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Exploring Subjective Attitudes Towards Public Transport of Intercity Travel and Their Relationships

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Abstract

With the continuous development of urban agglomerations, higher demands are placed on intercity public transport travel services. To improve these services, it is necessary to comprehensively understand the views and evaluations of travelers. Taking the Guanzhong Plain urban agglomeration in China as the object, this study explores subjective attitude indicators from self-administrated survey data and examines the relationship among perceived accessibility, preference, and satisfaction for intercity public transport using a structural equation model. The results show that perceived service quality has a direct positive impact on perceived accessibility and satisfaction. Perceived accessibility and preference significantly affect satisfaction. In addition, perceived accessibility mediates the effect of service quality on satisfaction. This study provides valuable insights from a policy perspective to improve the subjective evaluation of intercity public transport travelers while emphasizing the importance of subjective variables in transport system evaluation and advocates for their subdivision to more comprehensively improve travel experience.

Keywords: intercity public transport, perceived accessibility, satisfaction, structural equation model

1. Introduction

The development of China's urban agglomerations has brought closer intercity communications and further promoted regional economic development (Ning, 2011). In recent years, with the continuous construction and upgrading of transportation infrastructure such as highways, high-speed railways, and subways, public transport has played an important role in intercity travel (Allard & Moura, 2018). It has the advantages of large carrying capacity and low travel costs, which can meet the general travel demands of the public; at the same time, the public transport system helps to reduce transportation emissions and energy consumption, and promote regional sustainable development (Hadiuzzaman et al., 2019). However, compared to private cars, public transport also has some limitations, such as fixed routes and schedules, which lack flexibility and freedom. The demand for transfer is also a challenge faced by intercity public transport. In addition, public transport often lacks the ability to provide personalized services. With the development of informatization and artificial intelligence, intercity travel behavior and demand will also change (Varghese & Jana, 2018). Therefore, it is necessary to further explore how to improve the level of intercity public transport services and meet the higher travel needs of more travelers.

With the introduction of the concept of humanistic planning, personal subjective feelings have been recognized as a key factor in transportation planning and management (Tassierro & Tillotson, 2020). Attitude plays an important role in travel decision-making and therefore has a significant impact on travel behavior (Lättman et al., 2019). Recent research shows that attitudes have a greater impact on travel decisions than other variables such as socio-demographic or built environment factors (Bhagat Conway et al., 2024). The subjective perception and evaluation of the transportation system by travelers are also the basis for measuring and further improving transportation services. Understanding subjective attitudes can help to increase market share and save costs for public transport services (Tao et al., 2017).

Many scholars have studied the impact of subjective attitudes on intercity travel. Harvey et al. (2014) considered service level assessment and views on the usefulness of travel time when evaluating the attitudes of British travelers towards long-distance high-speed rail travel. Allard and Moura (2018) used passengers' perceived travel difficulties as an attitude variable when studying intercity mode selection. In addition, some studies focus on individual preferences for intercity travel, including mode of transportation choices and information technology

utilization (Hess et al., 2018). The cognitive dissonance between travel mode choices and preferences can affect travel satisfaction while enhancing positive awareness of public transport can positively influence people's tendency to use this mode (Negm et al., 2024). It can be seen that subjective attitudes can be evaluated and measured from different perspectives. Further exploration should be conducted on the segmentation of subjective evaluation, which is of great significance for improving intercity public transport services.

Thus, this study aims to explore urban agglomeration travelers' subjective evaluations of different dimensions of intercity public transport and their interrelationships. This study can provide a deeper understanding of the extent to which and how different attitudinal indicators influence the travel experience of intercity public transport travelers. Through this study, policymakers and urban planners can make informed decisions and provide more suitable intercity public transport services in the new development environment. Valuing and utilizing travelers' evaluations will help to promote the sustainable development of intercity transportation systems. The following parts of this paper are structured as follows: Section 2 provides a literature review; Section 3 shows the details for data collection and attitude variable extraction; Section 4 proposes the conceptual model and research hypotheses in this study; Section 5 demonstrates model results and discussed the possible policy implication; finally, Section 6 summarizes the research results and proposes suggestions for future research directions.

2. Literature Review

When evaluating intercity travel, researchers can utilize subjective indicators covering a variety of factors such as satisfaction, perceived value, loyalty, traveler expectations, and behavioral intentions, etc. Travel satisfaction is the most important subjective attitude variable widely used in previous research. Travel satisfaction refers to travelers' emotional experience during the trip and their cognitive evaluation of the entire trip or each stage after the trip (De Vos et al., 2022). This indicator is often used directly in modeling to predict travel mode choice (De Vos et al., 2016) and in improvements for transport service. Perceived accessibility refers to individuals' perceptions of the degree of difficulty associated with travel (Lättman et al., 2016b); and is defined as their perception of the potential for spatially distributed participation (Curl, 2018). Research on perceived accessibility has important implications for transportation planning, social exclusion, and promoting transportation equity. Traveler preference refers to an individual's tendency or preference in choosing travel mode, travel route, time, etc., to understand people's preferences under different travel needs (Guan et al., 2023).

In addition, researchers have also begun to study the impact and role of various attitudes, especially the impact on satisfaction. It is generally believed that the service quality of public transport has an important impact on satisfaction. The study found that travelers' perception of travel time is a strong predictor of satisfaction with public transport. The comfort and cost of public transport have a significant impact on travel satisfaction (Mouwen, 2015). For some passengers, safety can also significantly affect travel satisfaction. For example, the safety of public transport stations is an important determinant of female passenger satisfaction (Susilo & Cats, 2014). Travel preferences also play a role in travel satisfaction (Guan et al., 2023). Furthermore, past travel experiences have varying degrees of impact on perceived accessibility (Masoumi, 2019). Some scholars have found that population groups in different regions have differences in the impact of perceived quality of public transport services on perceived accessibility (De Oña et al., 2020).

