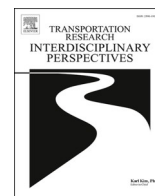Contents lists available at ScienceDirect

Transportation Research Interdisciplinary Perspectives

journal homepage: www.sciencedirect.com/journal/transportation-research-interdisciplinary-perspectives

Structural equation modeling of public transport use with COVID-19 precautions: An extension of the norm activation model

Muhammad Ashraf Javid [a], Muhammad Abdullah [b,*], Nazam Ali [c], Charitha Dias [d]

[a] *Department of Civil Engineering, NFC Institute of Engineering and Fertiliser Research, Faisalabad*
[b] *Department of Civil Engineering, National University of Computer & Emerging Sciences, Lahore 54770, Pakistan*
[c] *Department of Civil Engineering, University of Management and Technology, Lahore 54770, Pakistan*
[d] *Qatar Transportation and Traffic Safety Center, Department of Civil and Architectural Engineering, College of Engineering, Qatar University, P.O.Box. 2713, Doha, Qatar*

A B S T R A C T

This study aims to identify the travelers' attitudes and preferences towards the use of public transport during COVID-19 through the Norm-Activation Model (NAM). A questionnaire survey was designed to assess the traveler's awareness, sense of responsibility, and moral obligations to comply with safety norms or guidelines while using public transport in Lahore, Pakistan. The Structural Equation Modeling method was applied to analyze the collected 1516 complete responses. The survey results and measurement equations confirmed the association between observed and corresponding latent variables. The results of SEM revealed that the travelers' Awareness of Consequences (AC) and Ascription of Responsibility (AR) are positively correlated with Personal Norms (PN), whereas attitudes towards public transport are negatively related to the PN. The perceived behavioral control (PBC) and PN have negative structural correlations with public transport use. However, the attitudes towards public transport are strong predictors of travelers' behavior towards public transport. The current motorcycle users and high-income people have low preferences, whereas current users of public transport modes and middle-income people have high preferences to choose public transport during a pandemic. The travelers' perceived difficulty of complying with safety guidelines while traveling, such as wearing a facemask, use of sanitizers, and maintaining a social distance, have a significant impact on their public transport use. The travelers' better awareness, responsibility, and trust in using public transport may have a strong influence on their preferences towards public transport during a pandemic situation.

Introduction

Transport is among one of the severely affected sectors during the COVID-19 pandemic. The virus spreads through close contact with infected people and by coming in contact with infected surfaces. Many countries imposed lockdowns resulting in reduced mobility. Most of the countries have now either lifted or eased the lockdowns mainly due to financial concerns or a reduced number of new cases. The transport sector is gradually resuming its operations throughout the world. However, road transport including public transport has been found to accelerate the spread of infectious diseases (Muley et al., 2020). Cooley et al. (2011) reported that the subway played the main role in spreading the influenza epidemic. A statistically significant association was described between Acute Respiratory Infection (ARI) and the use of bus

or tram during the influenza season during 2008–2009 in UK (Troko et al., 2011). Feske et al. (2011) reported that tuberculosis (TB) patients, who used the buses frequently, had significantly more transmission risk than the ones who did not use public transportation that often.

As of May 29, 2021, around 911,302 infections and 20,540 deaths had been reported in Pakistan (WHO, 2021). A nationwide lockdown was implemented on April 01, 2020, which was eased in phases and finally lifted on August 07, 2020. Public transport especially inter-city buses remained banned during the complete lockdown phase. People started traveling for various purposes such as work, studies and other purposes as soon as the complete lockdown was lifted, which may increase the demand for public transport. In addition, it is necessary to revive the public transport system in order to reduce the losses. However, promoting public transport use during the post-COVID-19 era is a

difficult task and requires responsible user behavior to keep it safe (Budd and Ison, 2020). The spread of the COVID-19 virus due to public transport can be curbed by following the necessary precautions such as maintaining social distance and wearing facemasks (Lyu and Wehby, 2020). However, not following the necessary instructions can further accelerate the disease spread. For example, not wearing a facemask and the duration of exposure can spread the virus to several people in an indoor environment such as a public transport bus (Tirachini and Cats, 2020). A study found that most of the public transport buses in Ghana followed social distancing guidelines; however, compliance with wearing facemasks was low indicating that public transport remains to be a hotspot for COVID-19 transmission (Dzisi and Dei, 2020). However, researchers have also stated that maintaining even a minimum social distance may make it impossible to use public transport (Suman et al., 2020). The real problem during this pandemic is how to bring back the travelers to public transport and other ride-sharing modes (Hensher, 2020). In this scenario, the assessment of user's perceptions is essential related to following social distancing and other guidelines while using public transport.

The intention to follow the pandemic-related instructions while using public transport depends on pro-social behavior to achieve overall benefits for the society by giving up on personal benefits and can be modeled using the Norm Activation Model (NAM). Schwartz (1977) developed this theory to explain the pro-social behavior. The NAM has three components, namely Awareness of Consequences (AC), the Ascription of Responsibility (AR), and Personal Norms (PN). The AC is related to the individual's awareness regarding the positive or negative outcome of their behavior and AR shows the sense of responsibility among the people for the outcomes related to their particular behavior (Schwartz, 1977). The PN variable depicts the people's moral obligation to comply with a set of rules or guidelines for the betterment of society (Schwartz, 1977). This study extends the application of the NAM theory by combining two additional variables of Perceived Behavioral Control (PBC) and attitudes towards behavior from the Theory of Planned Behavior (TPB). The PBC variable defines the individual's ability to perform a certain behavior seeking various personal, legal, and social constraints (Ajzen, 1985). The attitudes towards the behavior are the positive or negative evaluation by any individual performing a certain behavior (Ajzen, 1985). Behavior is the approach in which one performs certain actions in a given scenario concerning a set of targets. Since using public transport and following the pandemic-related instructions will be beneficial for society as a whole, the NAM theory in the combination of PBC and attitudes variables can be used to determine people's intentions to use public transport and follow the safety instructions or guidelines during the pandemic.

People have been traveling for work, study, and other purposes after the lifting of the lockdown. An increase in outdoor activities may increase the demand for public transport use, however, little is known about its use during the COVID-19 pandemic. This study fills this gap by employing NAM to model users' intentions to use public transport while adhering to the safety instructions during the COVID-19 pandemic in Pakistan. A questionnaire survey was designed and conducted in Lahore city, Pakistan. A total of 1516 complete responses were collected and the Structural Equation Modeling (SEM) technique was used to analyze the data.

The remainder of this paper is organized as follows: The theoretical background along with relevant literature is presented in Section "*Theoretical background*". This is followed by the details on research methods (Section "*Research methods*"). Then the survey and analysis results are presented in Section "*Survey and analysis results*". Discussion on results is provided in Section "*Discussion on results*". Key conclusions are summarized in the last section.

Theoretical background

Transport is one of the most hard-hit sectors due to the COVID-19

pandemic as people were either not allowed or are hesitant to travel resulting in reduced traffic volumes. The risk of infection inside of public transport vehicles might be lower compared to other crowded places; however, the transport vehicles may have transported infected people (Zhang, 2020). During normal life, public transport use is considered to be a pro-social behavior i.e., preferring public transport over private cars is generally beneficial for the whole society. For example, reduction in noise, CO2 emissions, and accidents are associated with public transport use (Nordfjærn et al., 2019). However, the public transport ridership was remarkably declined during Covid-19. This is mainly due to the reason that the virus is transmitted to a person mainly via close contact with an infected person and it is hard to maintain a proper social distancing inside public transport vehicles. Evidence suggests that indoor environments such as public transport vehicles are associated with the spread of infectious diseases (Goscé and Johansson, 2018; V et al., 2020). It is required to minimize the risk of infection in public transport operations by wearing masks and ensuring safe social distance (Gutiérrez et al., 2020). Researchers have suggested that strategies, such as personal protection, cleaning and disinfection, and health education, can improve the safety of public transportation (Shen et al., 2020). It has been reported that wearing face masks and maintaining social distance can reduce the spread of the virus in indoor environments (Ngonghala et al., 2020; Wei and Li, 2016). (Abdullah et al., 2021) developed a binary logistic regression model to explain the choice of public transport and solo modes. This study demonstrated that "safety precautions", i.e., the combination of maintaining social distancing, wearing facemasks and using hand sanitizers, is a significant predictor of the choice of public transport relative to solo modes during COVID-19. In mass transportation, social distancing seems to be the main approach to reduce the spread of COVID-19 while traveling (Hensher, 2020). However, it is believed that the subsequent social distancing about the COVID-19 situation will reduce the use of public transport (De Vos, 2020). Pro-social behavior i.e. a responsibility to protect the community among other factors was found to be associated with adhering to social distancing guidelines during the COVID-19 pandemic (Coroiu et al., 2020). Therefore, adhering to the safety precautions can be considered as a pro-social behavior while using public transport during ta pandemic situation.

