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People's Behavioral Intentions Towards Public Transport in Lahore: Role of Situational Constraints, Mobility Restrictions and Incentives

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Abstract

This paper aims to identify the relationships between people's attitudes on service quality attributes of private car and public transport, and intentions to use public transport under situational constraints, mobility restrictions on car use, public transport incentives and moral obligation. A questionnaire survey was conducted in Lahore and 354 usable samples obtained. Results revealed that people's intentions to use public transport vary under different situations and mobility restrictions. The fiscal restrictions and policy of car entry restriction have significant influence on changing people's intentions. Modeling results revealed that social/aesthetic, personal and instrumental attitudinal aspects of private car and public transport are underlying factors in determining the people's intentions towards public transport under stated conditions. It is argued that social/aesthetic and personal dimensions of public transport should have equal importance in making improvements along with instrumental dimensions. This study implicates that improvement in service quality of public transport need to integrate with mobility restrictions on car use for effective change of travel behavior. The findings of this study would be helpful for concerned authorities in considering the appropriate attributes of public transport for improvement, and other related policy measures to make significant promotion from car to public transport.

Keywords: *travel behavior, service quality, private car, public transport, TDM, attitudes, lahore*

1. Introduction

Rapid growth in population and vehicle ownership has resulted increase in travel demand and transport problems. The trend of automobile ownership and usage has changed the shape of many metropolitan areas and way of travel (Susilo and Kitamura, 2008). This trend tends to make road network congested and increase in travel time and cost, energy consumption and air pollution. Like other developing cities, Lahore city is also facing problem of achieving some appropriate standard of public transport mobility. Population of Lahore city has nearly doubled in last 20 years and current population is almost 8.65 million (JICA, 2012). The car ownership growth has reached to almost 17% per annum (JICA, 2012). The main reasons of increase in car ownership and its usage are low ownership and usage cost, and inefficiency and under development of public transport system. It is believed that Lahore city has high potential of transit development because of high-density development in inner zone (Imran and Low, 2005). The population density varies from almost 450 persons per hectare in inner zone to 100 persons per hectare in outer zone, and almost 70% of population is living in a radius of 7-8 Km from city center (JICA, 2012). In Lahore, non-motorized modes and public transport are mainly modes of poor people. There are significant differences among people living in different parts of the city in terms of lifestyles, income and vehicle ownership and its usage (JICA, 2012; Javid *et al.*, 2014) The old city is highly concentrated with population and commercial activities with narrow streets and road network. The people living in high-density areas possess different lifestyle and travel attitudes compared with the people living in medium to low density area (i.e., outer part of the city). The development of new housing schemes and extensive road infrastructure have produced diversity of travel demand and required supply of transportation infrastructure. In the last decade, the capacity of the road infrastructure has improved continuously which include construction of new roads, widening of existing roads, and constructions of ring roads/bypass, flyovers and underpasses. Unfortunately, the development of public transport sector was ignored in the same

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period. Traffic conditions are still worst in the city despite significant improvement in the capacity of the road infrastructure. The public face daily traffic jams on major arteries of the city that results increase in travel time and cost as well as increase in energy consumption and environmental pollution. It is unfair to build more road infrastructure just to facilitate car and motorcycle users and neglecting the mobility of poor people. Currently, among motorized modes the car and motorcycle posses maximum share (i.e., motorcycle: 22.4% and car: 9%) in the modal share of the city (JICA, 2012). The motorcycle accounts almost 50% of the traffic on road network (Urban Unit, 2010). The public transportation modes constitute almost 20.1% of modal share (bus and wagon: 12.5%; rickshaws, taxi, etc. 7.6%) (JICA, 2012). More than 800,000 passengers are using public transport in Lahore where only 800 high occupancy buses are operating along with Para-transit service (JICA, 2012). There are almost 53 planned routes for buses and 48 routes for wagons along with concentration of motorcycle rickshaws (Qingqis) on some routes. There is a still big gap between demand and provision of an efficient public transport despite construction of almost 27 Km Bus Rapid Transit (BRT) line in 2013. These cited issues and traffic situations demand an efficient, affordable and sustainable public transport system in the city, which should provide good mobility to existing users and has potential to attract private vehicle users. With proper modal shift from private vehicles to transit modes after making improvements, the traffic congestion and its related problems can be reduced. It can help in reducing the average travel time and cost, and to improve environmental, social and economic conditions in the city.