The primary models commonly employed for examining the relationship between subjective variables include regression analysis and structural equation modeling(SEM). Ettema et al. (2012) used regression analysis to establish that travelers' emotions and preferences for public transport significantly influence their travel satisfaction. Lättman et al. (2019) utilized a structural equation model to confirm the positive effect of perceived accessibility on both travel satisfaction and overall life satisfaction, with age acting as a moderating factor. De Oña (2020) developed uses a multiple indicators and multiple causes structural equation model to analyze the impact of satisfaction and perceived service quality on travelers' intention to use public transport. Compared to multiple regression models, SEM can model unobserved latent variables and estimate the relationships between multiple latent variables, including direct and indirect effects. In addition, Yang et al. (2022) established a Bayesian network to analyze the influencing factors of travel satisfaction; Zhang et al. (2022) combined a gradient boosting decision tree to identify the nonlinear impact of service quality on satisfaction.

It can be seen from existing research that there are various variables of travelers' attitudes, and the relationships between them are of great significance. Although there have been many studies on subjective attitudes toward intercity public transport, few studies have systematically integrated multiple subjective variables such as perceived service quality, perceived accessibility, preference, and satisfaction, and discussed their relationships. Therefore, this study aims to comprehensively consider multiple dimensions of subjective attitudes and use a structural equation model to analyze the correlation of subjective factors in intercity public transport travel to

propose main measures to improve intercity public transport services.

3. Data Collection and Extraction

This study involves a subjective evaluation of intercity public transport travel among travelers. Therefore, a self-administrated survey was conducted to collect data for further analysis.

3.1 Survey Design and Administration

The questionnaire was divided into two parts. The first part aims to explore the various attitudes towards intercity travel using public transport and evaluate the service quality provided by each mode. The available intercity public transport modes encompassed high-speed rail (G/D), conventional rail (K/T/Z), and intercity bus. Additionally, the individual socioeconomic characteristics of respondents were collected, including gender, age, income, education level, and car ownership.

Nine questions were asked about subjective attitudes towards intercity travel, each of which was measured on a Likert-style 5-point scale (from very dissatisfied to very satisfied). The designed statements considered travelers' assessments of travel difficulty and potential opportunities for participation in spatial distribution (Lättman et al., 2016a). Overall satisfaction, consistency of public transport services with expectations, and adequacy in meeting needs are also taken into account (De Oña, 2021). Compared with cars, using public transport faces a major challenge of transfer requirements and preferences towards public transport and cars for traveling in the Guanzhong Plain urban agglomeration towards public transport and cars were investigated respectively (De Oña, 2020). The descriptive statements for each item are shown in Table 1.

The survey also asked about the perceived service quality of various intercity public transport modes from five dimensions: travel time, transfer convenience, safety, cost, and comfort (De Oña et al., 2013). A 7-point Likert scale from 1–7 (very bad to very good) was used to measure the level of service. The survey is administrated in the Guanzhong Plain Urban Agglomeration from October to November 2022. Guanzhong Plain Urban Agglomeration includes 11 cities in Shaanxi Province, Gansu Province and, Shanxi Province. The survey aims at travelers who travel between cities in the Guanzhong Plain Urban Agglomeration in the past year. The respondents must be over 18. The survey is mainly conducted by online survey due to the impact of COVID-19. The link of the survey is distributed to intercity travelers by recruiting investigators within the urban agglomeration. A total of 1,852 surveys were collected. After data cleaning procedures, too incomplete samples, or samples with apparently major inconsistencies were removed, a final count of 1,433 valid surveys was obtained, resulting in an effective recovery rate of 77.4%.

Table 1. Statements on travel attitudes

Variable	Item
pbeasy	It is easy to travel between cities in the Guanzhong Plain by public transport.
pbonly	If public transport is my only mode of transportation, I can also easily travel in the Guanzhong Plain urban agglomeration.
pbany	I can go anywhere I want to in the Guanzhong Plain urban agglomeration by public transport.
pbsati	I feel very satisfied with taking public transport in the Guanzhong Plain urban agglomeration.
pbneed	The existing public transport system has very well satisfied my intercity travel demand in the Guanzhong Plain urban agglomeration.
pbideal	Using the public transport system is my ideal way to travel between cities in the Guanzhong Plain urban agglomeration.
pbpre	I like to use public transport to travel between cities in the Guanzhong Plain urban agglomeration.
carpre	I like to use a car to travel between cities in the Guanzhong Plain urban agglomeration.
pbtrans	It is troublesome to transfer when using public transport when traveling between cities in the Guanzhong Plain urban agglomeration.

3.2 Sample Characteristics

Statistical characteristics of the sample were presented in Table 2, it is observed that 53.2% of the respondents are male, with a slightly higher proportion than that of females, indicating a gender ratio similar to that observed in society. The majority of participants fall in the age groups of 26–35 (36.1%) and 36–45 (27.4%), suggesting their active involvement in social activities and frequent intercity travel. Furthermore, there exists minimal disparity between the low-income group (54.6%) and high-income group (45.4%), thereby mitigating any potential impact from income inequality on our analysis outcomes.

Additionally, the distribution of main occupations among respondents appears relatively balanced when compared to societal norms. Moreover, a significant proportion (60.8%) of participants hold a bachelor's degree

qualification or higher educational attainment level as per our findings from this study sample.