Such pro-social travel behaviors can be modeled using the Norm Activation Model (NAM) (Bamberg and Schmidt, 2003). This theory was originally developed by Schwartz in 1977 (Schwartz, 1977). There are three components associated with this theory: Awareness of Consequences (AC), the Ascription of Responsibility (AR), and Personal Norms (PN). A study reported that Personal Norms (PN) and Awareness of Consequences (AC) could reduce car use for commuting purposes in Canada (Abrahamse et al., 2009). Bamberg et al. (2007) found an association between PN and public transport use in Bochum/Dortmund and Frankfurt samples. A study reported that PN had a positive effect on willingness to reduce personal car use in a Swedish city (Nordlund and Garvill (2003). Groot et al. (2008) established that NAM to be successful in explaining the pro-social behavior about the intention to reduce private car use and acceptability of a transport pricing policy in various European countries. Mehdizadeh et al. (2019b) demonstrated that the NAM theory is associated with the use of multimodal and monomodal green modes during summer (Mehdizadeh et al., 2019b). The PNs were associated to choose eco-friendly travel options as explained in a study conducted in Queenstown, New Zealand (Doran and Larsen, 2016). It can be noted that, most of such studies have been performed in developed countries (Møller et al., 2018). A study on the application of NAM conducted in the Iranian context found that the NAM was not associated with sustainable mode choice (Mehdizadeh et al., 2019a). On the other hand, a study conducted in Vietnam reported that AC and PN had a strong impact on the mode choice by the commuters (Trinh and Linh Le, 2018). The commuters showed their willingness to shift to public transport if it had fewer negative effects on their daily living environment. Researchers have also used the variables of the theory of planned

behavior (TPB) in a combination with the NAM theory to explain the pro-social and sustainable travel behavior of the travelers in the context of developing and developed countries (Javid et al., 2015; Liu et al., 2017; Setiawan et al., 2014). The traveler's perceived behavioral control has a significant and direct influence on determining their pro-social travel behavior (Javid et al., 2015; Setiawan et al., 2014). Similarly, the specific attitudes have been found to be strong predictors of travelers sustainable travel behavior (Liu et al., 2017; Setiawan et al., 2014; Wang and Chen, 2012). Researchers have also shown a significant influence of travelers' personal and travel characteristics on travel behavior (Abdullah et al., 2020; Nguyen et al., 2017; Shamshiripour et al., 2020). The hypotheses of the NAM theory can be tested using Structural Equation Modeling (SEM) approach. The SEM is a multivariate analysis technique, which has been used by several researchers to test numerous hypotheses in the transportation engineering domain (De Oña et al., 2013; Javid et al., 2020, 2018; Rahman et al., 2016). For example, Mokarami et al. (2019) employed SEM to explore the relationship between accidents and safety culture mediated by unsafe behavior among public transport drivers; Lois et al. (2009) used SEM to evaluate the direct and indirect effects of instrumental motivations and symbolic motivations on car use mediated by affective motivations; Wang et al. (2020) used SEM to test the hypothesized positive association between public transport quality and public transport equity; and Wan et al. (2016) used SEM to test various hypotheses related to satisfaction with service quality of a bus rapid transit system in the New York City. Hence, structural equation modeling is an appropriate and widely used technique in the field of transportation planning and engineering.

The public transport system is an important entity of urban transportation infrastructure as it assures the mobility of the masses. The public transport system needs to be resilient in a pandemic situation. The intention of adhering to the safety guidelines and instructions while travelling on public transport vehicles during a pandemic has not been explored in the past especially for developing countries. (Abdullah et al., 2021) developed three regression models to describe the intentions of using public transportation modes during COVID-19 in general, while adhering to the safety measures, and while suffering from COVID-19 symptoms. However, underlying behavioral aspects and attitudes were not considered in that study. The current study fills this gap by applying an extended form of the NAM theory to model the public transport use during the COVID-19 pandemic while following the safety and health guidelines such as maintaining a social distance, wearing a face mask, and use of disinfectants. On the other hand, the current study can be considered as an extension of the previous study by (Abdullah et al., 2021).

According to the NAM, it is assumed that Personal Norm (PN) is an important determinant of travelers' public transport choice behavior during a pandemic while they have to follow the required guidelines. Awareness of Consequences (AC), i.e., awareness about the effects of not adhering to social distancing and other health guidelines on other passengers and Ascription of Responsibility (AR), i.e., a personal responsibility due to the spread of the virus, may explain the intentions to follow the safety precautions when travelling using public transport during a pandemic to protect the well-being of others. In addition, it was hypothesized that the individual's Perceived Control in complying with the safety guidelines may influence their public transport choice behavior during a pandemic situation. The attitudes towards public transport are supposed to display a significant influence on the PNs and public transport choice behavior. The conceptual application of the NAM theory was further extended by including the variables of PBC and attitudes towards public transport and observed variables related to personal and travel characteristics of the travelers.

Research methods

Study area and its characteristics

Lahore is the provincial capital of Punjab province and one of the largest cities in Pakistan. It has a population of about 11.12 million (Pakistan Bureau of Statistics, 2020). This city houses several educational institutions, industries, and commercial centers. In the last two decades, there has been a huge development of housing societies in the outskirts of the city. The urban population is increasing as many people migrate from other places to acquire better educational and employment opportunities. This trend induces increased travel demands on road infrastructure. It also increases the need for good quality public transport infrastructure to meet the required demand. In Lahore city, the public transport system is comprised of a metro bus (Bus Rapid Transit), orange line metro train system, conventional bus service, and Para-transit modes. The Para-transit modes mainly include minibuses, wagons, Swvl/Airlift bus services (mobile App-based services), motorcycle rickshaw (Qingqi), auto-rickshaws, and taxi services. The taxi services include conventional taxi, Careem, and Uber. Fig. 2 shows the available public transport and para transit modes in Lahore city. The newly opened orange line train has also become a key part of the public transport system in the city. Public transport modes account for about 20% of the Lahore city model share (Japan International Cooperation Agency (JICA), 2012). The first case of COVID-19 in Pakistan was reported on February 26, 2020. The current statistics and the time series trends of COVID-19 in Pakistan are shown in Fig. 1.

Questionnaire design and hypothesis

A comprehensive questionnaire was designed to explore travelers' intention of adhering to the safety guidelines and instructions while choosing public transport for travelling purposes during Covid-19. The questions and statements in the questionnaire were designed considering the theoretical background of the NAM theory. The first part of the survey included the respondent's personal and travel characteristics, for example, age, gender, marital status, income, education, profession, car and motorcycle ownership, present travel mode, and frequency of trips per week. Each characteristic was evaluated using a set of pre-defined categories. The second part of the questionnaire consisted of four statements concerning respondent's travel behavior using public transport. The behavioral statements were designed to seek respondents' preferences to use public transport in the pandemic situation when passengers and service providers have to follow specific health and safety guidelines recommended by the authorities. The designed statements included using public transport during COVID-19 in general, and using public transport while maintaining social distance, wearing a facemask, and using hand sanitizers or disinfectants. All four statements were evaluated using a five-point Likert scale, i.e., never, rarely, sometimes, often, and always.