The mobility of existing public transport users is a critical issue in developing countries because most of them belong to low-income group, and public transport facilities are insufficient and/or inefficient. This issue needs to address primarily as Banister (2005) said that transport planners have to think more positively about the conditions of public transportation in future in developing countries. Travel Demand Management (TDM) measures are considered as effective tools in influencing the travel behavior, and have impact on reduction in travel time and cost, and convenience of travel options (Garling *et al.*, 2002; Loukopoulos *et al.*, 2005). It is very important to promote such incentive and disincentive policies, which should reduce advantage of car use and increase the benefits of public transport usage (Garling and Schuitema, 2007). Therefore, a well-designed fiscal policies on private vehicle usage would be more effective rather than the introduction them in isolation. However, in a city, where a public transport system is weak, such fiscal or economic measures alone do not necessarily result in switching to public transport from private vehicle. Beirao and Cabral (2007) believe that transport policies that aim at increasing public transport usage should promote its image, but at the same time, public transport systems need to become more market-oriented and competitive. It is still unsure that the public transport system would be able to provide a service quality that can attract car users for switching to public transport (Hensher, 1998). Improvements in service quality are required to address these issues, which can only be made through clear understanding of travel attitudes, consumer needs and expectations. Researchers also believe that combined TDM measures have more influence on expected car use reduction compared to individual measures (Eriksson, 2010; Steg and Vlek, 1997). In this context, it is required to integrate public transport improvements with some mobility restrictions on car use in order to make significant shift from private car to public transport. Moreover, individual's adaptation mechanism to specific mobility restrictions on car use and other congestion related demand management measures varies depending upon socio-economic characteristics, lifestyles and attitudes (Cao *et al.*, 2013; Choo and Mokhtarian, 2012). These mobility restrictions or TDM measures include parking charges and limitations, road tax or toll, and car entry restrictions in public transport service area. This research includes some TDM measures or mobility restrictions related to car use and analyze their acceptance and effectiveness in conjunction with public transport improvements strategy.

Previous studies (Van and Fujii, 2006; Steg *et al.*, 2005; Steg, 2005; Choocharukul, 2006) classify the attitudinal factors towards private car and public transport into three categories i.e., symbolic/affective, instrumental, and social orderliness. These studies explore the significant implications of these factors in reduction of car use in developed countries, whereas implications for developing countries are still unsure. People's intentions to use public transport are also influenced by individual's characteristics and situational factors or constraints (Steg, 2003), and perceived service performance of each transport mode (Beirao and Cabral, 2007; Javid *et al.*, 2012). It is needed to explore the significance of these factors and mobility restrictions in developing countries in making effective use of public transport, and reduction of car use in the era of rapid motorization. In this context, it is essential to evaluate attitudes of people towards service quality of transport modes in a specific region in order to identify the attitudinal factors that need to consider in improvements of public transport. Moreover, design of questionnaire to grasp user's preferences in developing countries is a critical task because of difficulties in getting reliable data. Selection of questionnaire items, target groups and survey methods require special attention. Therefore, this study aims to examine the attitudes of people towards service quality factors of private car and public transport through a questionnaire survey i.e., how people regard various car and public transport oriented attitudes. The other main objective is to evaluate commuter's intentions towards public transport considering situational factors, mobility restrictions on car use, public transport incentives and moral obligation. Under these objectives, this study attempts to develop structural relationship between people's attitudes on attitudinal aspects of existing public transport and private car, and their intentions to use improved public transport under stated conditions (i.e., incentives and disincentives). Initially, factor analyses have been conducted for categorization of respondent's beliefs on car and public transport attitudinal aspects into three latent variables.

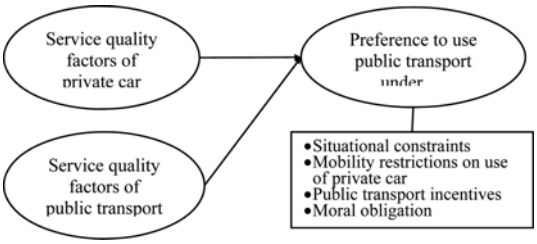

Fig. 1. Conceptual Framework of Structural Modeling

Finally, these extracted factors have been used to develop structural models of people's intentions towards public transport using structural equation modeling techniques. A hypothetical model of this study is presented in Fig. 1. This paper is organized in this way. Section 2 briefly describes data collection methods. Section 3 discusses the results of questionnaire survey, and factor analysis, and section 4 presents the results of structural equation modeling. Last section summarizes the key findings, conclusions and implications.

