQ influences PV in both travel modes in a direct, significant, but different manner (Figures 4 and 5). Compared with metro, results show that SQ has a more substantial effect on PV for BRT. In addition, two latent variables are responsible for explaining SQ in both modes. They are the core service and the physical environment. Comparison of coefficients shows that in the metro, SQ is more affected by core service (rather than physical environment), whereas, for BRT, two variables of core service and physical environment produce similar effects. Considering variables such as vehicle regulation, service hours as well as information facilities which play an important role in the reliability of the vehicle and also the great number of mandatory trips with metro, it is inferred that vehicle reliability and comfort in the metro are important factors in satisfying metro users.

Among satisfaction indicators, the indicator "in this vehicle, it is tried to satisfy people" has the greatest standardized regression coefficient both in metro and BRT (Tables 3 and 4). This shows that in contrast with other factors, bringing customers' satisfaction is a stronger indicator of their satisfaction. To satisfy users, a customer-oriented approach is recommended to meet customers' needs and to resolve defects, shortcomings, and difficulties in providing services. Among the indicators of PV, "affordable ticket price" in metro and "proper SQ" in BRT have the highest standardized regression coefficients. Hence, keeping both the ticket price and SQ moderate for the metro and BRT will have a more noticeable impact on PV. The comparison of the standardized regression coefficients (Tables 3 and 4) related to the core service show that the most influential item for metro is "Service regularity" and for BRT is "overall information facilities". Therefore, it is suggested that the following solutions are necessary for satisfying the passengers: developing intelligent systems that shows the timetable of metro and increase the reliability in travel time and waiting time in metro, and for BRTs, improving information facilities such as schedules, routes, stations, waiting time, arrival time, and the system for announcing the names of stations. Among the indicators of physical environment, "vehicle security" in metro and "hygiene" in BRT have the

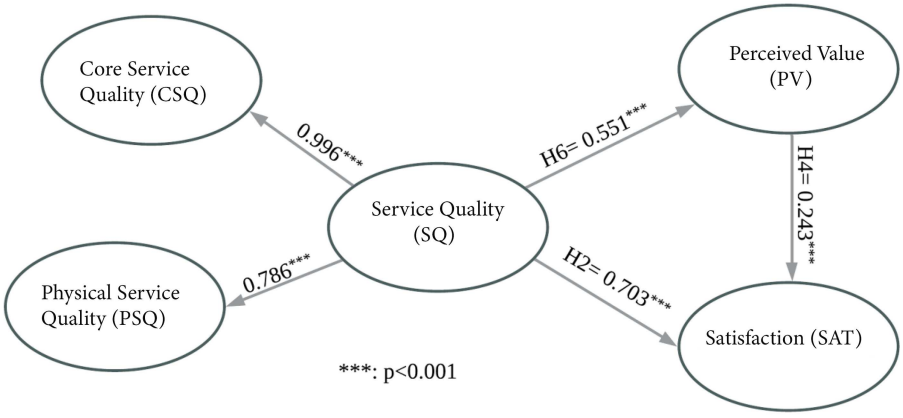

Figure 4. Proposed model with standard regression coefficients for metro.

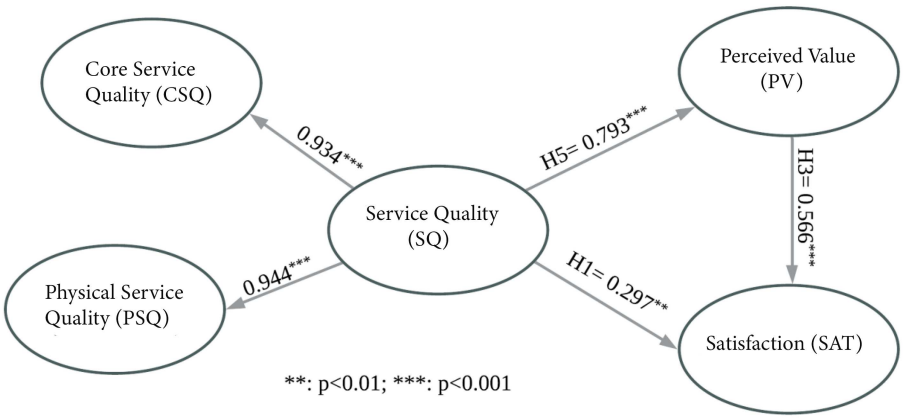

Figure 5. Proposed model with standard regression coefficients for BRT.