The third part of the questionnaire included several statements related to the awareness of the consequences, ascription of the responsibility, personal norms, attitudes towards public transport, and perceived behavioral control. The main motives in the design of statements in this part were the respondents' awareness related to the outcomes of their behavior in a COVID-19 like situation, and sense of responsibility of their behavior to make traveling safe and healthy through following safety and health guidelines. The statements were also designed to capture specific attitudes of the respondents towards the use of public transport and ability to travel in public transport modes while they have to comply with the health guidelines, i.e., maintaining social distance, wearing facemask, and use of disinfectants. All these statements were evaluated using a five-point Likert scale from 1 (=strongly disagree) to 5 (=strongly agree).
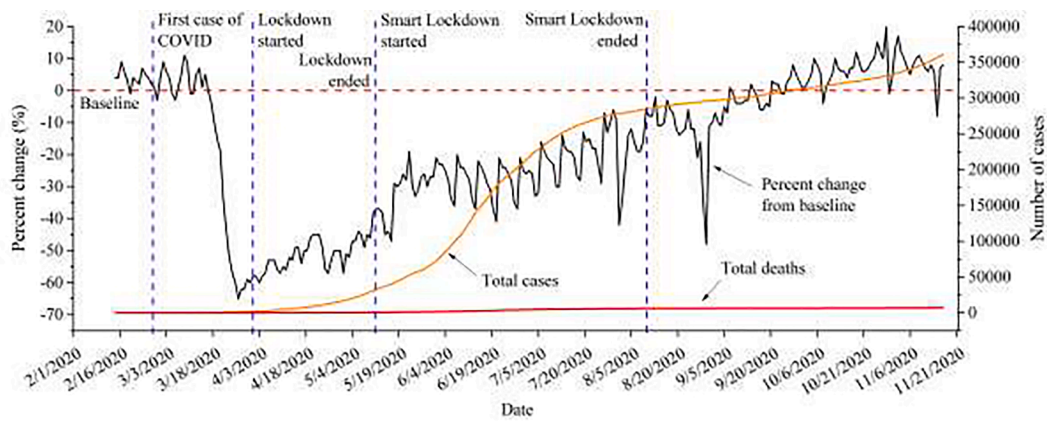
Fig. 1. Time series statistics of COVID-19 infection cases, deaths, and change in mobility at transit stations in Pakistan.

Sampling strategy and sample size

This survey targeted travelers in Lahore city, Pakistan. The main objective of this survey was to identify the differences of various modes users for preferences with public transportation in a COVID-19 like pandemic situation. The survey was conducted at several important locations in Lahore city. The selected locations included Liberty Market, Race-course, Qaddafi Stadium, Anarkali, Mall road, Mughalpura Railway Station, and different bus stations (Fig. 3). All the safety guidelines were followed during the survey to protect the surveyors and respondents from the infection. The sample size requirement was determined considering the minimum sample size criteria for conducting the structural equation modeling (SEM) as suggested in (Boomsma and Hoogland, 2001; Kline, 2005). A large sample size is usually preferred to reduce the biases in the collected data and obtain more meaningful results. A convenience based random sampling method was deployed when selecting the target respondents. The survey team consisted of well-trained members to conduct this survey at the selected locations. The team members were instructed to follow the required safety procedures while conducting the survey, e.g., wearing facemasks, use of hand sanitizers, and maintaining a social distance from the respondents.

All the respondents were interviewed to assure the reliability of the collected data. The total collected samples were 1516. The survey was conducted during October and November 2020 when the lockdown had been lifted. It was mandatory to wear a facemask at public places even after the lockdown had been lifted; however, the compliance remained a challenge for the authorities.

Analysis specifications

The Structural Equation Modeling (SEM) technique was applied to analyze the collected data. The SEM is a popular multivariate analysis technique and has been used by many researchers in transportation engineering domain to explore travel behavior (De Oña et al., 2013; Javid et al., 2020, 2018; Kamaruddin et al., 2012; Rahman et al., 2016). It enables researchers to test multiple hypotheses in a single structural model. This SEM analysis was conducted using AMOS software which is a component of the IBM SPSS Statistics software package. In this study, the questionnaire items were designed considering the theoretical background of NAM and it was required to conduct a confirmatory analysis on the collected data. Therefore, the AMOS statistical package was preferred as it uses a confirmatory approach to test the research
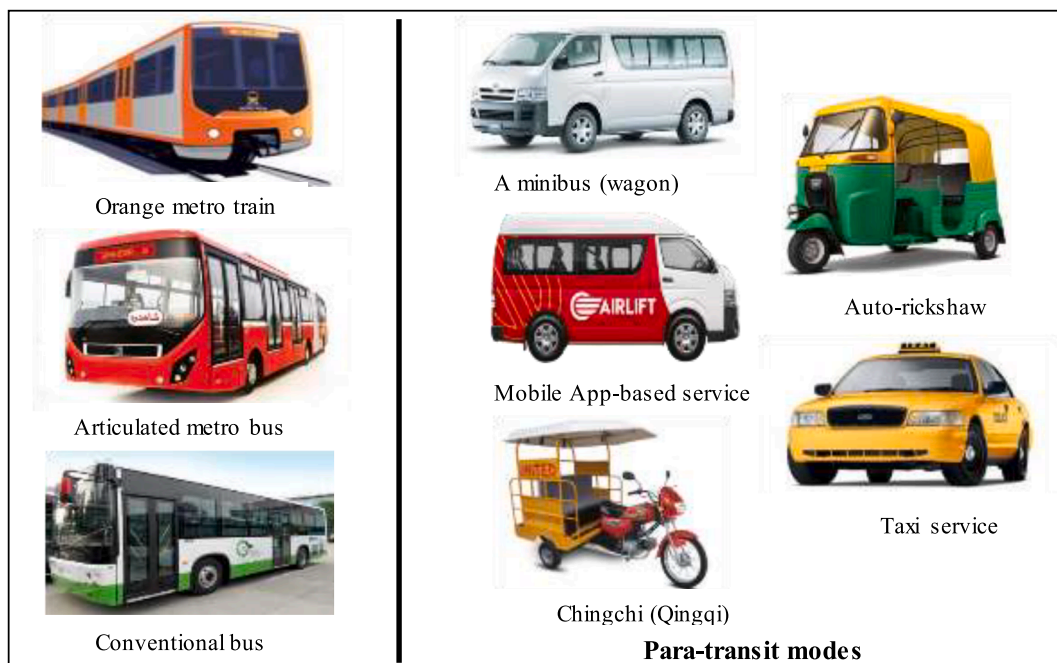

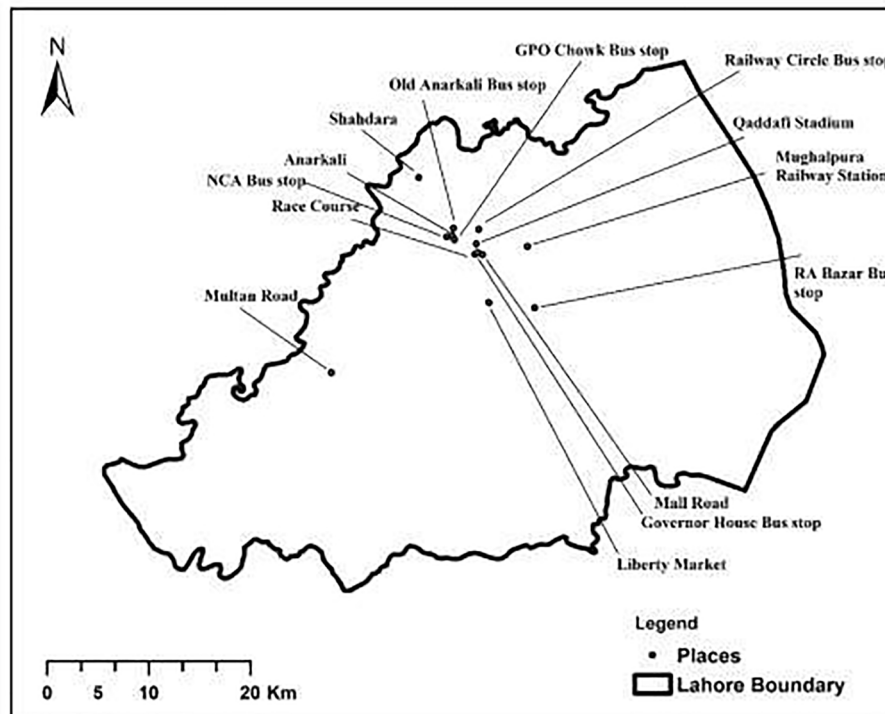**Fig. 2.** Available public transport modes in Lahore city.