2. Data Collection Methods

2.1 Questionnaire Design

A questionnaire survey was conducted in Lahore to obtain data required to accomplish study objectives. In this study, a questionnaire was designed considering the characteristics of the target group of travel market (i.e., current car users and potential car users). The questionnaire items were designed deeming literacy level of target group. The number of questions was kept less in order to get reliable data. The objectives of the questionnaire and filling guidelines were mentioned at the start of each part. In order to get reliable data on stated preferences, the alternative policy options were presented with proper illustrations and explanations. In addition, to make questionnaire understandable for the general reader, the terminologies used in this SP survey were explained well at the start of each part. This questionnaire was consisted of three parts. Part one included personal and trip information of respondents i.e., gender, marital status, age, income, education, occupation, vehicle ownership, possesses driving license or not, one-day one-way travel pattern from home to office/campus (all modes of travel, travel time and cost for each mode).

In part two, various service quality attributes of car and existing public transport were selected. The structure of questionnaire items in this part was primarily based on Osgood's (Osgood *et al.*, 1957) semantic differential technique with five point adjective scale. Semantic differential scales provide the interval data that can be arranged in order and measured. Semantic differential scales measure a person's attitude toward concepts and are useful in situations with different age groups or cultures. This technique was used in this research because it has following advantages: easy to construct, easy to use for the respondents, provides reliable quantitative data and can correlate highly with score from Likert scales. The attitudes towards private car and public transport were measured by using beliefs in the form of pairs of opposite adjectives. These attitudinal attributes included expensive-cheap, unreliable-reliable, uncomfortable-comfortable, inelegant-elegant, slow-fast, risky-safe, inconvenient-convenient, traditional-advance, noisy-calm, public-personal, stressed-relaxed, low social value-high social value, unrespectable-respectable, boring-exciting, unattractive-attractive, unhealthy-healthy, crowded-uncrowded, unfriendly-friendly, environmentally destructive-environmental friendly.

In part three, respondents were asked to show their preference to use public transport under situational factors, mobility restrictions on car use, public transport incentives and moral obligation. All questions in part 3 were evaluated using five point Likert scale i.e., never, almost never, sometimes, almost every time and every time/always. This part consisted of 18 conditional statements as presented in Table 2, and against each condition respondents needed to show preference for the use of public transport. The respondents were asked to show their preference to use public transport under different situational constraints such as commuting alone, commuting with family members or friends, and travelling with elder family members. Some mobility restrictions on car use were included such as limited parking space at destination, very far parking from destination, road tax and parking charges on car use, and car entry restrictions in public transport service area. Some incentives measures were also included on public transport usage such as reliable service, direct access to many destinations, low travel cost as compared to car, and less travel time as compared to car. The respondents were also asked to give their preference for public transport usage when they felt moral obligation for reduction of traffic congestion, air pollution and preservation of natural resources by reducing car use. The respondents were requested to assume one car in house if currently they did not have. They needed to show preferences deeming the specifications of improved public transport as presented in Table 1. These specifications were selected considering the under-constructed BRT line and its future perspective in Lahore city.

2.2 Survey and Sampling

This survey was conducted in engineering university, and various private and civil organizations during September-October 2012. One main objective of this questionnaire survey was to target current and potential car users. Therefore, respondents who used car and had more potential of using in future were targeted in the university and other organizations. Purpose of conducting this questionnaire survey was stated at the start of

Table 1. Specification of Improved Public Transport Scenario

• CNG vehicle • Every 2-4 mint service • Air-conditioned bus • Separate bus lane on road • Well dressed staff • Electronic fare collection	

questionnaire along with details of conducting authority. The filling guidelines were also mentioned at the start of each part. The respondents were selected randomly in each organization, and survey was conducted with the help of university graduate students. Initially, students were trained for the purpose and contents of questionnaire, and methods of conducting survey. One-day pilot survey was conducted before actual survey for clarity of sentences, and checking the easiness of respondents in filling the questionnaire. Self-completion approach was used in conducting the survey. The questionnaires were distributed by visiting selected sites, and instructions were given to the respondents for the purpose and contents of questionnaire items, and filling procedure in order to ensure the reliability of data. The survey team members were instructed to keep in contact with the respondents for their help in filling and getting reliable data. Moreover, regular meetings were conducted with survey team to assure the reliability of information, and timely completion of survey. During survey, some respondents were reluctant in sharing personal information, and opinions on other survey items. Initially, respondents were requested to return the filled questionnaire after two weeks, and filled questionnaires collected again with the help of survey team. However, additional time of one week was given to those respondents who did not able to complete in the initial period.

