

Research Article

Behavioral Intentions of Urban Rail Transit Passengers during the COVID-19 Pandemic in Tianjin, China: A Model Integrating the Theory of Planned Behavior and Customer Satisfaction Theory

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Received 15 July 2021; Accepted 3 November 2021; Published 30 December 2021

Academic Editor: Tomio Miwa

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Understanding the behavioral intentions of public transit passengers during the COVID-19 pandemic is important for transmission control interventions oriented towards public transport system travel behavior. This paper studies the relationship between passengers' intentions to use public transport, a set of psychological variables, and the influence of transport management policies (POLs) under COVID-19. Specifically, this study presents a framework integrating the theory of planned behavior (TPB) and customer satisfaction (CS) theory and uses partial least squares structural equation modeling (PLS-SEM) applied to the survey responses of 983 residents of Tianjin, China. The empirical results support the validity of this integrated model of public transit use intentions by confirming several hypothesized relationships among the psychological variables studied. Moreover, POLs under COVID-19 are shown to enhance commuters' intentions primarily via subjective norms (SNs), perceived behavioral control (PBC), perceived service quality (PSQ), and CS. These findings reveal the psychological mechanism through which passengers adjust their public transport travel intentions during the COVID-19 period. Based on the results, some feasible suggestions are proposed to help restore confidence in public transport after the pandemic.

1. Introduction

With the development of urbanization and, hence, the growing urban population in China, increasing car use in urban areas has negative impacts, such as traffic congestion and environmental pollution. Compared to individuals choosing public transport, such as bus, rail, and metro travel, car users are associated with a higher risk of accident involvement, causing greater damage to the environment by contributing to CO₂ emissions [1]. Transportation is considered one of the most high-emission sectors, accounting for 23% of total CO₂ emissions in 2013 [2]. In China, where there was a more than 33-fold increase in the number of civil motor vehicles during the 1999–2019 period [3, 4], the country became the world's largest CO₂ emitter in

2005. In 2019, China's carbon emissions accounted for 28.8% of the global total and were almost twice the amount generated in the USA [5]. Hence, it is critical to reduce private transport use and promote the use of public transport as an alternative to reduce environmental problems and the risk of road accidents. The Chinese government has initiated policies such as limiting property purchases to encourage individuals to choose public transport as a low-carbon travel mode [6]. Reforms such as the "Guiding Opinions of the State Council on the Prioritized Development of Urban Public Transport" have also been launched to support public transport, aiming to improve satisfaction towards public transport service through increasing service quality [7]. However, despite these encouraging policies, urban public transport generally accounts for 10% to 30% of

total transport in China, which is lower than the international average [7]. This low public transport travel proportion suggests that China's public transport services are unsatisfactory. As many studies have suggested, the service quality of public transport, that is, the ability to attract and retain passengers, mainly determines its competitiveness and success [8, 9]. Compared to private transport, public transport, such as urban rail transit, is usually less comfortable and convenient, which influences the intentions of passengers to choose and reuse public transport. In addition, under the unprecedented COVID-19 pandemic, the perceived risk of infection from public transport might affect public transport passengers' travel intentions. Therefore, evaluating the service quality of public transport is highly important, particularly during this pandemic situation, as a better service quality will lead to a higher level of customer satisfaction (CS), thus increasing passengers' intentions to choose public transport.

The COVID-19 pandemic started on December 31, 2019, in Wuhan, China, and spread rapidly, first to other parts of China. By January 23, 2020, China reported 495 confirmed cases in total and 23 deaths [10]. The severe situation led to the implementation of a shutdown policy in Wuhan [11], followed by a series of control measures employed in other cities in China to control and prevent the transmission of the disease. On the next day, the first-level response to public health emergencies (FLRPHE) was launched in Tianjin [12]. Under a pandemic, public transport systems are considered to be highly important since public transport vehicles are confined and conducive to human-to-human transmission. Recent studies have already shown that under COVID-19, traveling by public transport vehicles such as trains [13] and airplanes [14, 15] is significantly associated with getting infected with COVID-19. Hence, since January 24, 2020, several specific operational and personal management policies have been implemented in the Tianjin urban rail transit system to reduce the risk of infection and control the transmission of the disease through public transport vehicles.

Under a pandemic, great anxiety among passengers has been reported [16]. Previous findings suggest that passengers believe that public transport involves a great risk of infection during a pandemic situation. Seventy-five percent of respondents from Europe and Asia stated that in response to a hypothetical influenza pandemic, they would avoid public transport [17]. A study in Malaysia reported that during the influenza A virus subtype H1N1 outbreak, one-third of respondents used public transport less frequently [18]. Hence, passengers' attitudes towards and behaviors regarding public transport can be considered affected by this pandemic. It is critical for transport management to understand passengers' current view on public transport and rebuild their confidence in it. Therefore, this paper investigates the influence of a pandemic on passengers' intentions to use public transport from a two-dimensional perspective, incorporating both internal (i.e., psychological) factors and external (i.e., the transport management policy (POL) employed) factors. In particular, this research focuses on understanding residents' current views on urban rail transit under the COVID-19 pandemic, explicitly studies how psychological factors and external driving factors affect

individuals' intentions to travel by urban rail transit both directly and indirectly.