Fig. 3. Distribution of survey locations in Lahore.

hypotheses (Samuels, 2017). Compared to the conventional regression analysis, the SEM has many advantages. In SEM, it is possible to incorporate several observed variables (indicators) and unobserved (latent) variables in a single model. It also provides an opportunity to identify direct and indirect effects between the variables. Initially, measurement models are developed and correlations between observed and latent variables are confirmed. Then the measurement models were combined to develop the structural model. A structural model is a path diagram which elaborates the measurement and structural equations. Several observed variables of respondents' personal and travel characteristics were identified and incorporated in the model to test their significant correlation or association with public transport choice behavior. The reliability of the developed structural model or path diagram is confirmed by comparing the goodness of fit parameters with their permissible values. Previous studies have recommended that goodness of fit measures, such as Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), and Comparative Fit Index (CFI), are required to be more than 0.9 and Root Mean Square Residual (RMR) and Root Mean Square Error of Approximation (RMSEA) are needed to be less than 0.08 for a reliable structural model (Bentler and Chou, 1987; Hooper et al., 2008; Hu and Bentler, 1999).

Survey and analysis results

Distribution of socio-economic demographics (SEDs) of respondents

Table 1 shows the descriptive statistics of respondents' SEDs characteristics. The proportion of male respondents was higher compared to female respondents. This gender distribution is consistent with the males and female share in the working population in Lahore. More than half of the respondents were single and belonged to a young age group such as 20–40 years. More than 70% of the respondents had an education level of Bachelor or above. More than 60% of the respondents had an income between 30,000 and 60,000 PKR. Motorcycle, car, and taxi and auto-rickshaw had a major share in the model split of this study. The bus and Para-transit modes accounted for 23.4% of the model share. The

non-motorized modes had a share of 6.8%. Around 70% of the respondents declared that their trip frequency was 5 or more days a week.

Average responses for the variables of NAM theory

The description of questionnaire statements concerning NAM theory is presented in Table 2 along with respondents' average scores for the responses, standard deviation, and estimated Cronbach's alpha values. Cronbach's alpha values were calculated to confirm the internal reliability of defined latent variables. A value of more than 0.7 shows an acceptable level of reliability of a factor or latent variable (Taber, 2018; Tavakol and Dennick, 2011). The estimated values of Cronbach's alpha for the most of the latent variables were more than 0.7 and that shows acceptable reliability of the collected data and extracted factors. The Cronbach's alpha of PBC variable is close to 0.7 and more than 0.5 and that describes a moderate level of reliability of the variable. These values also show good internal consistency among respondents in the evaluation of observed variables. The average responses of the respondents' public transport choice behavior for wearing a facemask and use of sanitizers are higher than maintaining a social distance within the vehicle and use of public transport during the COVID-19 pandemic. The average scores for the responses of all four statements of the PN variable were more than 4 which depicts that most of the respondents feel a moral obligation to wear a facemask, use hand sanitizers, maintain a social distance and avoid traveling on public transport when they have COVID-19 symptoms. Most of the respondents have an agreement with all the variables of AC and AR as average scores for the responses were close to four on a five-point scale. These results show that the travelers have the awareness and sense of responsibility regarding the positive outcomes of compliance with safety guidelines of wearing facemasks, maintaining appropriate social distancing, using disinfectants, and avoiding traveling public transport if they have symptoms. The positive sense of moral obligation, awareness, and sense of responsibility among travelers in a pandemic can play a positive role in reducing the infection rate and enhance the use of public transport modes. In PBC latent variable, the average responses of indicators of maintaining a social

Table 1
Distribution of the socio-economic and demographic characteristics of the respondent.

Characteristics	Item	Distribution (%)
Gender	Male	65.5
	Female	34.5
Marital status	Single	56.7
	Married	43.3
Age (years)	Under 20	11.9
	20–30	48.2
	31–40	30.8
	41–50	7.5
	above 50	1.5
Education	High school	13.3
	Higher secondary school	14.8
	Bachelor degree	45.5
	Master degree and above	26.5
Profession	Students	22.8
	Civil employees	27.3
	Private employees	35.2
	Others	14.8
Household income (PKR)	Under 30,000	14.7
	30,000–60,000	64.8
	More than 60,000	20.5
Car ownership	Yes	37.6
	No	61.7
Motorcycle ownership	Yes	61.8
	No	38.2
Present frequent travel mode	Car	18.3
	Motorcycle	28.9
	Taxi and auto-rickshaw	22.6
	Bus	12.7
	Para-transit	10.7
	Walking and bicycle	6.8
The trip frequency with the above mode	1–2 days a week	11.8
	3–4 days a week	18.7
	5–6 days a week	43.2
	Almost every day a week	26.3

distance and traveling on public transport in a pandemic situation are near to 4.0 and higher than the other two indicators in the PBC. It shows that most of the respondents perceived it difficult to maintain a social distance while traveling using public transport and also feel difficult to travel on public transport during COVID-19. However, the perceived behavioral difficulty is low for wearing a facemask and using disinfectant while using public transport. The travelers have positive attitudes toward public transport when safety procedures are properly followed, and vehicles are properly disinfected. However, they would avoid travelling in public transport vehicles if they have a fear of getting the infection and need to pay high travel costs during a pandemic situation.

Structural equation modeling of public transport choice behavior

A structural model was developed using the maximum likelihood method, as the main target was to confirm the measurement equations of defined variables considering the NAM theory. The measurement models confirmed the correlations between observed variables () and latent variables (). All the measurement equations were significant at a 1% level. The standardized estimates of measurement equations of public transport travel behavior variable were more than 0.7 that explains a higher level of agreement among respondents to use public transport with COVID-19 precautionary measures. The standardized estimates of measurement equations of the AC variable depict that there

is a significant level of awareness among respondents regarding the importance of social distance, wearing a facemask, and the use of disinfectants while traveling. The regression weights of AR measurement equations were more than 0.7 except AR-4. It means that most of the respondents had a good sense of responsibility for the consequences of their behavior to follow safety guidelines while traveling using public transport. The high values of regression weights of PN measurement equations describe a good internal consistency among respondents for their level of agreement regarding their moral obligation to the guidelines of social distance, wearing a facemask, and using hand sanitizers. In the PBC latent variable, two measurement equations had regression weights more than 0.8, whereas the regression weights of PBC-3 and PBC-4 were around 0.40. It describes that the respondents' perceived difficulty in using face masks and hand sanitizers all the time has more influence in explaining the PBC variable, and influence of PBC variable on the public transport travel behavior. The respondent's positive attitudes towards public transport are high when safety guidelines are fully followed and vehicles are properly disinfected as the regression weights are more than 0.8.

Several observed variables of respondents' socio-economic and travel characteristics were identified and included in the structural model to identify their correlations with public transport choice behavior. All these observed variables were coded as binary variables (1, 0). Many variables were defined and tested for significant structural correlation with the behavior. In Fig. 4, only significant variables are reported. These significant observed variables of household income included high income (1 if income is more than 60,000 PKR, 0 otherwise), and middle income (1 if income is more than 30,000–60,000 PKR, 0 otherwise). The variable of low income (less than 30,000) was insignificant. Other defined variables were related to frequent travel mode, i. e., motorcycle users (1 if the traveling mode is a motorcycle, 0 otherwise), taxi and auto-rickshaw users (1 if the traveling modes are taxi and auto-rickshaw, 0 otherwise), bus users (1 if the traveling mode is a bus, 0 otherwise), and Para-transit modes users (1 if the traveling modes are wagon and chingchi (Qingqi), 0 otherwise). The variable of car users was insignificant. Similarly, the variable of gender, profession, education, age, and marital status were defined, however, no any significant correlations with public transport choice behavior were found.