In this survey, total 500 questionnaires were distributed in selected organizations and only 372 samples obtained, which represented a return rate of 74.4%. Some samples were discarded due to incomplete information and double answers on some questions. Therefore, further analysis is based only on 354 samples. Almost 90% of respondents have education bachelor or above which is much higher than actual literacy level in Lahore. This is due to high share of current and potential car users in sample because in Lahore education level and vehicle ownership increases with the increase of household income (JICA, 2012). Consequently, the likelihood of using car at present and in future is higher with higher education. The share of male and female respondents in sample is 68.4% and 31.6% respectively. The female respondents are less because they do not drive motorcycle, and share of working women is much less in Lahore city. Almost 52% of respondents have car, and 60.2% motorcycle. Personal income per month distribution is follows as less than 10,000 PKR (19.5%), 11,000-20,000 (13.8%), 21,000-30,000 (16.7%), 31,000-40,000 (17.2%), 41,000-60,000 (17.8%), 61,000-80,000 (8.8%), and more than 80,000 PKR (6.2%). Almost 85% of respondents were aged between 21-30 years, and only 47% have driving license. The share of different modes is follow as walking (7.3%), bicycle (1.5%), car (31.2%), motorcycle (27.6%), auto-rickshaw/taxi (12.3%), campus/office transport (7.1%), and public transport (13.0%).

3. Results and Factor Analyses

Average response and factor loadings were estimated using results of questionnaire survey. Factor analysis is a best-known statistical procedure for investigation of relationships between sets of observed and latent variables. In using this approach to data analysis, the researchers examine the covariance among a set of observed variables in order to gather information on their underlying latent constructs (i.e., factor). In general, the factor analytic model focuses solely on how, and the extent to which, the observed variables are linked to their underlying factors. Specifically, it is concerned with the extent to which observed variables are generated by the underlying latent constructs and thus strength of the regression paths from the factors to the observed variables (the factor loadings) are of primary interest. In this study, a Confirmatory Factor Analysis (CFA) was conducted using respondent's response for their behavioral intentions towards public transport under stated conditions. Exploratory Factor Analyses (EFA) were conducted for respondents attitudinal response on service quality attributes of private car and public transport as presented in section 3.2. EFA is designed for the situation where links between the observed and latent variables are unknown or uncertain. The analysis thus proceeds in an exploratory mode to determine how, and to what extent, the observed variables are linked to their underlying factors. Typically, the researchers wish to identify the minimal number of factors that account for co-variation among the observed variables. In contrast, CFA is appropriate to use when the researcher has some knowledge of the underlying latent variable structure (Byrne, 2010).

3.1 Factor Loadings and Average Response for Public Transport Usage

Initially, average response was calculated for respondent's intentions to use public transport under stated conditions. For this purpose, response was coded on a bipolar scale i.e., -2 (never), -1 (almost never), 0 (sometimes), 1 (almost every time) and 2 (every time). Four latent variables were defined for people's preferences to use public transport considering nature of different factors, incentives and disincentives. These latent variables included 'Situational Constraints (SC), acceptance of mobility restrictions on car use (AMR), Acceptance of Public Transport Incentives (APTI), and Moral Obligation (MO)'. The factor loadings were estimated for indicators of each latent variable. Results of factor loadings are presented in Table 2. Cronbach's alpha value was also estimated for each latent variable as given in Table 2. Cronbach's alpha value tells about the reliability of latent variables and internal consistency in evaluation among respondents for indicators of each latent variable.

It can see from results as presented in Table 2 that respondent's stated intentions to use public transport vary under different situational constraints i.e., preference is more when they commute alone and with friends compared to other scenarios. Travelling with family members accounted less average response. It can be said that people feel insecure and less privacy while travelling with family members especially with female. The factor loading for commuting with family members is also more compared with travelling alone and travelling with friends, which indicate higher

internal consistency among respondents in evaluating these indicators. As most of the respondents belong to middle-high-income group and high education class; therefore, it can be argued that such people may have more concern about their privacy and security matters in travelling. It implies that such factors should be focus at planning stage of transit policies for the attraction of the private vehicle users towards public transport belonging to targeted groups in this study.