It is generally recognized that behavioral intentions are key to actual behavior [19]. To that end, many researchers have incorporated various internal and external factors when investigating passengers' behavioral intentions. Academics have adopted classical CS theory to evaluate travelers' intentions towards public transport [20–22]. These studies focus on better determining service quality and CS by evaluating several characteristics. In addition, several researchers consider psychological factors by utilizing the theory of planned behavior (TPB) to assess travelers' transport mode use [23], and they extend the model by introducing variables such as value and image [24]. However, while previous studies deeply investigated to better measure passengers' travel intentions, few have considered the influence when a dramatic change in the external environment, such as the COVID-19 pandemic, occurs. Moreover, little effort has been made to integrate the TPB and CS theory, even though both models have been demonstrated to be critical in explaining travelers' intentions towards public transport. Building on this idea, we studied the influence of satisfaction and other psychological factors towards rail transit travel intentions by combining the CS and TPB models, considering the COVID-19 situation and the newly implemented management policies for urban rail transit. Under a pandemic, it can be assumed that the challenging external environment and the newly applied policies psychologically affect travelers and the service quality of the urban rail transit system. Thus, this research presents a model integrating the TPB and CS theory to determine how the public transport travel intentions are affected both directly and indirectly by the current situation and a number of COVID-19 policy variables.

The rest of this paper is structured as follows. In Section 2, the two theories and relationships between the factors are reviewed in detail, based on which a series of hypotheses and an integrated framework are proposed. Sections 3 and 4 explain the research method based on a survey of residents' attitudes on public transport under COVID-19. Following these sections, the results section is provided, in which the integrated framework is identified and the mechanisms influencing travel intentions are explained. The last section further discusses the empirical modeling results, some policy implications, and suggestions for future research.

2. Theoretical Background and Hypothesis Development

Prior to developing a combined theoretical framework, the recent literatures on the TPB and CS theory are summarized in the following sections in the context of behavioral intentions towards the use of public transport. The relationships between influential variables are discussed, from which the theoretical framework in this research is developed.

2.1. Customer Satisfaction Theory. As public transport is increasingly perceived as a service, passengers consider the

service quality of public transport to be highly important when choosing their travel mode. In the field of transportation, researchers have long adopted the perceived service quality (PSQ) CS-behavioral intention structure when evaluating various public transit services. Specifically, PSQ measures the extent to which the service delivered matches customer expectations [25], and CS is the overall affective response to a perceived difference between prior expectations and perceived performance after consumption [26]. A large number of studies focus on evaluating aspects of a service that are perceived with importance by passengers [8, 27–29]. For example, De Oña et al. [21] stated that frequency, information, and punctuality have a major influence that explains PSQ. Various studies have confirmed that PSQ is critical when assessing CS and behavioral intentions and has positive effects on CS [8, 30]. CS resulting from service quality has been reported to have a positive influence on passengers' behavioral intentions when choosing public transport [8, 20]. Moreover, Chen [31] stated that although both group-level service quality and CS positively influence behavioral intentions, group-level service quality can negatively moderate the positive effect of CS on intentions. Hence, the first two hypotheses of this research are proposed as follows:

H1: PSQ positively influences CS with urban rail transit services

H2: CS positively influences people's intentions to use urban rail transit services

2.2. Theory of Planned Behavior. Different from CS theory, the TPB provides a model that explains the psychological factors of an individual's behavior [19], and the model is widely applied in various fields, such as education and marketing. According to the TPB, behavioral intentions are determined by three factors: attitudes towards the behavior, subjective norms (SNs), and perceived behavioral control (PBC). Specifically, attitudes refer to the extent to which an individual favorably or unfavorably evaluates a behavior, and studies have stated that a positive attitude generally leads to a greater intention to perform a certain behavior [32]. SNs represent the social pressure perceived by the individual to complete a certain behavior nor not. PBC, which is assumed to reflect the previous experience and anticipated obstacles, refers to the degree of perceived ease or difficulty of performing a certain behavior. It is generally believed that positive SNs and PBC will promote an individual's intentions to perform a behavior [19].

Scholars have utilized the TPB when studying individuals' intentions towards public transport by taking psychological factors into account. The three concepts have been considered separately as well as with various other factors. For instance, Şimşekoğlu et al. [1] reported that a favorable attitude towards public transport use is a positive predictor of the intention to choose public transport. SNs were found to be important sources of overall satisfaction and to thus positively influence the frequency of use of public transport [33]. Chowdhury and Ceder [34] adopted

the TPB to include the construct of control beliefs and found that PBC mediates the relationship between control beliefs and intentions. In addition, the TPB model as a whole has been used when evaluating travel mode choices, although contradictory findings appear. Attitudes, SNs, and PBC were found to positively influence intentions towards both car use and public transport use [23]. Ambak et al. [35] reported that as all three determinants positively affect behavioral intentions towards public transport use, attitudes towards public transport serve as the dominant factor. However, after including other determinants in addition to the dimensions of the TPB, only attitudes and SNs were reported with significant influence towards passengers' public transport reuse intentions [24]. The third to fifth hypotheses of this research are proposed as follows:

H3: Attitudes towards using urban rail transit services positively influence people's intentions to use urban rail transit services

H4: SNs positively influence people's intentions to use urban rail transit services

H5: PBC positively influences people's intentions to use urban rail transit services