The structural model in Fig. 4 predicts good correlations between variables of the NAM theory, which depicts that this theory can be applied to predict public transport behavior in the context of Lahore, Pakistan. The respondents' awareness and sense of responsibility concerning the positive outcomes of following the safety measures such as wearing facemasks, the use of disinfectants, and maintaining social distance were positively associated with each other. The AC and AR displayed positive and significant structural relationships with the PN. These structural equations explain that the traveler's awareness and sense of responsibility are significant in defining their moral obligations to follow the required safety guidelines when they need to use public transport in a pandemic situation. The respondent's specific attitudes towards public transport are negatively and significantly related to the PN. This negative structural estimate shows that there are travelers who feel a moral obligation to follow the mentioned safety guideline, but still, they have low attitudes to use public transport considering complying with safety guidelines. The variable of AR, AC, and attitudes towards public transport explain almost 69% of the variance in the PN.

The variable of attitudes towards public transport has a positive and highly significant structural relationship with the latent variable of public transport choice behavior. This structural equation depicts that the respondents, who have positive attitudes towards public transport, have high preferences to use public transport while there is a need to comply with safety procedures. The structural estimate of PBC with the variable of behavior is significant and negative which shows that the travelers, who feel hard to comply with safety guidelines (i.e., wearing a facemask, use of sanitizers, maintaining social distance, etc.), have low preferences to use public transport in a COVID-19 like situation. The

Table 2
Estimates of average scores, standard deviation, and Cronbach's alpha.

Observed/ latent variables description	Mean score	Standard deviation	Cronbach's Alpha
Public transport travel behavior (Behavior)			
How often would you use public transport while you have to wear a facemask? (Behavior-1)	2.737	1.223	0.858
How often would you use public transport while you have to use hand sanitizers or disinfectants? (Behavior-2)	2.530	1.289	
How often would you use public transport while you have to maintain a social distance? (Behavior-3)	2.205	1.110	
How often would you use public transport considering the COVID-19 situation? (Behavior-4)	2.160	1.207	
Personal Norms (PN)			
I feel a moral obligation to maintain a social distance while traveling on public transport.(PN-1)	4.063	0.778	0.864
I feel a moral obligation to use hand sanitizers or disinfectants while traveling on public transport. (PN-2)	4.010	0.820	
I feel a moral obligation to wear a facemask while traveling on public transport. (PN-3)	4.261	0.662	
I feel a moral obligation to avoid traveling on public transport if I have COVID-19 symptoms. (PN-4)	4.278	0.762	
Awareness of Consequences (AC)			
I believe that maintaining a social distance helps in avoiding COVID-19 infection while traveling on public transport. (AC-1)	3.739	1.200	0.870
I believe that wearing a face mask protects us from COVID-19 while traveling on public transport. (AC-2)	3.964	1.141	
I believe that the use of hand sanitizers can prevent us from COVID -19 infections while traveling on public transport. (AC-3)	3.619	1.078	
I believe that avoiding traveling with COVID -19 symptoms can reduce the spread of the disease. (AC-4)	4.050	1.032	
Ascription of Responsibility (AR)			
I feel an equal responsibility to keep a social distance from passengers while traveling on public transport. (AR-1)	4.010	0.839	0.775
I feel an equal responsibility to use sanitizers for the safety of all passengers. (AR-2)	3.949	0.973	
I feel an equal responsibility to avoid traveling on public transport with COVID -19symptoms. (AR-3)	4.266	0.796	
I feel an equal responsibility to wear a facemask for the safety of all passengers. (AR-4)	4.186	0.822	
Perceived Behavioral Control (PBC)			
It is difficult to use hand sanitizers all the time while traveling on public transport. (PBC-1)	3.187	1.146	0.680
It is difficult to wear a facemask all the time while traveling on public transport. (PBC-2)	3.159	1.286	
It is difficult to travel on public transport during a Pandemic situation (e.g. COVID -19). (PBC-3)	3.945	0.985	
It is difficult to maintain social distance all the time while traveling on public transport. (PBC-4)	3.968	0.994	
Attitudes towards public transport (Attitudes)			
I will only use public transport when COVID -19 related safety guidelines are fully followed. (Attitude-1)	3.647	1.089	0.761
I will only use public transport when vehicles are properly disinfected. (Attitude-2)	3.463	1.094	
I do/would avoid using public transport as I have a fear of being infected. (Attitude-3)	3.708	1.165	
I am willing to pay a high cost of traveling if required safety guidelines are properly followed. (Attitude-4)	2.931	1.211	

negative and significant structural equation of the PN with behavior depicts that there are travelers who possess low preferences towards public transport despite they have shown a high moral obligation of complying with safety guidelines.

The defined observed variables of high-income and motorcycle users showed significant and negative structural coefficients with public transport choice behavior. Results show that travelers belonging to the high-income group and those who are dependent on motorcycles would not prefer to use public transport service when they are required to follow safety guidelines. The current users of a bus, Para-transit modes, taxi and auto-rickshaw have high preferences to use public transport as the structural coefficients are positive. In addition, travelers who belong to the middle-income group, have more preference for public transport. The values of the goodness of fit parameters explain that the constructed structural model display an acceptable level of reliability in predicting the travelers' public transport choice behavior as the mentioned values are close to the recommended values.

Discussion on results

The survey results revealed that travelers' preferences are low to use public transport in a pandemic situation. They may have fear of being infected with the virus while traveling on public transport as there are chances of interacting with a person who is a carrier of the COVID-19 virus. The travelers' difficulty or low interest to adhere to the required safety guidelines could also be a reason for low preferences. Those respondents who belong to the high-income group and those whose present mode of travel is motorcycle would not prefer to use public transport even if all the guidelines are followed. Such groups of people usually depend on their private vehicles and have little flexibility in changing travel alternatives (Nguyen et al., 2017). In addition, they

would not opt for public transport when there is a probability of getting infected while traveling on public transport. The current users of public transport modes would continue to use transit service as they are captive riders. Further, middle-income people have a positive association with public transport choice behavior. There is a need to develop public transport policies considering the demands of current users and potential users such as middle-income people.

The travelers' better awareness and sense of responsibility concerning the positive outcomes of complying with safety guidelines while using public transport assist to develop or activate the moral obligations of protecting society from the spreading of the virus. These personal norms are useful to develop pro-social travel behaviors among the riders as reported in other studies as well (Liu et al., 2017; Trinh and Linh Le, 2018). However, the results of this study revealed that despite possessing high personal norms, many respondents have low preferences to choose public transport when they need to comply with safety guidelines such as wearing a facemask, use of sanitizers, and keeping a social distance from other passengers. Similarly, the travelers' public transport-oriented attitudes are negatively related to the PN which implies that there is a group of travelers who possess different attitudes and personal norms. The travel preferences of such kind of people also differ significantly because despite having high moral norms, they have negative attitudes towards public transport.