In acceptance of mobility restrictions on use, estimated average response depicts that restriction on car entry in public transport service area has more potential of reducing car use compared with fiscal and parking restrictions. It is said that improvement in service quality of public transport with car entry restrictions would be an effective policy to reduce traffic congestion in highly congested areas. However, implementation of such entry restrictions in transit-oriented areas can limit the freedom and flexibility of the travelers. Moreover, the private vehicle users may oppose this policy even in the presence of good quality public transport system. Strong political will, public acceptance and proper enforcement are the main contributing factors in the potential implementation of such polices. Parking charges and road tax on car use have almost same influence on car use reduction. The factor loadings for fiscal restrictions on car use are high i.e., near to .80, which shows that most of the respondents perceived these restrictions equally. Limited and far parking have less influence on car use reduction. This may be due to excessive availability of parking facilities in most of commercial and business areas.

In public transport incentives, average response shows that direct access to destination and reliability are the most influencing attributes of public transport along with less travel cost. It looks that sitting has less importance in defining the service quality level of public transport for target group of people. However, importance of sitting depends on length of trip and class of travelers. With same travel cost and time, people may prefer their private vehicle even with assurance of seat; however, people's intentions may be different if travel cost and time are less. The factor loadings are higher for reliability, less travel cost and shorter travel time, and more than .80 that shows high consistency among respondents in evaluating these variables. The factor loading for direct access is lower because some respondents may feel that it is difficult to have such public transport service that can provide direct access to every destination. In other words, it can be said that as most of respondents are car, motorcycle, auto-rickshaw and taxi users and these modes provide more accessibility than public transport; therefore, they believe less on direct access by public transport to every destination.

Results of average response and factor loadings depict that moral obligations are high for reduction in air pollution and preserving natural resource compared to reduction in traffic congestion by reducing car use. It means that people have more concern for air pollution and natural resources than traffic congestion. This may be due to increase in air pollution from transport sector that causes health problems and shortage of fuels and increase in fuel prices in recent years. Moreover, they may

Table 2. Average Response and Factor Loadings for Public Transport Usage under Incentives and Restrictions

Description of items	Mean	Factor loading	α
Situational/Social Constraints (SC)			
Commuting with family members	-1.08	.887	0.82
Travelling with elder family members	-1.23	.827	
Commuting with friends	-.427	.627	
Commuting alone	-.412	.567	
Acceptance of Mobility Restrictions on car use (AMR)			
When you need to pay road tax Rs.100 for use of car	.429	.814	.85
When you need to pay Rs. 100 parking fee at destination	.350	.800	
Parking is far from destination	.226	.704	
When entry of car is restricted in public transport service area	.673	.665	
When parking is limited at destination	.121	.647	
Acceptance of Public Transport Incentives (APTI)			
If public transport is reliable than car	.517	.837	.90
When travel cost by public transport is half of car	.412	.832	
When travel time by public transport is 10 minutes less than car travel time	.263	.812	
When seat is assured in public transport with same travel time as car	.146	.757	
When seat is assured in public transport with same travel cost as car	-.008	.706	
When you can directly access many important places by public transport	.576	.697	
Moral Obligation (MO)			
to preserve natural resources e.g. oil & gas	.771	.873	.83
to protect environment from air pollution by reducing car use	.735	.847	
to reduce traffic congestion by reducing car use	.573	.593	

Note: All the factor loadings were significant at $p < .05$, α: Cronbach's Alpha

feel that these issues are more serious than traffic congestion and need to be cured.