2.3. An Integrated Framework. In recent years, when studying passengers' travel intentions, scholars have noticed the limitations of the two models and have struck a compromise by introducing various additional variables. Although CS theory has been strongly supported by empirical studies, it has been criticized for having limited generalizability, as a change in context sometimes leads to inconsistent and contradictory results [8]. Similarly, PBC from the TPB model was reported to have no influence on travelers' intentions to reuse public transport after including image and perceived value in addition to the TPB dimensions [24]. These limitations demonstrate that neither CS theory nor the TPB alone is sufficient to predict travelers' intentions towards public transport, especially when facing changing contexts. Previous empirical studies have reported that a pandemic influences individuals' behavioral patterns regarding public transport, while recent studies on COVID-19 have obtained similar findings. A study conducted during the early phase of the COVID-19 pandemic reported that 78% and 63% of respondents from Wuhan and Shanghai, respectively, engaged in several avoidance behaviors, such as fewer social activities and less public transport use [36]. Individuals' attitudes and risk perceptions are important sources of their intentions towards adopting COVID-19 prevention behavior in China [37]. Hence, under the current unprecedented pandemic, it is necessary to consider a comprehensive model from multiple perspectives to better evaluate travel intentions. Previously, a few researchers considered combining both approaches, and it is clear that there still remain several unexplained interactions among variables. Thus, multiple elements, such as personal factors (TPB and CS variables) and situational factors (special management measures under COVID-19) should be incorporated to improve the

predictive power of integrated models and to better understand public travel intentions during the COVID-19 pandemic. To that end, this study presents an integrated theoretical framework that takes the TPB (attitudes, SNs, and PBC), CS theory (PSQ and CS), and the POL implemented during the COVID-19 pandemic into consideration. In addition to the hypotheses proposed above, the comprehensive model further takes into account the within- and between-model interactions among latent variables. Hence, hypotheses 6 to 11 are proposed as follows:

- H6: SNs positively influence attitudes towards using urban rail transit services
- H7: PBC positively influences attitudes towards using urban rail transit services
- H8: CS positively influences attitudes towards using urban rail transit services
- H9: PSQ positively influences attitudes towards using urban rail transit services
- H10: SNs positively influence the PSQ of urban rail transit
- H11: PBC positively influences CS with urban rail transit services

Under COVID-19, following the FLRPHE launched in Tianjin, the local transportation department implemented several operational and personal management policies for the Tianjin urban rail transit system. These measures can be divided into four types. The first group of measures consists of personal requirements for urban rail passengers. Passengers are required to wear face masks, undertake body temperature tests, and scan the health code to enter subway stations. The second group consists of operational policies implemented for the rail transit system. All stations must carry out daily disinfection, and a visualization of the passenger volume in each station is provided for commuters to better manage their travel plans. Third, the urban rail transit running interval was extended to 10 minutes. Finally, some subway station entrances were temporarily closed. Since these policies were implemented at both the personal and operational levels, we intuitively assume that these measures affect commuters' perceptions and shape their behavior regarding urban rail transit. Ahmad et al. [37] reported that governments' guidelines and risk perceptions with regard to epidemic prevention are important factors contributing to Chinese individuals' intentions to adopt epidemic prevention behavior. While public transport is viewed as involving a risk of infection, it is possible that the policies that have been implemented will alter commuters' perceptions. Although measures such as the extended running interval and temporary closures of entrances have created possible difficulties for rail transit passengers, the hygiene requirements may potentially reduce their risk perceptions of public transport. Hence, hypotheses 12 to 16 are proposed as follows:

- H12: POL positively influences attitudes towards using urban rail transit services

H13: POL positively influences the SNs regarding using urban rail transit services

H14: POL positively influences PBC over using urban rail transit services

H15: POL positively influences the PSQ of urban rail transit services

H16: POL positively influences CS with urban rail transit services

To incorporate these factors into our investigation, we provide the theoretical framework shown in Figure 1.

3. Study Site and Questionnaire Design

The case study in this research was conducted in Tianjin, one of the four municipalities in China with a relatively well-developed public transport system. A survey was conducted with a sample of Tianjin residents to collect empirical data. All questions in the survey were answered during the FLRPHE period (January 24 to April 30), during which a total of 136 confirmed COVID-19 cases were reported in Tianjin [38]. This period includes both an early stage, during which most cases were reported, and a later stage, during which enterprises resumed work and production. The survey included two parts. The first part gathered the respondents' demographic and socioeconomic characteristics, such as their age, gender, occupation, and whether they owned a private vehicle. The second part was composed of items that measure constructs of CS, the TPB, the POL implemented, and the respondents' intentions to choose urban rail transit during the pandemic. The questionnaire repeatedly emphasized that the answers should reflect the respondents' perceptions and behavior during Tianjin's FLRPHE period. A small-scale pilot study was conducted prior to the formal investigation to check the reliability and validity of the factor scales. Several elements were removed from the designed questionnaire due to their relatively low reliability.

The formal investigation was conducted in June, 2 months after the FLRPHE period in Tianjin. The study was mainly administered on a network platform and distributed through WeidiaoCha, a popular Chinese online survey platform. The respondents were limited to being aged 18 or over and to being residents of Tianjin by restricting the potential respondents' IP addresses. After removing invalid responses (multiple questionnaires with the same IP address) and incomplete questionnaires, 983 questionnaires were finally obtained. The sociodemographic composition of this sample is displayed in Table 1. The respondents were relatively reasonably distributed across gender, age, and income groups, and thus, any potential gender and income bias can be eliminated from the sample dataset. In addition, on average, approximately 25% of Tianjin residents owned private vehicles in 2019 [39]. This proportion in the sample data set was 40%, a reasonably higher number since only adults were included in the study. Additionally, more than two-thirds of the respondents were full-time employees, meaning that a large proportion of the respondents were likely to commute on a daily basis. Hence, the consistency of