Table 2. Sample sociodemographic characteristics

Category	**Group**	No.	Pct.
Gender	Male	762	53.2%
	Female	671	46.8%
Age (years)	18–25	277	19.3%
	26–35	518	36.1%
	36–45	392	27.4%
	46–55	211	14.7%
	56–65	35	2.5%
Income	Less than 100k	782	54.6%
	More than 100k	651	45.4%
Education	Bachelor's degree	871	60.8%
	No Bachelor's degree	562	39.2%
Car ownership	Yes	1059	73.9%
	No	374	26.1%
Driver License	0	345	24.1%
	1	990	69.1%
	≥2	98	6.8%

3.3 Exploratory Factor Analysis

Some latent variables (or latent constructs) cannot be directly observed, so they cannot be measured by a single item (Costello & Osborne, 2005). Nine items are designed about travelers' attitudes towards intercity public transport, and necessary to reduce the dimension of these items. Therefore, exploratory factor analysis was adopted to identify the interrelationships among items and extract multiple key dimensions of subjective attitudes towards intercity travel.

Before the factor analysis, KMO and Bartlett's spherical test were conducted first. The results are shown in Table 3. The measurement results show that the KMO test coefficient is 0.921, greater than 0.5, and Bartlett spherical test P value is 0.000, less than 0.05, indicating that the sample data is very suitable for factor analysis.

Table 3. Result of KMO and Bartlett spherical test

Kaiser-Meyer-Olkin metric		0.921
Bartlett spherical test	Chi-square value	9489.130
	Df	55
	Sig.	0.000

To assess the internal consistency of the index, we employed the maximum variance rotation principal component analysis method based on eigenvalue extraction (eigenvalues >1). The factor loading matrix after orthogonal rotation is presented in Table 4. Through dimensionality reduction, the 9 observed variables were condensed into 3 factors with eigenvalues exceeding 1. The cumulative variance explained accounted for 78.163%, and all observation variables exhibited factor loadings greater than 0.6 for their respective factors. The nine subjective attitude items can be categorized into three latent variables, factor 1 is perceived public transport accessibility, factor 2 is public transport preference, and factor 3 is public transport satisfaction.

The reliability of the three latent variables was examined. As shown in Table 5, the Cronbach's α coefficients for each variable exceeded 0.8, indicating a high level of reliability in the obtained EFA results.

Table 4. Rotated component matrix of factor analysis

Observation Variable	Factor 1	Factor 2	Factor 3
pbeasy	.850		
pbonly	.828		
pbany	.723		
pbtrans		-.904	
carpre		-.896	
pbpre		.790	
pbideal			.772
pbneed			.641
pbsati			.632

Table 5. Result of latent variable reliability analysis

Latent variable	α coefficient
perceived accessibility	0.84
public transport preference	0.88
public transport satisfaction	0.84

4. Research Hypotheses

When examining travelers' perceptions of intercity public transport, the quality of service provided becomes a key factor to consider. The availability of the public transport system greatly facilitates people's daily travel, but the poor quality of service creates barriers that affect the ease of engaging in daily activities (Friman et al., 2020). Travelers' evaluation of overall service quality will positively affect their perceptions of transportation accessibility, with higher service quality meaning easier access to services (Lättman et al., 2016a). In addition, some researchers have found that perceived safety and walking comfort are key factors influencing pedestrians' perceived accessibility to metro stations (Bivina et al., 2019). Therefore, it can be hypothesized that, for intercity travel, the perceived service quality of intercity public transport directly and positively affects the individual's perceived accessibility with intercity travel.

Hypothesis 1: Perceived service quality has a direct positive effect on perceived accessibility (H1).

Numerous studies have examined the impact of intercity public transport service quality on satisfaction. Different attributes of service quality have different effects on satisfaction. Travel time, travel cost, and transfer convenience are considered the most influential attributes (De Oña et al., 2021). The convenience of transferring, comfort, information availability, and perceived safety have also been shown to have a positive impact on public transport satisfaction to varying degrees. (De Oña et al., 2020). Sukhov et al. (2021) have compared travel satisfaction data before and after the improvement of service quality and confirmed that improvements in public transport system service quality have a significant impact on satisfaction. Existing research has shown that service quality is a necessary factor to consider the impact of satisfaction. Hence, in this study, we hypothesize that satisfaction with using public transport for intercity travel is positively related to perceived service quality.

Hypothesis 2: Perceived service quality has a direct positive effect on satisfaction (H2).

Individual differences can lead to different perceptions of the same transport facilities or environments (Pot et al., 2021), and discussing the impact of perceived accessibility based on travelers' subjective evaluations may be more specific. Researchers found that perceived accessibility is related to transportation satisfaction and life satisfaction (Lättman et al., 2019). A comparative study explored the impact of objective accessibility and perceived accessibility on residents' living satisfaction influence, indicating that the higher the perceived accessibility of the bus station, the higher the residents' satisfaction, while the objective accessibility does not directly affect their satisfaction (Olfindo, 2021). Therefore, it is hypothesized that there is a positive relationship between perceived accessibility and satisfaction with intercity public transport travel.

Hypothesis 3: Perceived accessibility has a direct positive effect on satisfaction (H3).

De Vos (2018) found that preferences for travel modes significantly impact individuals' travel satisfaction. Scholars measured the satisfaction of travelers who preferred different modes of transportation, and the results showed that commuters who commuted by bicycle or on foot were more satisfied with their journey to work than those who used other modes of transportation (Friman et al., 2013). There are also studies that show a positive correlation between the propensity to use public transport for cross-border commuting and satisfaction with

public transport, while the attitude towards private cars is the opposite (Gerber et al., 2020). Accordingly, we hypothesize that in the context of intercity travel, travelers' preference for public transport will affect their satisfaction with using public transport for intercity travel.