The people who possess positive attitudes also have high preferences to use public transport. Several previous studies have also shown that there is a significant influence of attitudes on travelers' intentions of using public transport and choice behaviors (Beirão and Cabral, 2007; Borhan et al., 2014; Javid et al., 2015). It implies that there is a need to develop such positive attitudes among travelers to promote the use of public transport in a pandemic situation while adhering to health precautions. Some travelers have shown willingness to pay more if the
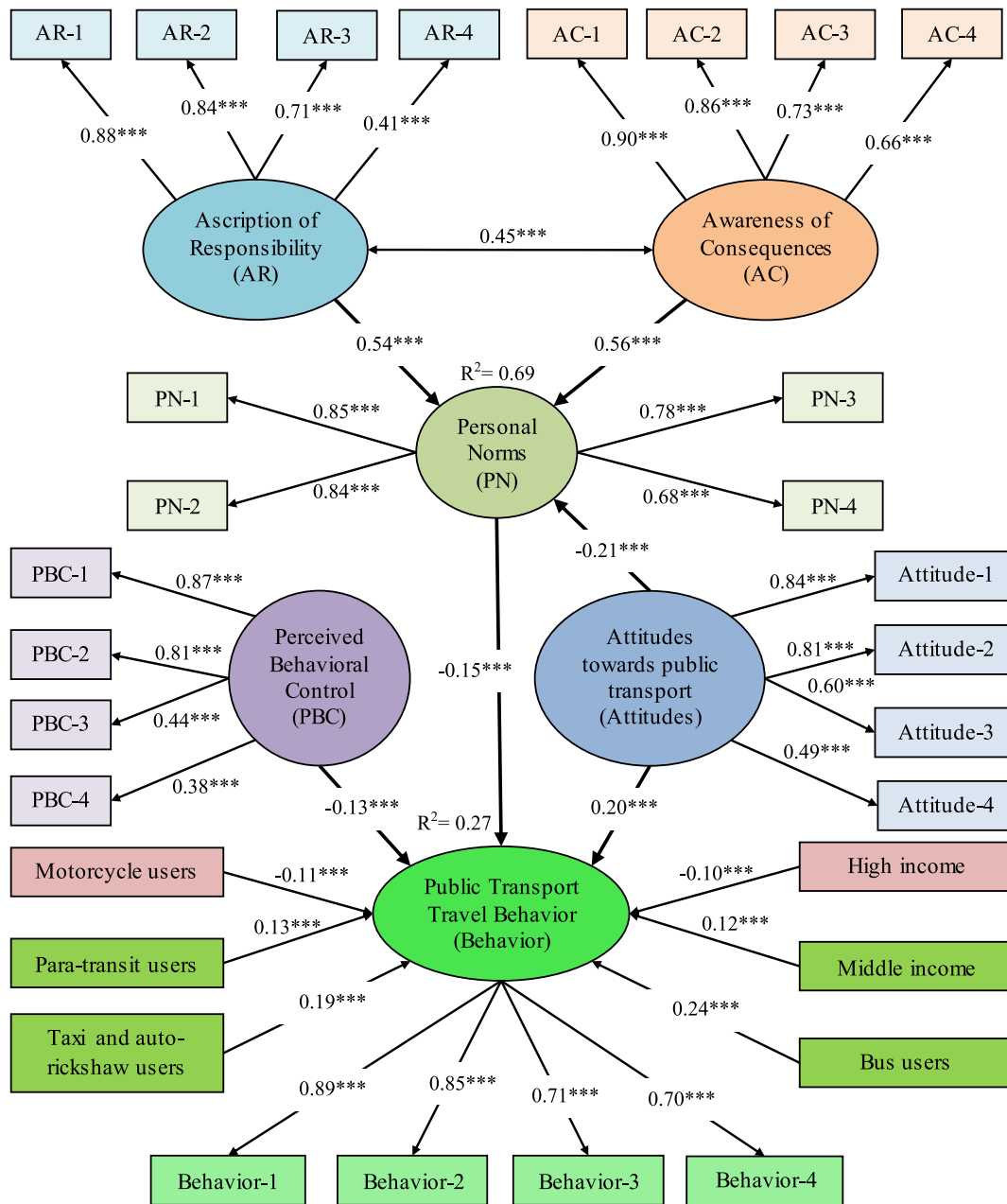
Chi-square = 7871.885, DF= 393, GFI = 0.808, AGFI = 0.757, CFI = 0.792, RMR = 0.085,

RMSEA = 0.091, *** significant at 1%

Fig. 4. Standardized estimates of measurement and structural equations.

safety standards are followed properly. The attitudes will be positive when safety procedures are properly followed such as proper disinfection of transit vehicles and provision of hand sanitizers within the vehicle by the service providers, and travelers' compliance with precautions, i.e., wearing of facemask and maintaining social distance. However, the travelers, who perceived difficulty to comply with safety guidelines or procedures, would have low intentions to use public transport. It is logical as some people may feel uncomfortable when they need to wear facemask all the time and difficulty in maintaining the social distance from other passengers. Maintaining social distance in a populated country with limited resources and a lack of proper education and awareness is difficult. The factor of perceived difficulty becomes more significant in the use of public transport if some of the passengers

are not aware of the required safety guidelines or when they do not follow the guidelines properly. These results imply that there is a need to reduce the perceived difficulty of existing and potential travelers through proper implantation of the guidelines. Passenger's better control of their perceived behavior would be preferred in improving their preferences to use public transport (Fu and Juan, 2017; Liu et al., 2017; Pronello and Gaborieau, 2018; Tsai, 2010).

All stakeholders need to follow the required procedures properly to alter the perceptions of passengers and to improve public transport ridership during pandemics. The providers or operators of public transport services need to understand the special requirements of customers in a pandemic situation. Proper disinfection and cleaning of transit vehicles, keeping few seats vacant for proper social distancing,

less crowded vehicles, and passengers' adherence to required safety procedures would assist in improving the use of public transport and keep public transport in operational condition during a pandemic. Passengers would be willing to pay an additional cost of traveling for safer public transport. The mass transit and Para-transit modes differ in operational characteristics and sometimes have unique service quality dimensions. The requirements of social distancing need to be compatible with the operational and physical features of Para-transit modes as they provide a different level of service to the community. The public and private agencies should make efforts to create awareness and a sense of responsibility among the public in using the public facilities as such aspects would help in developing confidence and trust among the present and potential travelers. The required information should be provided at the terminals, stops, stations, and within the vehicle as well. The relevant guidelines can also be provided using audio-visual techniques at the main terminals and within the vehicle. Personal health protection through awareness, environmental cleaning and disinfection, and adhering to social distance are vital in enhancing the use of public transport modes during a pandemic situation.

Conclusions

The outbreak of COVID-19 in the beginning of 2020 has affected the mobility of the people in Pakistan as it did all around the globe. The travelers' preferences towards public transport are affected by the service quality characteristics of transit modes and safety guidelines that required to be followed while traveling during the pandemic. This study attempted to assess the public transport travel behavior while complying with required safety guidelines using the theoretical background of NAM theory. The collected data confirmed the correlation of defined observed variables with their corresponding latent variables. The latent variables displayed a good internal reliability as confirmed with Cronbach's alpha values, i.e., the values were greater than 0.7. The AC, AR, and attitudes towards public transport were significant predictors of PN; however, the attitudes have a negative structural relationship with the PN. The PN, PBC, and attitudes towards public transport along with other observed variables of personal and travel characteristics were strong predictors of travelers' public transport choice behavior. The travelers, who perceived difficulty to comply with safety guidelines (e. g., wearing a facemask, use of disinfectant, maintaining social distance), would have low preferences to use public transport modes. Travelers, who possess positive attitudes towards public transport, would have high preferences to use public transport. The high-income people and those who currently use motorcycles have low intentions to use public transport in a pandemic situation. However, the middle-income people and current users of transit modes have high preferences for the continuation of the use of public transport.

The results imply that travelers' awareness and sense of responsibility are useful in activating personal norms. There is a need to develop positive attitudes and confidence among travelers of being safe while using public transport. This can be achieved with the implementation of required safety guidelines recommend by the relevant concerned authorities. The public transport service providers, operators and passengers need to properly understand the associated benefits of following the safety guidelines. Awareness campaigns can be initiated to create awareness, educate, and develop trust among travelers to improve the use of public transport. The continued operation of public transport services is crucial to assure the economic stability of the system. However, the operators need to follow the required guidelines and comply with the anticipated desires of passengers to remain safe while using a public transport service in a pandemic situation.

This study only considered the safety dimensions concerning COVID-19 and did not include the other service quality characteristics related to a public transport service. Future studies may assess the travelers' attitudes towards public transport and choice behaviors considering special constraints of a pandemic situation in conjunction with service quality

characteristics of public transport infrastructure. A comparison can be drawn between users of different modes for their attitudes, intentions, and choice behaviors associated with public transport modes. A detailed analysis is required to evaluate the potential of mass transit modes and Para-transit modes separately as it will help in assessing the requirements of each category of modes. Despite some limitations, the findings of this research would provide significant insight into special requirements concerning to operation of public transport services in a pandemic situation.

CRediT authorship contribution statement

Muhammad Ashraf Javid: Conceptualization, Methodology, Software, Writing – original draft, Writing - review & editing. **Muhammad Abdullah:** Conceptualization, Writing – original draft, Writing - review & editing. **Nazam Ali:** Conceptualization, Writing – original draft, Visualization, Writing - review & editing. **Charitha Dias:** Conceptualization, Writing – original draft, Writing - review & editing.

Declaration of Competing Interest

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.