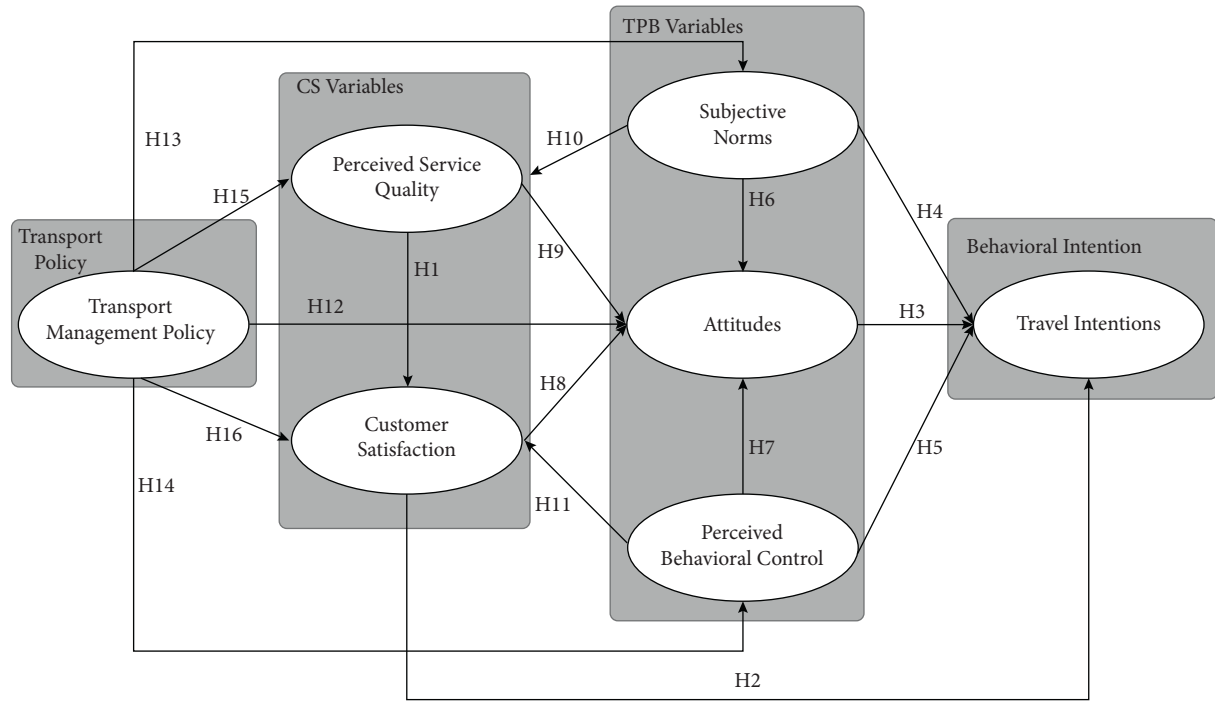


FIGURE 1: The proposed theoretical framework.

TABLE 1: Summary statistics.

Background		Frequency	Percentage (%)
Gender	Male	510	51.9
	Female	473	48.1
Age	18–24	300	30.5
	25–34	292	29.7
	35–44	256	26.0
	45–54	86	8.7
	55–64	45	4.6
	>64	4	0.4
Income (yuan)	<2,000	126	12.8
	2,001–4,000	116	11.8
	4,001–6,000	301	30.6
	6,001–8,000	219	22.3
	>8,000	221	22.5
Education	Doctoral degree	10	1.0
	Master's degree	63	6.4
	Bachelor's degree	372	37.8
	College degree or below	538	54.7
Occupation	Full-time worker	699	71.1
	Part-time worker	51	5.2
	Student	158	16.1
	Retiree	20	2.0
	Someone who works from home	26	2.6
	Other	29	3.0
Owning a private car	Yes	392	39.9
	No	591	61.1
Total	—	983	100

the sociodemographic features between the sample data and the Tianjin resident population increases the representativeness of this study sample.

4. Measurement and Data Analysis

4.1. Measurement Instrument. Passengers' satisfaction level, the psychological factors from the TPB, and the selected POL factors under the pandemic were all used as a multidimensional construct. All measurements were made under the context of COVID-19, which differentiates the questions of this study from those of all previous studies. We followed Churchill's [40] research paradigm to create a measurement of intention.

To measure attitudes under the TPB framework, three items were adopted from the study by Hong et al. [41] and revised. To measure SNs, items presented by Liu et al. [6], in which the intention to choose low-carbon travel modes was investigated, were referenced and changed based on our specific content. For instance, "my family encourages me to choose low-carbon travel modes" was changed to "under COVID-19, my family supports me in choosing the subway travel mode" in this study. PBC was measured based on both internal and external factors following the study by Eriksson and Forward [42]. Additionally, a work exploring blood donation intentions during an avian influenza outbreak based on the TPB model was referenced [43]. That work further took into account risk considerations under a pandemic, specifically when measuring attitudes and PBC. Hence, after adoption and revision, three and two items were added for attitudes and PBC, respectively, to ensure better measurement. Under the CS framework, commuters' satisfaction with and PSQ of urban rail transit were measured with reference to the work by De Ona et al. [21] after considering the pandemic. In this study, PSQ was measured by the overall perception plus four specific items: cleanliness, frequency, safety, and the information provided. CS was measured with three items. As described in the previous section, the Tianjin local transportation department implemented several policies on the urban rail system as control measures, which can be grouped into four main categories. Therefore, after revising the results of the pilot study, two items were utilized to measure passengers' perceptions of those four groups of management policies.

The TPB, CS, POL, and intention variables were all measured using a five-point Likert scale (strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2, and strongly disagree = 1), except for the five risk consideration questions added for attitudes and PBC. These five questions were measured with an inversely five-point scale, that is, strongly agree = 1, agree = 2, neither agree nor disagree = 3, disagree = 4, and strongly disagree = 5. The resulting scale is shown in Table 2.