Hypothesis 4: Public transport preference has a direct positive effect on public transport satisfaction (H4).

The conceptual model is established based on the above-mentioned assumptions, which are shown in Figure 1.

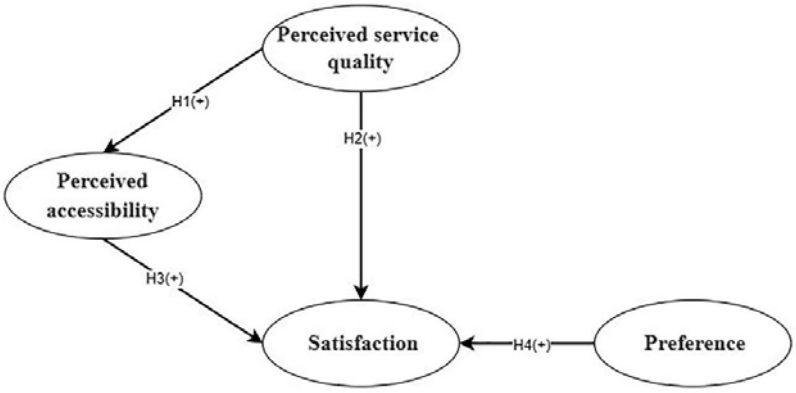

Figure 1. Conceptual model

5. Results

5.1 Methodology

To investigate the relationships among multiple variables, this study employs structural equation modeling (SEM) to examine the latent attitude variables and explore mediating effects to comprehend the underlying mechanisms. SEM is a multivariate analysis technique that enables simultaneous consideration of both direct and indirect relationships between multiple factors. Additionally, SEM allows for the analysis and calculation of latent constructs derived from factor analysis. The calculations involved in structural equation modeling employ simultaneous equations to reveal the relationship between exogenous and endogenous variables (Kline & Little, 2015). Each latent attitude variable is defined through a measurement model, represented by the following fundamental equation.

$$\begin{aligned} x &= \Lambda_x \xi + \delta \# \\ y &= \Lambda_y \eta + \varepsilon \# \end{aligned} \tag{1}$$

in which x is the vector of exogenous observation variables, which refers to perceived service quality, perceived accessibility, and preferences; and y is the vector of endogenous observation variables, which refers to satisfaction; ξ is the vector of exogenous latent variables, and η is the vector of endogenous latent variables; and Λ_y are the factor loading vectors of (x, y), which refers to the relationships between the measured variable and the latent variable; δ is the measurement error of exogenous variables, and ε is the measurement error of endogenous variables.

The structural model depicts the relationship between exogenous and endogenous variables, namely independent and dependent variables. The fundamental equation of the structural model is as follows:

$$\eta = B\eta + \Gamma\xi + \zeta \# \tag{2}$$

in which Γ is the structure coefficient matrix between exogenous and endogenous latent variables; B is the matrix of the structure coefficients among endogenous latent variables. ζ represents the residual term (Bollen & Hoyle, 2012).

5.2 Model Results

5.2.1 Model Fitness

To assess the goodness of fit of the adopted model, χ2/df, GFI, and RMSEA indices were selected. It was observed that the χ2/df index exceeded 5 by a value of 16.643. Chi-square values are proved to be influenced by

sample size and data distribution characteristics. In cases where sample sizes exceed 200 and non-normal data distributions are presented, maximum likelihood estimation may result in variance expansion (Enders, 2009). However, the sample size used in our study was significantly larger than 200, and a normality test was performed. The skewness coefficient exceeded 3 and the kurtosis coefficient exceeded 8.

To mitigate potential misestimation of model fit, the Bollen-Stine method was employed to correct the model fitting (Bollen & Stine, 1992). After 5000 bootstrap sampling corrections using the Bollen-Stine method, the final Bollen-Stine bootstrap p-value was found to be 0.000, indicating a negligible probability of poor model fitting in the 5001st sampling. After correction, the $\chi 2/df$ ratio (1.1) of the model remained below 5, and other fitting indicators also performed well. These findings confirm that the relatively poor model fit previously observed can be attributed to the larger sample size. The revised results, shown in Table 6, demonstrate an overall good fit for hypothesis testing of the structural model.

Table 6. Model Fit Indices of the SEM Model

Model fit indices	$\chi 2/df$	GFI	RMSEA
Recommended Values	<5	>0.9	<0.10
ML estimate	16.643	0.899	0.105
Bollen-stine bootstrap	1.100	0.990	0.010

5.2.2 Model Path Analysis

The model results are shown in Figure 2, and Table 7 shows the statistical results of the influence paths of various potential variables in the structural equation model. According to the results, it can be seen that perceived public transport service quality has a significant positive impact on perceived public transport accessibility ($\beta = 0.448$, $p < 0.001$). Hypothesis 1 of this study is supported, indicating that the higher the evaluation of public transport attributes, the higher and the stronger of the perceived accessibility. Perceived public transport service quality has a significant positive impact on satisfaction with intercity public transport travel ($\beta = 0.053$, $p < 0.05$). Hypothesis 2 is also accepted, but its mediating effect requires further analysis. In addition, perceived public transport accessibility has a positive impact on satisfaction ($\beta = 0.862$, $p < 0.001$), and there is a significant positive correlation between public transport preference and travel satisfaction ($\beta = 0.343$, $p < 0.001$), therefore, Hypothesis3 and Hypothesis4 are also supported.