3.2 Factor Analysis for Attitudes on Attributes of Public Transport and Private Car

A factor analysis was conducted to identify the factors for respondent's attitudes on service quality attributes of public transport and private car. Three factors were identified based on Eigen value greater than 1. These factors as presented in Table 3-4 were named considering the tendencies associated with attributes from users perspective i.e. Instrumental Attributes (IA), Social/Aesthetic Orderliness (SO/AO), and Personal Orderliness (PO). The people's attitudes measured on semantic differential scales were clearly factorized into three distinct latent variables in both cases, which show the effectiveness of this scale in measuring attitudes. A factor loading of 0.40 was used as a cut-of-point for extraction of factors. Attributes with higher factor loadings are highly influential in explaining the extracted factors. The instrumental attitudinal aspects consisted of functional features of private car and public transport such as convenience, comfort, reliability, and safety. Social/aesthetic orderliness attitudinal aspects include elegant, respect, health, calmness, social value, environmental impact and exciting. Similarly, third factor personal orderliness includes attributes related to user's privacy, and friendly environment of vehicle. All the factor loadings were significant at $p < 0.05$. The attitudinal attribute "expensive-cheap" did not find significant correlation with three extracted factors at factor loading of 0.40 in both cases; therefore, excluded from the further analysis. Similarly, attitudinal attribute "environmentally destructive-environmental friendly" in case of private car, and "traditional-advance" in case of public transport did not find significant correlation with any extracted factors at factor loading of 0.40. The extracted three factors explain 49.59% and 44.71% of the total variance for public transport and private car respectively. Most of the attributes in three factors are same for two modes except attribute "slow-fast". However, the factor loadings of some attributes vary between two modes. Cronbach's alpha value of extracted factors shows that the internal consistency is relatively good among respondents in evaluation. Average score was calculated for each factor using respondent's response on bipolar scale. The major difference in evaluation of attitudinal aspects between two modes is that the attitudes of respondents are negative for public transport and positive for private car. It means the people have negative perceptions regarding image of existing public transport. These extracted factors of attitudinal aspects were used to evaluate their influence on behavioral intentions towards public transport under stated conditions as mentioned in Table 2.

Table 3. Rotated Factor Loadings for Public Transport

Attitudinal attributes	Social/Aesthetics Orderliness (SO/AO)	Instrumental Attributes (IA)	Personal Orderliness (PO)
Elegant	.773		
Relaxed	.747		
Healthy	.747		
Respectable	.700		
High social value	.698		
Exciting	.630		
Environmental friendly	.617		
Attractive	.569		
Calm	.547		
Comfortable		.771	
Convenient		.680	
Reliable		.673	
Safe		.495	
Fast		.425	
Personal			.762
Friendly			.463
Un-crowded			.452
Cronbach's Alpha	.913	.825	.524
Factor average	-.606	-.527	-1.01
% of variance explained	26.78	16.25	6.56

Table 4. Rotated Factor Loadings for Private Car

Attitudinal attributes	Social/Aesthetics Orderliness (SO/AO)	Instrumental Attributes (IA)	Personal Orderliness (PO)
Elegant	.740		
Respectable	.656		
Exciting	.622		
High social value	.603		
Relaxed	.586		
Healthy	.552		
Fast	.479		
Advance	.439		
Calm	.421		
Reliable		.659	
Comfortable		.644	
Convenient		.533	
Attractive		.433	
Safe		.427	
Personal			.710
Un-crowded			.685
Friendly			.523
Cronbach's Alpha	.877	.766	.683
Factor average	1.20	1.238	.928
% of variance explained	19.57	13.63	11.51

4. Structural Equation Modeling (SEM) of Intentions Towards Public Transport

In the field of transport and behavioural research, Structural Equation Modelling (SEM) techniques have been used widely to evaluate travel behaviour (Jang and Hwang, 2009; Steg, 2003; Javid *et al.*, 2012a, b; Golob, 2003) and different software packages are available for this purpose such as SPSS Amos 19.0. Structural Equation Modelling (SEM) is a statistical methodo-

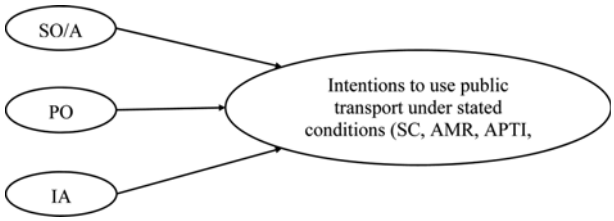

Fig. 2. A Typical Diagram of Structural Model

logy that takes a confirmatory approach (i.e., hypothesis testing) to the analysis of structural theory bearing on some phenomenon. Typically, this theory represents "*causal*" processes that generate observations on multiple variables (Bentler, 1988). The term structural equation modelling tells two important aspects of the procedure: (a) that the causal processes under study are represented by a series of structural equations (i.e., regressions) and (b) that these structural relations can be modelled pictorially to enable a clear conceptualization of the theory. An SEM model includes measurement model, which identify latent constructs underlying a group of observed variables, and/or structural equations, which depict the directional relationships among latent and observed variables. An SEM model can handle a large number of endogenous and exogenous observed variables as well as latent variables specified as linear combinations of the observed variables (Golob, 2003). It has ability to test multiple hypothesis at one time with multiple dependents, provides flexibility in assumptions, and can illustrate direct effects between variables and indirect effects through mediating variables (Jang and Hwang, 2009). Estimation of SEM is performed using the con-variance analysis method. If goodness-of-fit is adequate, the model argues for the plausibility of postulated relations among variables; if it is inadequate, the tenability of such model is rejected (Byrne, 2010). In this paper, structural models were developed using results of factor analysis on attitudinal aspects of private car and public transport, and intentions to use public transport under stated conditions. Fig. 2 shows a typical construct of structural equation modelling of this section.