greatest regression coefficients. This is due to the fact that travelers are often exposed to dangers such as harassment, theft, and crime. As a result, by setting up police and security units at stations and installing advanced cameras in trains and stations, the metro will be more secure and people will be more satisfied.

4.5. EC as moderator

In Figure 6, EC are shown as a moderator of the relationships between IV and DV variables. On the basis of the estimation results, it can be concluded that taking this variable into account moderates the relationship between SQ and PV with satisfaction in both metro and BRT. According to the comparison of regression coefficients, EC is a significant moderator of the relationship between PV and satisfaction for both metro and BRT systems. This value is much higher in BRT (Regression coefficient=0.166) than in metro (Regression coefficient=0.100). Both for metro and BRT, the relationship between PV and satisfaction for people with great EC is greater than its relationship for people with less EC. By improving the PV of BRT and metro, people with higher EC are more satisfied than those with lower EC. As a result, it is easier to satisfy those with more EC due to the PV of both the metro and BRT options.

Moreover, EC may play a negative role in moderating the relationship between SQ and satisfaction in both modes. Thus, the positive effect of SQ on customer satisfaction is likely to be reduced significantly as the level of EC increases. This reduction is greater in BRT (Regression coefficient=−0.165) than in metro (Regression coefficient=−0.061). Due to the use of clean fuels, such as electricity, metros produce significantly less pollution than BRTs. Therefore, the relationship between SQ and satisfaction for metro users is less weakened than for BRT users. Moreover, the moderating effect of EC on SQ and PV is only significant for BRT.

In Table 7, the path coefficients and results of hypothesis testing are summarized. It was determined that 11 of the 12 hypotheses (H_{11}-H_{12}) were supported.

5. Conclusion

This paper aimed to determine the factors affecting individuals' satisfaction with public transportation services including Bus Rapid Transit (BRT) and metro with a focus on the moderating effect of EC using Structural Equation Modeling (SEM).

5.1. Findings and inferences

Estimation results of SEM of indicate that people's satisfaction with metro and BRT is significantly, positively, but differently influenced by two factors of PV and SQ. Using standard regression coefficients, it has been determined that, in the metro, service quality has a higher impact on satisfaction than perceived value. In contrast, for BRT, PV has a greater impact on satisfaction. In addition, metro completes a great deal of mandatory trips, which is due to its on-time schedule. In addition, the consideration of EC indicates that it is a negative moderator of the relationship between SQ and satisfaction. Since clean fuels like electricity are used in the metro, it produces less pollution than BRT. Therefore, the relationship between SQ and satisfaction

Table 7. Results of the constructs' hypothesized causal impact.

Hypotheses	λ	Supported?
H_1: SQ → SAT (BRT)	0.293^{**}	Yes
H_2: SQ → SAT (Metro)	0.703^{***}	Yes
H_3: PV → SAT (BRT)	0.566^{***}	Yes
H_4: PV → SAT (Metro)	0.243^{**}	Yes
H_5: SQ → PV (BRT)	0.793^{***}	Yes
H_6: SQ → PV (Metro)	0.551^{***}	Yes
H_7: EC MODERATE (SQ → SAT (Metro))	-0.061^{**}	Yes
H_8: EC MODERATE (PV → SAT (Metro)	0.100^{***}	Yes
H_9: EC MODERATE (SQ → PV (Metro)	0.070^{NG}	No
H_{10}: EC MODERATE (SQ → SAT (BRT))	-0.165^{**}	Yes
H_{11}: EC MODERATE (PV → SAT (BRT)	0.166^{***}	Yes
H_{12}: EC MODERATE (SQ → PV (BRT)	0.165^{*}	Yes

SQ: Service Quality; SAT: Satisfaction; PV: Perceived Value; EC: Environmental Concerns. $^{*}: p < 0.05$; $^{**}: p < 0.01$; $^{***}: p < 0.001$; NG: Not Significant.