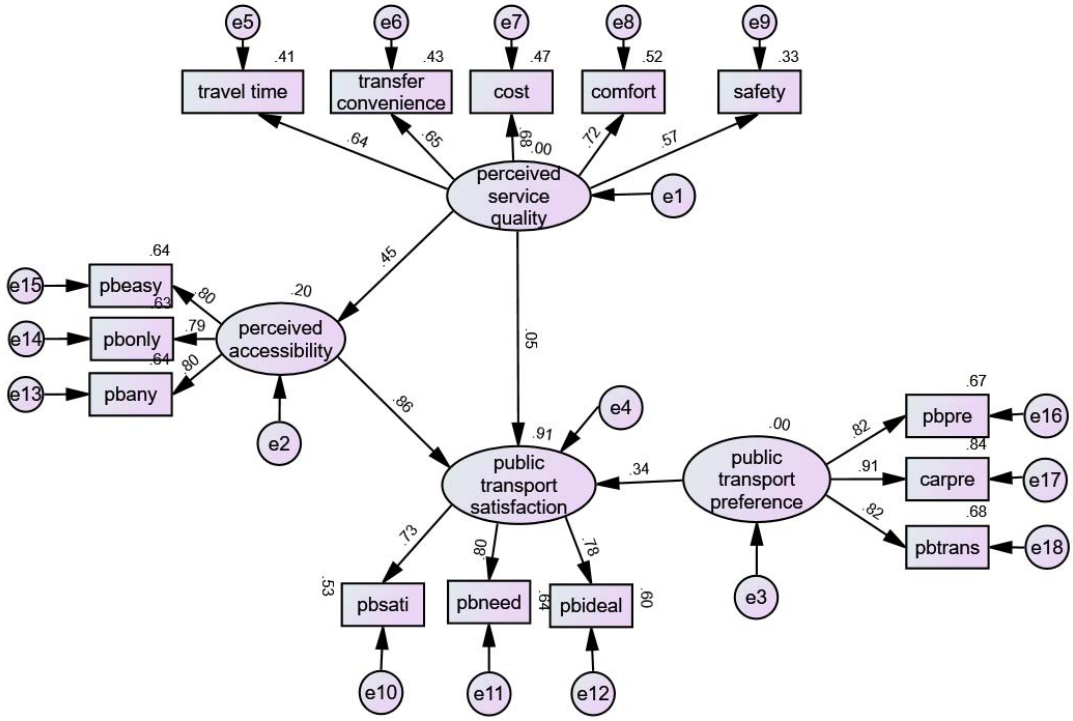

Figure 2. Results of model path analysis

Table 7. Results of structural model path analysis

Path	β	S.E	P
perceived service quality -> perceived accessibility	0.448	0.053	***
perceived service quality -> public transport satisfaction	0.053	0.035	*
perceived accessibility -> public transport satisfaction	0.862	0.030	***
public transport preference -> public transport satisfaction	0.343	0.014	***

Note. * denotes $p < 0.05$, *** denotes $p < 0.001$.

5.2.3 Mediating Effect Analysis

Empirical evidence has demonstrated a significant positive impact of perceived public transport service quality has a significant positive impact on satisfaction with intercity public transport travel. However, based on the correlations between paths, the potential mediating role of perceived accessibility in this relationship needs to be further explored. The potential mediating role of perceived accessibility was tested by assessing the significance of the indirect effect of perceived service quality on satisfaction by including perceived accessibility as a mediating variable. Mediating effect analysis is conducted using the percentile Bootstrap method with deviation correction, employing 5000 repeated samplings and a confidence interval of 95%. The results of the mediating effect analysis are presented in Table 8.

Table 8. Results of mediating effect analysis

path	β	Boost SE	Bias-corrected 95% CI	
			Lower	Upper
perceived service quality -> perceived accessibility -> PT satisfaction	0.549	0.051	0.455	0.655

The results indicate that the mediating effect of perceived accessibility on the relationship between perceived service quality and satisfaction with intercity public transport travel, is statistically significant, and the 95% confidence interval of the path is [0.455, 0.655].

6. Discussion and Policy Implication

6.1 Discussion

In this study, perceived service quality, perceived accessibility, preference and satisfaction respectively correspond to travelers' evaluation of intercity public transport service quality, perception of the ease of using intercity public transport, preference on choosing intercity public transport mode compared with private car, and their overall evaluation on intercity public transport travel. It can be seen from the model results that the all hypotheses proposed in this study are accepted, indicating that there are structural correlations among the above subjective variables in intercity travel in urban agglomerations.

The model results show that perceived accessibility has the greatest impact on satisfaction with intercity public transport, which is consistent with previous research showing that accessibility is the most significant factor affecting well-being (Delbosc, 2012). The higher intercity travelers rate the accessibility of public transport, the higher their satisfaction is shown. It means that when travelers feel that using public transport services can make their intercity travel easier, they are more satisfied with the whole journey and hold an overall positive attitude towards intercity travel using public transport. It is confirmed that public transport accessibility is the key to affecting travelers' travel satisfaction, some planning and service enhancement measures can be proposed to improve the accessibility of intercity public transport, thereby improving passenger travel satisfaction.

The findings demonstrated the positive impact of perceived service quality on travel satisfaction. This shows that the higher the perceived service quality of intercity public transport, the better the passenger experience in intercity travel, and the more opportunities there are to benefit from intercity travel. Therefore, travelers will be more satisfied with intercity public transport travel. The model results also indicate that several dimensions of perceived service quality considered in the study are important. Therefore, by improving public transport travel time, transfer convenience, safety, cost, and comfort, satisfaction with intercity public transport can be improved.