References

Abdullah, M., Ali, N., Dias, C., Campisi, T., Javid, M.A., 2021. Exploring the Traveler's Intentions to Use Public Transport during the COVID-19 Pandemic While Complying with Precautionary Measures. Appl. Sci. 11 (8), 3630.

Abdullah, M., Ali, N., Javid, M.A., Dias, C., Campisi, T., 2021. Public Transport versus Solo Travel Mode Choices during the COVID-19 Pandemic: Self-reported Evidence from a Developing Country. Transp. Eng. 100078.

Abdullah, M., Dias, C., Muley, D., Shahin, M., 2020. Exploring the impacts of COVID-19 on travel behavior and mode preferences. Transp. Res. Interdiscip. Perspect. 8, 100255 https://doi.org/10.1016/j.trip.2020.100255.

Abrahamse, W., Steg, L., Gifford, R., Vlek, C., 2009. Factors influencing car use for commuting and the intention to reduce it: A question of self-interest or morality? Transp. Res. Part F Traffic Psychol. Behav. 12, 317–324. https://doi.org/10.1016/j.trf.2009.04.004.

Ajzen, I., 1985. From intentions to actions: a theory of planned behavior. Action Control 11–39. https://doi.org/10.1007/978-3-642-69746-3_2.

Bamberg, S., Schmidt, P., 2003. Incentives, morality, or habit? Predicting students' car use for University routes with the models of Ajzen, Schwartz, and Triandis. Environ. Behav. 35, 264–285. https://doi.org/10.1177/0013916502250134.

Bamberg, S., Hunecke, M., Blöbaum, A., 2007. Social context, personal norms and the use of public transportation: Two field studies. J. Environ. Psychol. 27, 190–203. https://doi.org/10.1016/j.jenvp.2007.04.001.

Beirão, G., Cabral, J.A.S., 2007. Understanding attitudes towards public transport and private car: a qualitative study. Transp. Policy 14, 478–489. https://doi.org/10.1016/j.tranpol.2007.04.009.

Bentler, P.M., Chou, C.P., 1987. Practical issues in structural modeling. Soc. Methods Res. 16, 78–117. https://doi.org/10.1177/0049124187016001004.

Boomsma, A., Hoogland, J.J., 2001. The robustness of LISREL Modeling revisited, in: structural equation models: present and future. In: Lincolnwood, I.L. (Ed.), A Festschrift in Honor of Karl Jöreskog. Scientific Software International, pp. 139–168.

Borhan, M.N., Syamsunur, D., Mohd Akhir, N., Mat Yazid, M.R., Ismail, A., Rahmat, R.A., 2014. Predicting the use of public transportation: a case study from Putrajaya, malaysia. Sci. World J. 2014, 1–9. https://doi.org/10.1155/2014/784145.

Budd, L., Ison, S., 2020. Responsible transport: a post-COVID agenda for transport policy and practice. Transp. Res. Interdiscip. Perspect. 6, 100151 https://doi.org/10.1016/j.trip.2020.100151.

Cooley, P., Brown, S., Cajka, J., Chasteen, B., Ganapathi, L., Grefenstette, J., Hollingsworth, C.R., Lee, B.Y., Levine, B., Wheaton, W.D., Wagener, D.K., 2011. The role of subway travel in an influenza epidemic: a New York city simulation. J. Urban Heal. 88, 982–995. https://doi.org/10.1007/s11524-011-9603-4.

Coroiu, A., Moran, C., Campbell, T., Geller, A.C., 2020. Barriers and facilitators of adherence to social distancing recommendations during COVID-19 among a large international sample of adults. PLoS One 15, e0239795. https://doi.org/10.1371/journal.pone.0239795.

De Oña, J., De Oña, R., Eboli, L., Mazzulla, G., 2013. Perceived service quality in bus transit service: a structural equation approach. Transp. Policy 29, 219–226. https://doi.org/10.1016/j.tranpol.2013.07.001.

De Vos, J., 2020. The effect of COVID-19 and subsequent social distancing on travel behavior. Transp. Res. Interdiscip. Perspect. 5, 100121 https://doi.org/10.1016/j.trip.2020.100121.

Doran, R., Larsen, S., 2016. The relative importance of social and personal norms in explaining intentions to choose eco-friendly travel options. Int. J. Tour. Res. 18, 159–166. https://doi.org/10.1002/jtr.2042.

Dzisi, E.K.J., Dei, O.A., 2020. Adherence to social distancing and wearing of masks within public transportation during the COVID 19 pandemic. Transp. Res. Interdiscip. Perspect. 7, 100191 https://doi.org/10.1016/j.trip.2020.100191.

Feske, M.L., Teeter, L.D., Musser, J.M., Graviss, E.A., 2011. Giving TB wheels: public transportation as a risk factor for tuberculosis transmission. Tuberculosis 91, S16–S23. https://doi.org/10.1016/j.tube.2011.10.005.

Fu, X., Juan, Z., 2017. Understanding public transit use behavior: integration of the theory of planned behavior and the customer satisfaction theory. Transportation (Amst) 44, 1021–1042. https://doi.org/10.1007/s11116-016-9692-8.

Goscé, L., Johansson, A., 2018. Analysing the link between public transport use and airborne transmission: mobility and contagion in the London underground 11 Medical and Health Sciences 1117 Public Health and Health Services. Environ. Heal. A Glob. Access Sci. Source 17. https://doi.org/10.1186/s12940-018-0427-5.

Groot, J.I.M.D., Steg, L., Dicke, M., 2008. Transportation trends from a moral perspective: value orientations, norms and reducing car use. In: Gustavsson, F.N. (Ed.), New Transportation Research Progress. Nova Science Publishers, New York U. S.A., pp. 67–91

Gutiérrez, A., Miravet, D., Domènech, A., 2020. COVID-19 and urban public transport services: emerging challenges and research agenda. Cities Heal. 1–4 https://doi.org/10.1080/23748834.2020.1804291.

Hensher, D.A., 2020. What might Covid-19 mean for mobility as a service (MaaS)? Transp. Rev. https://doi.org/10.1080/01441647.2020.1770487.

Hooper, D., Coughlan, J., Mullen, M.R., 2008. Structural equation modelling: guidelines for determining model fit. Electron. J. Bus. Res. Methods 6, 53–60.

Hu, L.T., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct. Equ. Model. 6, 1–55. https://doi.org/10.1080/10705519909540118.

Japan International Cooperation Agency (JICA), 2012. The Project for Lahore Urban Transport Master Plan in the Islamic Republic of Pakistan.

Javid, M.A., Okamura, T., Nakamura, F., Tanaka, S., Wang, R., 2015. Factors influencing the acceptability of travel demand management measures in lahore: application of behavioral theories. Asian Transp. Stud. 3, 447–466. https://doi.org/10.11175/eastsats.3.447.

Javid, M.A., Abdullah, S., Hashmi, A.I., Akbar, M.U., Ghazanfar-Ullah, M., 2018. Passengers' attitudes and preference towards metro-bus service in Lahore. J. Urban Environ. Eng. 12, 201–209. https://doi.org/10.4090/juee.2018.v12n2.201209.

Javid, M.A., Hussain, S., Anwaar, M.F., 2020. Passenger's perceptions on prospects of qingqi paratransit public transport service in lahore. Iran. J. Sci. Technol. – Trans. Civ. Eng. 44, 185–195. https://doi.org/10.1007/s40996-019-00273-z.

Kamaruddin, R., Osman, I., Pei, C.A.C., 2012. Public transport services in klang valley: customer expectations and its relationship using SEM. Procedia – Soc. Behav. Sci. 36, 431–438. https://doi.org/10.1016/j.sbspro.2012.03.047.

Kline, R.B., 2005. Methodology in the social sciences., in: Principles and Practice of Structural Equation Modeling.

Liu, Y., Sheng, H., Mundorf, N., Redding, C., Ye, Y., 2017. Integrating norm activation model and theory of planned behavior to understand sustainable transport behavior: evidence from China. Int. J. Environ. Res. Public Health 14, 1593. https://doi.org/10.3390/ijerph14121593.

Lois, D., López-Sáez, I., Lois, D., López-Sáez, M., 2009. The relationship between instrumental, symbolic and affective factors as predictors of car use: a structural equation modeling approach. Transp. Res. Part A Policy Pract. 43, 790–799.