4.2. Data Analysis and Measurement Model. The partial least squares structural equation modeling (PLS-SEM) is used in this paper to verify the hypotheses. PLS-SEM has several advantages. This method provides accurate estimations of

the paths between constructs through the procedure that simultaneously analyzes structural and measurement models. In addition, Hair et al. [44] stated that while structural equation modeling (SEM) is more suitable for theory testing, PLS-SEM is an appropriate statistical method for exploratory studies since it is able to analyze complicated relationships and test moderating effects. They also asserted in a later paper (2017) that PLS-SEM is especially suitable for a research model with more than five latent variables.

The measurement model was assessed through its convergent and discriminant validity. The Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) values were calculated to check convergent validity. Table 3 presents information on the reliability and validity of our measures. Both the Cronbach's alpha and the CR values were greater than the cutoff value of 0.7 [45]. All AVE values were above 0.5 except for the AVE value for PBC, which was also close to the cutoff value. Discriminant validity was checked using the Fornell-Larcker criterion that determines to what extent a construct within its components differs from other constructs [46]. The square root of the AVE (SRAVE) of each latent variable was greater than its correlation with other variables [45], as shown in Table 4. Hence, our measurement model has a good level of convergent and discriminant validity.

5. Results and Discussion

After assessing multiple alternative model structures and eliminating nonsignificant correlations, the final model is obtained based on some prior knowledge and fit indices, and it is shown in Figure 2. All path coefficients are standardized results directly from the computation. Table 5 summarizes explicitly the outcomes from testing the 16 hypotheses, with 2 of them being nonsignificant and being removed from the resulting PLS-SEM model. Table 6 displays the bootstrapping test results of the path coefficients. Notably, the results are established in the context of Tianjin. However, the characteristics of prevention and control measures for public transport in China allow us to generalize our findings from this case study in Tianjin to other areas of China. The POLs implemented for public transport systems in most Chinese cities in addition to Wuhan are very similar, mainly with differences in the time period of implementation. For instance, Beijing launched body temperature screening at all urban rail stations on January 31, 2020, while this policy was implemented in Shanghai 3 days later. Moreover, COVID-19-related information has been continuously updated during the pandemic through social media and national television. Hence, the passengers in most Chinese cities have shared knowledge about the pandemic. Therefore, with shared pandemic-related information and similar POLs, it is reasonable to assume that the findings in Tianjin can be generalized to other Chinese regions.

5.1. Identification of the Psychological Determinants of Travel Intentions under COVID-19. Each psychological dimension of travel intentions, that is, attitudes, SNs, PBC, and CS, has a

TABLE 2: Outer weights and loading coefficients of the model.

Dimensions and items	Outer weights	Factor loadings
TPB scale: Attitudes		
ATT1. Under COVID-19, travel by subway is convenient	0.204	0.745
ATT2. Under COVID-19, travel by subway is comfortable	0.205	0.750
ATT3. Under COVID-19, travel by subway is safe	0.236	0.876
ATT4. Under COVID-19, travel by subway causes me to be at a higher risk of being infected	0.194	0.809
ATT5. Under COVID-19, travel by subway increases my risk of inadvertently spreading the virus	0.194	0.815
ATT6. Under COVID-19, travel by subway subjects me to a higher risk of coming into contact with people infected with the virus	0.211	0.819
Subjective norms		
SUB1. Under COVID-19, my family supports me in choosing the subway travel mode	0.365	0.896
SUB2. Under COVID-19, my colleagues and friends support me in choosing the subway travel mode	0.369	0.920
SUB3. Under COVID-19, the government/health department supports me in choosing the subway travel mode	0.382	0.871
Perceived behavioral control		
PBC1. Under COVID-19, the subway can completely meet my daily travel needs	0.373	0.761
PBC2. Under COVID-19, I need to use subway travel	0.345	0.726
PBC3. There are restrictions on public transportation during the COVID-19 pandemic	0.225	0.632
PBC4. Knowing that there is an increasing risk of being infected during the COVID-19 pandemic	0.265	0.638
PBC5. Having restrictions on subway schedules during the COVID-19 pandemic	0.220	0.616
Customer satisfaction theory scale		
Perceived service quality		
PSQ1. The overall service quality during the COVID-19 pandemic	0.283	0.791
PSQ2. Subway cleanliness during the COVID-19 pandemic	0.209	0.752
PSQ3. The frequency of the subway during the COVID-19 pandemic	0.217	0.650
PSQ4. The safety of subway travel during the COVID-19 pandemic	0.345	0.771
PSQ5. The information provided for subway travel during the COVID-19 pandemic	0.273	0.774
Customer satisfaction		
CUS1. I feel happy with my travel experience by subway under COVID-19	0.371	0.857
CUS2. I believe that I made the right decision to choose subway travel under COVID-19	0.427	0.857
CUS3. I am satisfied with traveling by subway under COVID-19	0.368	0.858
Transport management policy*		
POL1. The policies in categories A, B, C, and D are necessary to encourage people to choose the subway during the COVID-19 pandemic	0.493	0.890
POL2. The policies in categories A, B, C, and D are valid for encouraging people to choose the subway during the COVID-19 pandemic	0.604	0.928
Travel intentions		
INT1. I strongly intend to choose the subway during the COVID-19 pandemic	0.415	0.922
INT2. I will encourage family members and friends to choose the subway during the COVID-19 pandemic	0.404	0.905
INT3. I prefer to travel by subway over other types of public transport during the COVID-19 pandemic now more than before	0.316	0.799

* Measures taken against COVID-19: Cat. A: customers must scan the health code, undertake body temperature tests, and wear a face mask to enter the subway station; Cat. B: all stations carry out daily disinfection and provide a visualization of the passenger volume in each station; Cat. C: the running interval is extended to 10 minutes; and Cat. D: a few entrances are temporarily closed.