Additionally, traveler preferences have a strong impact on satisfaction. The stronger travelers' preference for public transport, the higher their travel satisfaction. Preferences are generally affected by the traveler's long-term experience, interests, family and friends, etc., and are generally not easy to change quickly. However, it is still possible to improve travelers' intercity public travel experience by providing convenient public transport services, or by increasing publicity efforts to let travelers know more about intercity public transport. These may gradually increase passengers' positive attitude towards public transport and improve their intercity public travel experience, which could be effective ways to increase travelers' preference for public transport and improve their satisfaction.

This study also shows that perceived accessibility is a mediating variable. While the direct effect of perceived service quality on satisfaction with intercity public transport is evident, it also affects satisfaction indirectly through perceived accessibility. This finding is consistent with previous studies (Van der Vlugt et al., 2022; Lattman et al., 2019). Therefore, travelers' perceived accessibility partially explains the relationship between perceived service quality and satisfaction. Taking perceived accessibility as an important evaluation indicator can more accurately and comprehensively reflect the subjective feelings of intercity travelers.

Furthermore, the results of this study highlight the importance of subjective attitudinal variables in the evaluation of intercity transportation systems. The theoretical model constructed in this study can well represent the structural relationship between subjective variables of different dimensions (perceived service quality, perceived accessibility, preference and satisfaction). By segmenting the subjective variables, the interaction between these variables in the intercity public transport system can be better understood, thereby providing a comprehensive insight into intercity public transport experience and proposing more targeted policy recommendations.

6.2 Policy Implication

The results of this study have several practical implications. First, from the perspective of the transportation system, government departments should increase efforts to improve public transport accessibility and strive to reduce intercity public transport travel barriers. Intercity public transport should be properly planned, intercity public transport infrastructure should be continuously constructed and improved, intercity public transport should be enhanced to provide a convenient choice for intercity travel. High-speed rail networks should be continuously strengthened to shorten the time distance between cities. In terms of intercity transfer, it is necessary to provide the effective access between urban transportation and intercity transportation, and continuously optimize the connection between urban transportation network and intercity transportation network.

Secondly, from the perspective of operational services, enterprises can comprehensively use informatization and intelligent means to provide real-time travel information, it can help reduce uncertainty and waiting time of

travelers, and improve the accessibility of intercity public transport. Smart transfer stations can be established, combined with facial recognition algorithms and contactless payment technology, to improve passenger transfer convenience and optimize travel time efficiency. In addition, a wider range of public transport fare concessions, including intercity and intracity transfer discounts, can be implemented to reduce travel costs. Through in-vehicle intelligent video analysis and in-vehicle emergency rescue system, in-vehicle environment perception capabilities and supervision services can be promoted to ensure the safety during travel; stable in-vehicle Wi-Fi should be provided and activity spaces should be optimized to improve travel comfort and ultimately enhance travel experience.

In addition, it is recommended to provide customized intercity public transport services based on individual needs. Integrate passengers' comprehensive travel chain information, dynamic, real-time and accurate route query and recommendation services should be provided. In addition, user feedback channels should be established to encourage intercity travelers to make suggestions, handle and improve problems promptly, and promote the sustainable development of the intercity public transport system. At the same time, policies should be formulated to promote green travel, convey the significance and benefits of public transport to travelers, enhance travelers' tendency to use public transport for intercity travel, and further improve travel satisfaction.

7. Conclusion

This study aims to explore subjective attitudes towards public transport of intercity travel. Data was collected through a self-administrated survey in Guanzhong Plain urban agglomeration in China. And exploratory factor analysis was used to extract three subjective variables: perceived accessibility, preference, and satisfaction with intercity public transport. A conceptual model was established to describe the relationship between the perceived service quality of intercity public transport and the above three subjective variables. Subsequently, a structural equation model was established to empirically test the hypotheses of the conceptual framework. By segmenting subjective variables, the interaction between these variables in intercity public transport systems can be better understood. Perceived accessibility has the greatest impact on satisfaction with intercity public transportation; perception of intercity public transportation service quality significantly affects individuals' perceptions of accessibility and satisfaction with intercity public transportation. At the same time, public transportation preference is directly and positively related to intercity public transportation satisfaction. Finally, the mediating role of perceived accessibility between perceived service quality and satisfaction was determined.

This study emphasizes the importance of including subjective variables in transportation system evaluation. On the basis of considering objective evaluation indicators and passengers' subjective feelings about intercity public transport services, the evaluation system can be further improved and more comprehensive evaluation results can be provided. The findings provide empirical evidence to better understand travelers' intercity public transport experiences. Policymakers and urban planners should give priority to the needs of travelers, plan and optimize intercity public transport infrastructure properly, and make good use of information and artificial intelligence technologies; so that the of intercity public transport accessibility can be continuously strengthened, and the quality of public transport services should be improved in terms of travel time, transfers, safety, cost and comfort. Moreover, travelers' preference for intercity public transport should be further cultivated to improve intercity public transport satisfaction. Enhancing passengers' positive attitudes toward regional public transport systems will help promote the utilization of intercity public transport and promote the sustainable development of urban agglomeration transportation systems.

There are limitations to this study. Firstly, our survey was conducted in Guanzhong Plain urban agglomeration, which may have certain limitations when generalizing to other regions. Secondly, our model assumes a stable relationship between individual subjective attitude variables; however, it is necessary to acknowledge that this relationship may change with time and external factors. Given these limitations, future researchers are advised to consider using a broader range of data sources and fully consider spatiotemporal dynamics. In addition, future research can explore other factors that affect satisfaction with intercity public transport travel to gain a more comprehensive understanding of this phenomenon.