4.1 Models of People's Intentions Towards Public Transport with Factors of Public Transport

The models parameters were estimated separately for people's behavioral intentions towards public transport using extracted attitudinal factors of public transport. The SEM results as presented in Table 5 depict that people's attitudes on social/aesthetics and personal orderliness of public transport have significant and positive relationship with people's intentions to use public transport under Situational Constraints (SCs). It means the respondents who have negative attitudes on social and personal dimensions of public transport also have low preferences to use it under SCs. Attitudes on instrumental attributes of public transport have positive influence on public transport usage under mobility restrictions on car use. It can be argued that improvement in instrumental dimensions of public transport along with mobility restrictions on car would help in enhancing the use of public transport. However, the different mobility restrictions on car use may result different potential for the use of public transport among people depending upon their socio-economic class and trip characteristics as some restrictions offer compulsory choice to the travelers and some offer option choice for the use of public transport. some are Social/aesthetics and personal orderliness have significant and positive relationship with public transport incentives. These results imply that improvement in social and personal dimensions of public transport together with instrumental incentives would help in improving the image as well as use of public transport. The significant structural relationship between moral obligation and personal orderliness is negative which depicts that people feel moral obligation in using public transport for environmental protection, preservation of resources, and reduction of traffic congestion even they possess negative attitudes on personal dimensions of public transport. Positive relationship between instrumental factors and intentions under moral obligation implies that improvement in functional features of public transport has positive impact on activating the moral obligation of people for the use of public transport or reducing the use of car.

4.2 Models of People's Intentions towards Public Transport with Factors of Private Car

Results of structural models as presented in Table 6 for public transport usage with extracted attitudinal factors of private car show that attitudes on personal and instrumental attributes have negative effect on public transport usage under situational constraints. It means people who have high positive attitudes on personal and instrumental dimensions also have low preferences to use public transport under situational constraints. It can be argued that people do/would prefer to use private car while travelling with family members due to privacy and security matters. Considering the cases of mobility restrictions on private car and public transport incentives, social/aesthetics orderliness of private car have significant and negative relationship with intentions to use public transport. It shows that the strong attitudes on social/aesthetics dimensions result negative influence on acceptance of mobility restrictions on car use and public transport incentives. However, mobility restrictions and public transport incentives are little effective in changing the behavioral intentions even respondents have positive attitudes on instrumental attributes of private car as these relationships are positive. From these results, it is said that social and aesthetics dimensions of private car are more decisive factors than instrumental dimensions. Similarly, respondents who have positive attitudes on social/aesthetics dimensions of private car feel moral obligations less in using public transport. Nevertheless, relationship of personal and instrumental attitudes is positive with respondent's moral obligation. It means there are some people who have positive beliefs on these dimensions also feel moral obligation in using public transport or reducing the use of private car.

4.3 Goodness-of-fit of Structural Models

The values of indices of goodness of fit parameters for each

Table 5. People's Intentions to Use Public Transport Under Attitudinal Factors of Public Transport

Attitudinal latent variables of public transport	Latent variables of behavioral intentions			
	Situational Constraints (SC)	Acceptance of Mobility Restrictions (AMR)	Acceptance of Public Transport Incentives (APTI)	Moral Obligation (MO)
Social/Aesthetics Orderliness (SO/AO)	.34**	.06	.23*	.11
Personal Orderliness (PO)	.23**	.08	.14*	-.28**
Instrumental Attributes (IA)	.10	.27*	.13	.15*
Indicies of goodness-of-fti parameters of each structural model				
Chi-sq/DF	2.73	2.60	2.38	2.84
RMR	.077	.079	.080	.088
GFI	.881	.877	.883	.884
AGFI	.850	.847	.885	.851
CFI	.910	.910	.925	.912
RMSEA	.070	.068	.063	.072