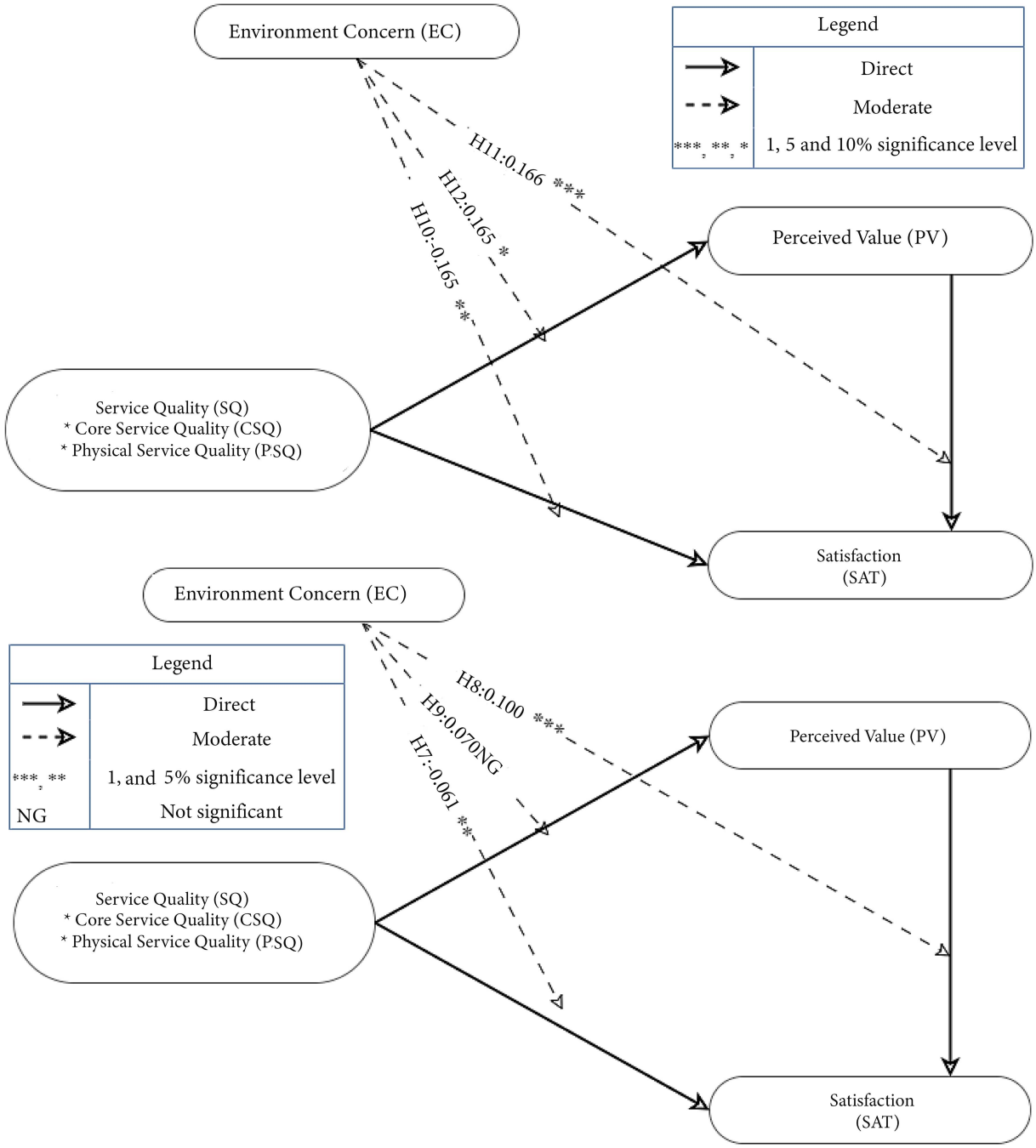

Figure 6. Examining the environmental concerns as a moderator in factors affecting the satisfaction with BRT (Top) and metro (Below).

for metro users is less weakened than for BRT users. Environmental concern is also a positive moderator of the relationship between PV and satisfaction in both metro and BRT (for BRT, the relationship is stronger). It means that by improving the PV of BRT and metro, people with EC are more satisfied than people with lower EC.

5.2. Implications for practice and policy

According to the findings, a series of policy implications are suggested to enhance the satisfaction of BRT and metro users:

1. More attention should be paid to SQ-related factors in metro such as security inside the vehicle and at stations, service regularity, and dealing with complaints. The authorities can use CCTVs and police to make metros and stations more secure. Additionally, developing a website or application for dealing with users' complaints can play a vital role

in improving the satisfaction of metro users;

2. Additionally, in order to increase the satisfaction of BRT users, factors related to SQ, such as general information facilities, complaint handling and vehicle hygiene, should be given priority. In this regard, the government could develop a website or application for dealing with users' complaints, regular cleaning of buses, as well as increasing information facilities for users, such as development of a smartphone application and using smart electronic bus stops to inform the arrival time of buses;
3. Local authorities can also use environmentally friendly measures in both metro and BRT, such as using clean fuels [52], removing paper tickets and promoting digital ticket usage, using exhaust filters, and installing trash cans at stations to increase user satisfaction, especially individuals with higher EC.

5.3. Limitations and recommendations for further studies

Considering the psychological nature of satisfaction, this study only examines attitudinal (latent) variables, while socioeconomic and travel-related factors have been ignored. The moderating effect of these variables could therefore be explored as part of future research. It is true that the research period spanned most trips with different purposes, but another limitation of this research was the analysis of satisfaction in a specific time frame.