Lyu, W., Wehby, G.L., 2020. Community use of face masks and COVID-19: evidence From A natural experiment of state mandates in the US. Health Aff. 39, 1419–1425. https://doi.org/10.1377/hlthaff.2020.00818.

Mehdizadeh, M., Nordfjaern, T., Mamdoohi, A.R., 2019a. Environmental norms and sustainable transport mode choice on children's school travels: the norm-activation theory. Int. J. Sustain. Transp. 14, 137–149. https://doi.org/10.1080/15568318.2018.1532542.

Mehdizadeh, M., Zavareh, M.F., Nordfjaern, T., 2019b. Mono- and multimodal green transport use on university trips during winter and summer: hybrid choice models on the norm-activation theory. Transp. Res. Part A Policy Pract. 130, 317–332. https://doi.org/10.1016/j.tra.2019.09.046.

Mokarami, H., Alizadeh, S.S., Rahimi Pordanjani, T., Varmazyar, S., 2019. The relationship between organizational safety culture and unsafe behaviors, and accidents among public transport bus drivers using structural equation modeling. Transp. Res. Part F Traffic Psychol. Behav. 65, 46–55. https://doi.org/10.1016/J.TRF.2019.07.008.

Møller, M., Haustein, S., Bohlbro, M.S., 2018. Adolescents' associations between travel behaviour and environmental impact: A qualitative study based on the Norm-Activation Model. Travel Behav. Soc. 11, 69–77. https://doi.org/10.1016/j.tbs.2017.12.005.

Muley, D., Shahin, M., Dias, C., Abdullah, M., 2020. Role of transport during outbreak of infectious diseases: evidence from the past. Sustain. https://doi.org/10.3390/SU12187367.

Ngonghala, C.N., Iboi, E., Eikenberry, S., Scotch, M., MacIntyre, C.R., Bonds, M.H., Gumel, A.B., 2020. Mathematical assessment of the impact of non-pharmaceutical interventions on curtailing the 2019 novel Coronavirus. Math. Biosci. 325, 108364 https://doi.org/10.1016/j.mbs.2020.108364.

Nguyen, H.T.A., Chikaraishi, M., Fujiwara, A., Zhang, J., 2017. Mediation effects of income on travel mode choice: analysis of short-distance trips based on path analysis with multiple discrete outcomes. Transp. Res. Rec. 2664, 23–30. https://doi.org/10.3141/2664-03.

Nordfjærn, T., Egset, K.S., Mehdizadeh, M., 2019. "Winter is coming": psychological and situational factors affecting transportation mode use among university students. Transp. Policy 81, 45–53. https://doi.org/10.1016/j.tranpol.2019.06.002.

Nordlund, A.M., Garvill, J., 2003. Effects of values, problem awareness, and personal norm on willingness to reduce personal car use. J. Environ. Psychol. 23, 339–347. https://doi.org/10.1016/S0272-4944(03)00037-9.

Pakistan Bureau of Statistics, 2020. Pakistan Bureau of Statistics [WWW Document]. URL http://www.pbs.gov.pk/ (accessed 10.26.20).

Pronello, C., Gaborieau, J.B., 2018. Engaging in pro-environment travel behaviour research from a psycho-social perspective: a review of behavioural variables and theories. Sustainability 10, 2412. https://doi.org/10.3390/su10072412.

Rahman, F., Das, T., Hadiuzzaman, M., Hossain, S., 2016. Perceived service quality of paratransit in developing countries: a structural equation approach. Transp. Res. Part A Policy Pract. 93, 23–38. https://doi.org/10.1016/j.tra.2016.08.008.

Samuels, P., 2017. Advice on Exploratory Factor Analysis. Cent. Acad. Success, Birmingham City Univ. 1–7. 10.13140/RG.2.1.5013.9766.

Schwartz, S.H., 1977. Normative influences on altruism. Adv. Exp. Soc. Psychol. 10, 221–279. https://doi.org/10.1016/S0065-2601(08)60358-5.

Setiawan, R., Santosa, W., Sjafruddin, A., 2014. Integration of theory of planned behavior and norm activation model on student behavior model using cars for traveling to campus. Civ. Eng. Dimens. 16, 117–122. https://doi.org/10.9744/ced.16.2.117-122.

Shamshiripour, A., Rahimi, E., Shabanpour, R., Mohammadian (Kouros), A., 2020. How is COVID-19 reshaping activity-travel behavior? Evidence from a comprehensive survey in Chicago. Transp. Res. Interdiscip. Perspect. 7, 100216 https://doi.org/10.1016/j.trip.2020.100216.

Shen, J., Duan, H., Zhang, B., Wang, Jiaqi, Ji, J.S., Wang, Jiao, Pan, L., Wang, X., Zhao, K., Ying, B., Tang, S., Zhang, J., Liang, C., Sun, H., Lv, Y., Li, Y., Li, T., Li, L., Liu, H., Zhang, L., Wang, L., Shi, X., 2020. Prevention and control of COVID-19 in public transportation: experience from China. Environ. Pollut. https://doi.org/10.1016/j.envpol.2020.115291.

Suman, H.K., Agarwal, A., Bolia, N.B., 2020. Public transport operations after lockdown: how to make it happen? Trans. Indian Natl. Acad. Eng. 5, 149–156. https://doi.org/10.1007/s41403-020-00121-x.

Taber, K.S., 2018. The Use of Cronbach's alpha when developing and reporting research instruments in science education. Res. Sci. Educ. https://doi.org/10.1007/s11165-016-9602-2.

Tavakol, M., Dennick, R., 2011. Making sense of Cronbach's alpha. Int. J. Med. Educ. 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd.

Tirachini, A., Cats, O., 2020. COVID-19 and public transportation: current assessment, prospects, and research needs. J. Public Transp. 22, 1–34. https://doi.org/10.5038/2375-0901.22.1.1.

Trinh, T.A., Linh Le, T.P., 2018. Investigating Proenvironmental Behavior: The Case of Commuting Mode Choice, in: IOP Conference Series: Earth and Environmental Science. p. 12067. 10.1088/1755-1315/143/1/012067.

Troko, J., Myles, P., Gibson, J., Hashim, A., Enstone, J., Kingdon, S., Packham, C., Amin, S., Hayward, A., Van-Tam, J.N., 2011. Is public transport a risk factor for acute respiratory infection? BMC Infect Dis. 11, 1–6. https://doi.org/10.1186/1471-2334-11-16.

Tsai, C., 2010. Applying the theory of planned behavior to explore the independent travelers behavior. Afr. J. Bus. Manage. 4, 221–234.

V, A.A.R., R, V., Haghighat, F., 2020. The contribution of dry indoor built environment on the spread of Coronavirus: Data from various Indian states. Sustain. Cities Soc. 62, 102371. 10.1016/j.scs.2020.102371.

Wan, D., Kamga, C., Hao, W., Sugiura, A., Beaton, E.B., 2016. Customer satisfaction with bus rapid transit: a study of New York City select bus service applying structural equation modeling. Public Transp. 2016 83 8, 497–520. 10.1007/S12469-016-0135-X.

Wang, T., Chen, C., 2012. Attitudes, mode switching behavior, and the built environment: A longitudinal study in the Puget Sound Region. Transp. Res. Part A Policy Pract. 10.1016/j.tra.2012.08.001.

Wang, Y., Cao, M., Liu, Y., Ye, R., Gao, X., Ma, L., 2020. Public transport equity in Shenyang: Using structural equation modelling. Res. Transp. Bus. Manage. 100555 https://doi.org/10.1016/J.RTBM.2020.100555.

Wei, J., Li, Y., 2016. Airborne spread of infectious agents in the indoor environment. Am. J. Infect. Control 44, S102–S108. https://doi.org/10.1016/j.ajic.2016.06.003.

WHO, 2021. https://covid19.who.int/region/emro/country/pk. (Accessed 29 May 2021).

Zhang, J., 2020. Transport policymaking that accounts for COVID-19 and future public health threats: a PASS approach. Transp. Policy 99, 405–418. https://doi.org/10.1016/j.tranpol.2020.09.009.