TABLE 3: Convergent validity.

	Alpha	Composite reliability (CR)	Average variance extracted (AVE)
Attitudes	0.889	0.916	0.606
SNs	0.877	0.924	0.803
PBC	0.711	0.808	0.458
CS	0.821	0.893	0.735
PSQ	0.806	0.864	0.561
POL	0.793	0.905	0.827
Intentions	0.849	0.909	0.769

TABLE 4: SRAVE values.

	Attitudes	CS	Intentions	PBC	POL	PSQ	SNs
Attitudes	0.804						
CS	0.644	0.858					
Intentions	0.652	0.752	0.877				
PBC	0.599	0.575	0.592	0.677			
POL	0.306	0.446	0.421	0.375	0.909		
PSQ	0.277	0.490	0.417	0.274	0.332	0.749	
SNs	0.711	0.620	0.667	0.637	0.350	0.226	0.896

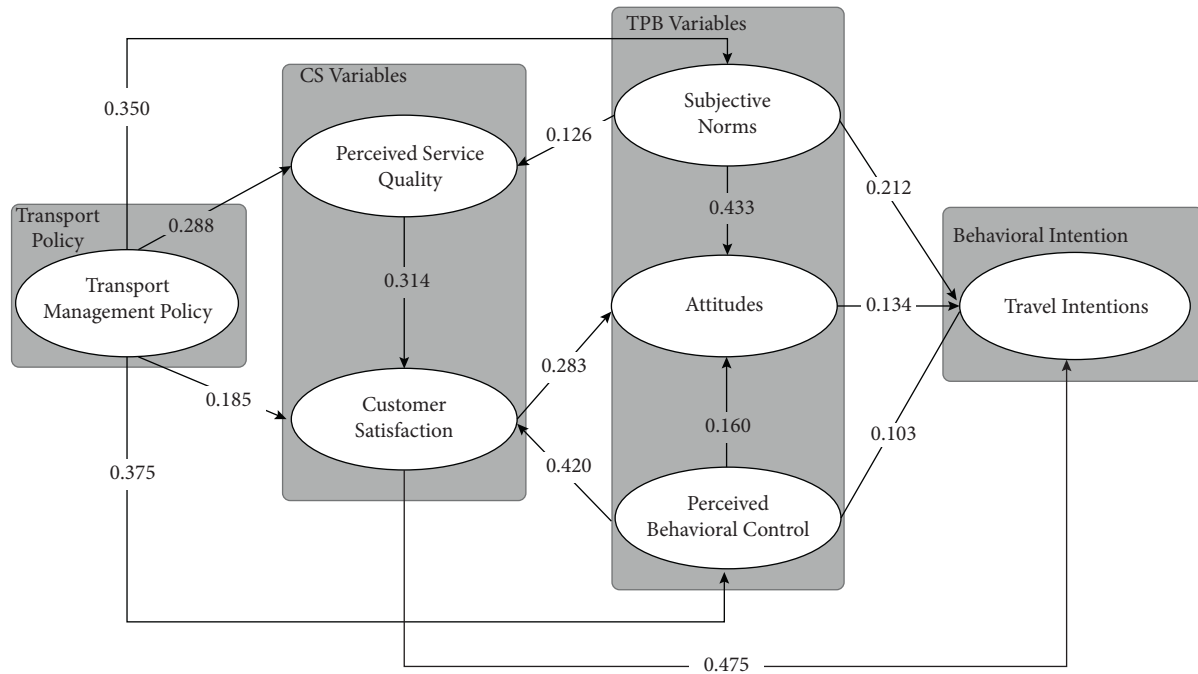


FIGURE 2: The results of the PLS-SEM model.

TABLE 5: Summary of the outcomes of the hypothesis testing.

No.	Hypothesis	Outcome	Coefficient
H1	PSQ \rightarrow CS	Confirmed	0.314
H2	CS \rightarrow travel intentions	Confirmed	0.475
H3	Attitudes \rightarrow travel intentions	Confirmed	0.134
H4	PBC \rightarrow travel intentions	Confirmed	0.212
H5	SNs \rightarrow travel intentions	Confirmed	0.103
H6	SNs \rightarrow attitudes	Confirmed	0.433
H7	PBC \rightarrow attitudes	Confirmed	0.160
H8	CS \rightarrow attitudes	Confirmed	0.283
H9	PSQ \rightarrow attitudes	Not confirmed	—
H10	SNs \rightarrow PSQ	Confirmed	0.126
H11	PBC \rightarrow CS	Confirmed	0.420
H12	POL \rightarrow attitudes	Not confirmed	—
H13	POL \rightarrow SNs	Confirmed	0.350
H14	POL \rightarrow PBC	Confirmed	0.375
H15	POL \rightarrow PSQ	Confirmed	0.288
H16	POL \rightarrow CS	Confirmed	0.185

significant positive relationship with commuters' travel intentions towards urban rail transit under COVID-19. Consequently, H2 to H4 are confirmed, with t statistics greater than 1.96 (Table 6). In addition, consistent with

previous studies, PSQ has a positive effect on CS (beta = 0.314), supporting H1. To a great extent, the results from this study under COVID-19 are consistent with those of previous researches, which use either of the two theories.