We recommend that future studies analyze the satisfaction of people during different periods, such as different seasons or the period of COVID-19. Finally, in future studies, the conceptual model of this study can be developed by considering the effect of satisfaction on the intention to use, the recommendation to friends, and loyalty.

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Biographies

Iman Farzin graduated from Isfahan University of Technology in civil engineering, and earned an MSc degree in Transportation Planning from Tarbiat Modares University. He received his PhD degree in transportation planning from Tarbiat Modares University, Tehran, Iran in 2021. His research interests are discrete choice modeling, behavioral models in transportation, supply chain, and travel demand management.

Mohammadhossein Abbasi received his BSc degree in Civil Engineering in 2016 from Ilam University, Ilam, Iran. He also earned his MSc degree in Transportation Planning in 2018 from K.N. Toosi University of Technology, Tehran, Iran. During his MSc, he worked on the impact of battery electric buses on the environment, traffic, and economic aspects in Tehran, Iran. He is currently a PhD candidate at Tarbiat Modares University, Tehran, Iran. His research focuses on the acceptability of shared autonomous vehicles in Tehran, Iran. His research interests include traffic simulation, behavioral models in transportation, active mobility, and traffic safety.

Alireza Mahpour received his BSc degree in Civil Engineering from the Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran in 2009 and then, obtained MSc and PhD degrees in transportation planning from Tarbiat Modares University, Tehran, Iran in 2011 and 2017, respectively. In 2019, he joined the department of civil water and environmental engineering, Shahid Beheshti University as an Assistant Professor. His current research interests include Transportation Demand Management (TDM), Transportation System Analysis and Transportation Psychology.