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Authors' contributions

Not applicable.

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Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

References

Allard, R. F., & Moura, F. (2018). Effect of transport transfer quality on intercity passenger mode choice. *Transportation Research* (Part A: Policy and Practice), *109*, 89–107. https://doi.org/10.1016/j.tra.2018.01.018

Bhagat-Conway, M. W., Mirtich, L., Salon, D., Harness, N., Consalvo, A., & Hong, S. (2024). Subjective variables in travel behavior models: A critical review and Standardized Transport Attitude Measurement Protocol (STAMP). *Transportation*, *51*(1), 155–191. https://doi.org/10.1007/s11116-022-10323-7

Bivina, G. R., Gupta, A., & Parida, M. (2019). Influence of microscale environmental factors on perceived walk accessibility to metro stations. *Transportation Research* (Part D: Transport and Environment), *67*, 142–155. https://doi.org/10.1016/j.trd.2018.11.007.

Bollen, K., & Hoyle, R. H. (2012). Latent variables in structural equation modeling. In *Handbook of Structural Equation Modeling* (pp. 56–67).

Bollen, K., & Stine, R. (1992). Bootstrapping Goodness-of-Fit Measures in Structural Equation Models. *Sociological Methods & Research*, *21*, 205–229. https://doi.org/10.1177/0049124192021002004

Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Exploratory Factor Analysis*, *10*(7). https://doi.org/10.1037/e518632013-232

Curl, A. (2018). The importance of understanding perceptions of accessibility when addressing transport equity: A case study in Greater Nottingham, UK. *Journal of Transport and Land Use*, *11*(1). https://doi.org/10.5198/jtlu.2018.1003

De Oña, J. (2020). The role of involvement with public transport in the relationship between service quality, satisfaction and behavioral intentions. *Transportation Research* (Part A: Policy and Practice), *142*, 296–318. https://doi.org/10.1016/j.tra.2020.11.006

De Oña, J. (2021). Understanding the mediator role of satisfaction in public transport: A cross-country analysis. *Transport Policy*, *100*, 129–149. https://doi.org/10.1016/j.tranpol.2020.09.011

De Oña, J., de Oña, R., Eboli, L., & Mazzulla, G. (2013). Perceived service quality in bus transit service: A structural equation approach. *Transport Policy*, *29*, 219–226. https://doi.org/10.1016/j.tranpol.2013.07.001

De Oña, J., Estévez, E., & de Oña, R. (2020). Perception of Public Transport Quality of Service among Regular Private Vehicle Users in Madrid, Spain. *Transportation Research Record: Journal of the Transportation*

Research Board, *2674*(2), 213–224. https://doi.org/10.1177/0361198120907095

De Oña, J., Estévez, E., & de Oña, R. (2021). How do private vehicle users perceive the public transport service quality in large metropolitan areas? A European Comparison. *Transport Policy*, *112*, 173–188. https://doi.org/10.1016/j.tranpol.2021.08.005

De Vos, J. (2018). Do people travel with their preferred travel mode? Analysing the extent of travel mode dissonance and its effect on travel satisfaction. *Transportation Research* (Part A: Policy and Practice), *117*, 261–274. https://doi.org/10.1016/j.tra.2018.08.034

De Vos, J., Mokhtarian, P. L., Schwanen, T., Van Acker, V., & Witlox, F. (2016). Travel mode choice and travel satisfaction: Bridging the gap between decision utility and experienced utility. *Transportation*, *43*(5), 771–796. https://doi.org/10.1007/s11116-015-9619-9

De Vos, J., Singleton, P. A., & Gärling, T. (2022). From attitude to satisfaction: Introducing the travel mode choice cycle. *Transport Reviews*, *42*(2), 204–221. https://doi.org/10.1080/01441647.2021.1958952

Delbosc, A. (2012). The role of well-being in transport policy. *Transport Policy*, *23*, 25–33. https://doi.org/10.1016/j.tranpol.2012.06.005

Enders, C. (2009). An SAS Macro for Implementing the Modified Bollen–Stine Bootstrap for Missing Data: Implementing the Bootstrap Using Existing Structural Equation Modeling Software. *Structural Equation Modeling: A Multidisciplinary Journal*, *12*. https://doi.org/10.1207/s15328007sem1204_6

Ettema, D., Friman, M., Gärling, T., Olsson, L. E., & Fujii, S. (2012). How in-vehicle activities affect work commuters' satisfaction with public transport. *Journal of Transport Geography*, *24*, 215–222. https://doi.org/10.1016/j.jtrangeo.2012.02.007

Friman, M., Fujii, S., Ettema, D., Gärling, T., & Olsson, L. E. (2013). Psychometric analysis of the satisfaction with travel scale. *Transportation Research* (Part A: Policy and Practice), *48*, 132–145. https://doi.org/10.1016/j.tra.2012.10.012

Friman, M., Lättman, K., & Olsson, L. E. (2020). Public Transport Quality, Safety, and Perceived Accessibility. *Sustainability*, *12*(9), 3563. https://doi.org/10.3390/su12093563

Gerber, P., Thériault, M., Enaux, C., & Carpentier-Postel, S. (2020). Links between Attitudes, Mode Choice, and Travel Satisfaction: A Cross-Border Long-Commute Case Study. *Sustainability*, *12*(21), 9203. https://doi.org/10.3390/su12219203

Guan, X., Zhou, M., & Wang, D. (2023). Reference points in travel satisfaction: Travel preference, travel experience, or peers' travel? *Transportation Research* (Part D: Transport and Environment), *124*, 103929. https://doi.org/10.1016/j.trd.2023.103929