TABLE 6: Bootstrapping test results of the path coefficients.

Path relationship	Standard error	<i>t</i> statistics
PSQ → CS	0.029	10.914
CS → travel intentions	0.033	14.512
Attitudes → travel intentions	0.03	4.029
PBC → travel intentions	0.033	6.348
SNs → travel intentions	0.032	3.202
SNs → attitudes	0.034	12.726
PBC → attitudes	0.034	4.703
CS → attitudes	0.029	9.818
SNs → PSQ	0.038	3.299
PBC → CS	0.027	15.468
POL → SNs	0.030	11.815
POL → PBC	0.031	11.898
POL → PSQ	0.037	7.825
POL → CS	0.030	6.087

CS directly influences travel intentions, while PSQ has positive effects on CS. After integrating both theories within the framework, CS under COVID-19 appears to be the dominant factor, with SNs ranking second (Table 5). First, this finding indicates that the empirically supported relationship between commuters' satisfaction and their travel intentions is fairly stable and has not been weakened by this unprecedented pandemic. Satisfaction with Tianjin's urban rail transit service during the COVID-19 pandemic is the most important trigger of travel intentions towards public transport. Moreover, while all of the TPB variables have a significant positive influence on travelers' behavioral intentions during this pandemic, none of them seems to significantly dominate. In contrast to previous research in which attitudes served as the strongest determinant of travel intentions [35], in this study, SNs were found with the largest direct effect among all TPB variables ($0.212 > 0.134 > 0.103$). Compared to positive personal attitudes and the perceived ease of use of Tianjin's public transport, support and encouragement from passengers' social groups are more likely to contribute to travel intentions under COVID-19.

Regarding the proposed hypotheses related to the interaction effects between the TPB and CS variables, all but one are supported. SNs, PBC, and CS all have significant positive effects on attitudes towards Tianjin's urban rail transit during the COVID-19 pandemic; thus, H6, H7, and H8 are all supported. Among them, SNs have the most dominant effect on attitudes ($\beta = 0.433$), followed by CS ($\beta = 0.283$). The dominant role of SNs is intuitive and has possibly been strengthened by the pandemic. With the risk of becoming infected through public transport, individuals may be more likely to seek advice from others and thus justify their favorable evaluation of public transport accordingly. Moreover, the predictive role of CS in attitudes can be empirically explained: if passengers are satisfied with using public transit, they will use public transit more frequently. Evidently, this relatively intuitive relationship is not disturbed by COVID-19. Notably, PSQ has no direct influence on passengers' attitudes towards Tianjin's public transit during the pandemic. One possible explanation is that due to the pandemic, commuters may be more tolerant of service quality, and thus, a relatively low PSQ level might

TABLE 7: Standardized coefficients of the direct and total effects of the predictor variables on the endogenous variables and model fit indices.

Paths	Direct effects	Indirect effects	Total effects
Attitudes → intentions	0.134***	—	0.134***
SNs → intentions	0.212***	0.078***	0.290***
PBC → intentions	0.103***	0.237***	0.340***
POL → intentions	—	0.370***	0.370***
PSQ → intentions	—	0.161***	0.161***
CS → intentions	0.475***	0.038***	0.512***

not necessarily lead to unfavorable attitudes. Moreover, SNs adjusted the effect of the CS factors towards travel intentions via PSQ ($\beta = 0.126$), supporting H10. This result indicates that if there is a general pro-public transit atmosphere around an individual during the pandemic, the person is likely to perceive the service quality of the urban rail transit system as being at a higher level. Hence, he or she will be more satisfied with and will be more likely to utilize public transit services. Similarly, PBC positively and somewhat heavily impacts CS ($\beta = 0.420$), supporting H11. This result means that if an individual feels easy to take public transport during the pandemic, his or her satisfaction with public transport will greatly increase, and hence, the individual will have greater travel intentions towards public transit. Interestingly, PBC exerts a greater influence on CS than on PSQ under the pandemic. This result indicates the possibility that under COVID-19, the ease of use of public transit is the greater trigger of satisfaction with it.

5.2. Identification of the Transport Management Policy-Related Determinants of Travel Intentions under COVID-19. All by one hypothesis related to the indirect effect of the POL factor on intentions via the psychological variables is supported. Consequently, POL is found with a positive indirect moderating effect (total effect = 0.370) as shown in Table 7. Specifically, the data in Table 5 supports the finding that from late January to April 2020 in China, the POL implemented in Tianjin as a response to COVID-19 has a significant indirect positive influence on intentions via SNs, PBC, PSQ, and CS, with all *t* statistics being greater than 1.96 (Table 6; $\beta = 0.35$, $\beta = 0.375$, $\beta = 0.288$, and $\beta = 0.185$, respectively). Therefore, H13 to H16 are supported. Moreover, the pandemic control and prevention policies at both the personal and operational levels implemented under COVID-19 exert positive moderating effects on travel intentions, mainly through two TPB variables: SNs and PBC. Policies at the personal level, such as body temperature tests before entering stations and hygienic requirements for transport facilities, are empirically justified and proven effective for transmission control. Hence, individuals tend to perceive a lower risk of infection when using public transport after the implementation of such policies. Consequently, the social groups of commuters support them in taking rail transit due to the awareness of these policies. In addition, despite measures such as the

longer rail running interval, which may cause potential inconvenience, these measures still increase the ease of use of public transit, with passengers perceiving a lower risk. Therefore, the ease of use that people perceive and the social support for traveling by Tianjin's urban rail transit that people receive are enhanced by these compulsory personal and operational policies. Notably, POL has no significant influence on attitudes towards urban rail transit. This result could be explained in a manner similar to the result above: under the pandemic, the protections and safety provided by these policies are more important to commuters than any potential inconvenience. Consequently, policies that might cause potential inconvenience may not necessarily have a negative influence on attitudes.

6. Conclusions and Policy Implications

Promoting public transport use is critical for dealing with increasing environmental pollution and the pressure on urban transport. During the COVID-19 health crisis, it is also important to prevent commuters from switching to private transport due to panic and safety concerns. While public transport systems are viewed as customer-oriented service products, it is the individual behaviors from the large population that compose traffic patterns. To understand the determinants of potential travelers' use intentions towards public transport, this study investigates how multiple psychosocial factors affect individuals' public transit facility use intentions during the COVID-19 pandemic. An integrated framework combining CS theory, the TPB, and POLs under COVID-19 is developed and verified by a case study conducted in Tianjin, China. Our results confirm most of the proposed hypotheses and reveal some interesting findings in the context of Tianjin, which is reasonable for generalization to other areas of China.

In our study, the CS factors and psychological factors from the TPB are all found to have significant positive effects on travelers' intentions towards urban rail transit in the context of COVID-19 in China. In particular, CS is found to be the most significant determinant of commuters' travel intentions towards public transport. This result is consistent with previous academics and further confirms the strength and validity of the relationship between CS and behavioral intentions under a pandemic. Moreover, when synthesizing the two theories, multiple interaction effects exerting an indirect influence on behavioral intentions are observed. Two TPB variables, SNs and PBC, have a significant positive influence on PSQ and CS, respectively. In addition, all of the factors from the two theories except PSQ have significant positive effects on attitude; among them, SNs have the greatest influence. In addition to the factors from the two theories, the POL under COVID-19 is included in the integrated framework as an additional determinant. This policy factor has a positive indirect moderating effect on travel intentions via SNs, PBC, PSQ, and CS. Despite all the special personal requirements and arrangements under COVID-19, this set of policies enhances commuters' travel intentions.

Based on the findings from the analysis in previous sections, some practical implications under COVID-19 can be suggested. Restoring passengers' confidence in public

transport after a health crisis is crucial for transport management. One previous study stated that under a hypothetical influenza pandemic, respondents perceiving the risk of infection tend to avoid public transport [17]. Consequently, large numbers of passengers may shift from public transport to other modes of transport and might cause several problems. For example, a potential increase in private car use may increase traffic congestion and air pollution. Additionally, this traffic pressure might be aggravated when society resumes production. However, this study suggests that under the practical situation of the COVID-19 pandemic, commuters' psychological factors serve as positive predictors of their travel intentions towards urban rail transit. In particular, CS of public transport provides the greatest positive influence on public transit use intentions. Under the COVID-19 pandemic, perceived safety, which is negatively affected by state anxiety, is reported to have a great positive influence on CS with public transport [47]. Therefore, measures should be taken to relieve passengers' anxiety and increase their perceived safety. For instance, Oh et al. [48] suggested that reliable information disclosed by trustworthy sources reduces anxiety. Hence, traffic management can provide passengers with timely, accurate, and sufficient information about protective measures taken on their behalf as well as information on the number of cases of infection from public transport.

Additionally, the implemented POLs enhance travel intentions via psychological factors. This result proves that although some measures are inconvenient for travelers, POLs are critical interventions for encouraging public transport use when society recovers and resumes production. Moreover, the effectiveness of these measures has been proven. No cluster transmission of COVID-19 caused by public transport facilities has been reported since China resumed work and production in March 2020 [49]. Hence, for public policymakers, under the situation of this global pandemic, the government should regularly emphasize and encourage these POLs against COVID-19 as regular pandemic prevention measures. In addition, incorporating the suggestion above, effective messages and information about POLs should be disclosed to commuters.

Notably, the primary goal of this study is to provide an applicable integration of CS theory, the TPB, and the policy factor in this specific external environment. Despite its contributions, this study has several limitations that need to be investigated in further studies. First, public transport service quality is measured only as a whole rather than separately based on specific attributes, which may cause its limited effects on travel intentions. Hence, more specific service features can be included to elaborate the PSQ factor. Second, different regional contexts might affect how the constructs behave in the integrated framework. The framework in this research is verified using data generated from a survey conducted in a Chinese urban region. As different regions of China have implemented similar POLs under COVID-19 and have shared information and shared culture, it is reasonable to assume that the conclusions from this case study can be generalized to the whole country. However, exactly the same results may not necessarily be

obtained when generating data from other countries. For example, the significant predictive power of SNs in this study may be attributed to the collectivistic culture of China. Under this collectivistic culture, people tend to be more subject to the influences of important social groups than people from Western countries, which have somewhat individualistic cultures [50]. Hence, it is possible that SNs will have less predictive power with regard to satisfaction and travel intentions in Western countries. Third and most importantly, as a public health emergency, COVID-19 involves great uncertainty, and thus, the data generated under this pandemic are likely to vary significantly. For example, the prevention and control measures for public transport vehicles and passenger terminals differ greatly between countries over time, with different levels of enforcement stringency and commuter acceptance. Hence, the generalizability of this framework may be limited. For future research, individuals' travel intentions under COVID-19 and the pandemic control and prevention policies in different regions and different time periods can be examined and compared.

Data Availability

The numerical application data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This work was supported by the Humanities and Social Sciences Foundation of Ministry of Education of China (21YJCZH169) and the National Natural Science Foundation of China (71834004).

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