Hadiuzzaman, M., Malik, D. M. G., Barua, S., Qiu, T. Z., & Kim, A. (2019). Modeling passengers' perceptions of intercity train service quality for regular and special days. *Public Transport*, *11*(3), 549–576. https://doi.org/10.1007/s12469-019-00213-0

Harvey, J., Thorpe, N., Caygill, M., & Namdeo, A. (2014). Public attitudes to and perceptions of high speed rail in the UK. *Transport Policy*, *36*, 70–78. https://doi.org/10.1016/j.tranpol.2014.07.008

Hess, S., Spitz, G., Bradley, M., & Coogan, M. (2018). Analysis of mode choice for intercity travel: Application of a hybrid choice model to two distinct US corridors. *Transportation Research* (Part A: Policy and Practice), *116*, 547–567. https://doi.org/10.1016/j.tra.2018.05.019

Kline, R. B., & Little, T. D. (2015). *Principles and Practice of Structural Equation Modeling* (4th ed.). Retrieved from https://api.semanticscholar.org/CorpusID:209775064

Lättman, K., Friman, M., & Olsson, L. E. (2016a). Perceived Accessibility of Public Transport as a Potential Indicator of Social Inclusion. *Social Inclusion*, *4*(3), 36–45. https://doi.org/10.17645/si.v4i3.481

Lättman, K., Olsson, L., & Friman, M. (2016b). Development and test of the Perceived Accessibility Scale (PAC) in public transport. *Journal of Transport Geography*, *54*, 257–263. https://doi.org/10.1016/j.jtrangeo.2016.06.015

Lättman, K., Olsson, L. E., Friman, M., & Fujii, S. (2019). Perceived Accessibility, Satisfaction with Daily Travel, and Life Satisfaction among the Elderly. *International Journal of Environmental Research and Public Health*, *16*(22), Article 22. https://doi.org/10.3390/ijerph16224498

Mao, Z., Wang, F., & Wang, D. (2022). Attitude and accessibility on transit users' travel satisfaction: A

person-environment fit perspective. *Transportation Research* (Part D: Transport and Environment), *112*, 103467. https://doi.org/10.1016/j.trd.2022.103467

Masoumi, H. E. (2019). A discrete choice analysis of transport mode choice causality and perceived barriers of sustainable mobility in the MENA region. *Transport Policy*, *79*, 37–53. https://doi.org/10.1016/j.tranpol.2019.04.005

Mouwen, A. (2015). Drivers of customer satisfaction with public transport services. *Transportation Research* (Part A: Policy and Practice), *78*, 1–20. https://doi.org/10.1016/j.tra.2015.05.005

Negm, H., Vos, J. D., & El-Geneidy, A. (2024). Does it matter if you like it? Exploring the relationship between travel mode choice, preference, and satisfaction. *Transportation Research* (Part D: Transport and Environment), *127*, 104053. https://doi.org/10.1016/j.trd.2024.104053

Ning, Y. (2011). Definition of Chinese urban areas and metropolitan regions: A discussion on the role of metropolitan regions in regional economic development. *Geographical Science*, *3*, 257–263.

Olfindo, R. (2021). Transport accessibility, residential satisfaction, and moving intention in a context of limited travel mode choice. *Transportation Research* (Part A: Policy and Practice), *145*, 153–166. https://doi.org/10.1016/j.tra.2021.01.012

Pot, F. J., van Wee, B., & Tillema, T. (2021). Perceived accessibility: What it is and why it differs from calculated accessibility measures based on spatial data. *Journal of Transport Geography*, *94*, 103090. https://doi.org/10.1016/j.jtrangeo.2021.103090

Sukhov, A., Lättman, K., Olsson, L. E., Friman, M., & Fujii, S. (2021). Assessing travel satisfaction in public transport: A configurational approach. *Transportation Research* (Part D: Transport and Environment), *93*, 102732. https://doi.org/10.1016/j.trd.2021.102732

Susilo, Y. O., & Cats, O. (2014). Exploring key determinants of travel satisfaction for multi-modal trips by different traveler groups. *Transportation Research* (Part A: Policy and Practice), *67*, 366–380. https://doi.org/10.1016/j.tra.2014.08.002

Tao, S., Corcoran, J., & Mateo-Babiano, I. (2017). Modelling loyalty and behavioural change intentions of busway passengers: A case study of Brisbane, Australia. *IATSS Research*, *41*(3), 113–122. https://doi.org/10.1016/j.iatssr.2016.10.001

Tassiello, V., & Tillotson, J. S. (2020). How subjective knowledge influences intention to travel. *Annals of Tourism Research*, *80*, 102851. https://doi.org/10.1016/j.annals.2019.102851

Van der Vlugt, A.-L., Curl, A., & Scheiner, J. (2022). The influence of travel attitudes on perceived walking accessibility and walking behaviour. *Travel Behaviour and Society*, *27*, 47–56. https://doi.org/10.1016/j.tbs.2021.11.002

Yang, M., Wang, Z., Cheng, L., & Chen, E. (2022). Exploring satisfaction with air-HSR intermodal services: A Bayesian network analysis. *Transportation Research* (Part A: Policy and Practice), *156*, 69–89. https://doi.org/10.1016/j.tra.2021.12.011

Zhang, J., Yang, M., Ji, J., Feng, T., Yuan, Y., Chen, E., & Wang, L. (2022). Customizing the promotion strategies of integrated air-bus service based on passenger satisfaction. *Transportation Research* (Part D: Transport and Environment), *109*, 103385. https://doi.org/10.1016/j.trd.2022.103385