Note: **Significant at 5% and *Significant at 10%, SO/AO: social/aesthetic orderliness, PO: personal orderliness, IA: instrumental attributes

Table 6. People's Intentions to Use Public Transport Under Attitudinal Factors of Private Car

Attitudinal latent variables of private car	Latent variables of behavioral intentions			
	Situational Constraints (SC)	Acceptance of Mobility Restrictions (AMR)	Acceptance of Public Transport Incentives (APTI)	Moral Obligation (MO)
Social/Aesthetics Orderliness (SO/AO)	-.12	-.21*	-.29*	-.21*
Personal Orderliness (PO)	-.22*	-.06	-.07	.24**
Instrumental Attributes (IA)	-.23*	.16*	.15	.17*
Indicies of goodness-of-fti parameters of each structural model				
Chi-sq/DF	2.99	2.84	2.475	3.06
RMR	.078	.077	.076	.081
GFI	.887	.884	.894	.892
AGFI	.853	.851	.866	.857
CFI	.897	.898	.821	.903
RMSEA	.075	.072	.065	.076

Note: **Significant at 5% and *Significant at 10%, SO/AO: social/aesthetic orderliness, PO: personal orderliness, IA: instrumental attributes.

model are presented in Table 5 and Table 6. Following parameters were used to check the goodness of fit of each model: chi-square/Degree of Freedom (χ^2/DF), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA) and rOot Mean square Residual (RMR). Different researchers in the field of statistics have recommended permissible values for parameters of goodness of fit. As the ratio of chi-square to the Degree of Freedom (χ^2/DF) less than 5 indicate a reasonable fit of SEM model (Marsh and Hocevar, 1985), GFI, AGFI, and CFI greater than .90 indicate good fit of model (Bentler and Bonett, 1980), RMSEA less than .08 shows a good fit (MacCallum *et al.*, 1996), RMR less than .08 is acceptable (Hu and Bentler, 1999). Seeking these recommendations it can be argued that the developed models have reasonable fit in estimating the respondent's attitudes and behavioral intentions.

5. Conclusions

This paper focuses on the evaluation of people's intentions to use public transport under situational factors, mobility restrictions and incentives, and moral obligation. It is found that situational constraints significantly influence the people's intentions to use improved public transport i.e., people travelling with family members would prefer to use their private car instead of public transport. However, they might use public transport occasionally while travelling alone. This study implies that such social and family constraints contribute in mode choice behavior in Lahore city. In mobility restrictions on car use, fiscal measures are found to be highly influential in changing intentions along with car entry restrictions in public transport service area. It implicates that these fiscal restrictions on car use need to integrate with public transport improvement policies for the promotion of targeted groups to public transport from private vehicle. Otherwise, alone public transport improvement will not be effective in changing the travel attitudes and behavior of the current and potential car users. Parking charges and road tax need to impose and/or increase from existing level gradually on car use depending on type of land use and nature of transportation problems to be handled. In addition, car entry restrictions can be imposed in highly congested areas considering the nature of land use such as central business district or city center and other areas with concentration of commercial and business activities, but with guarantee of availability of an efficient and affordable public

transport facility. Similarly, parking facilities can be restricted in transit-oriented areas for the enhancement of public transport usage. For proper implementation of these land use and fiscal policies, the selection of appropriate target segment of travel market is very important as the socioeconomic and trip characteristics of different segments vary; therefore, different transport policies are required for different segments of travel market. It is found that people's high moral obligation for preservation of natural resources and reduction of air pollution can be helpful in making effective use of public transport. However, some self-motivation and regulation programs are required for auto users in order to attract them towards improved public transport.

It is found that people have negative attitudes with existing public transportation of Lahore city; therefore, major improvements are required in all aspects of service quality in order to change attitude from negative to positive of people belonging to targeted groups. This study finds that social/aesthetics and personal orderliness and instrumental attitudinal aspects of private car and public transport are significant determinants of people's intentions to use improved public transport under stated conditions. However, different service quality factors of private car and public transport affect differently the consideration and acceptance of policy measures. The respondent's negative attitudes on social/aesthetic and personal aspects of current public transport tend to decrease the use of improved public transport under both situational factors and public transport incentives. However, improvement in these dimensions would enhance the use of public transport. It is also found that improvements in instrumental aspects of public transport would help in better acceptance of mobility restrictions on car use. It would also help in lifting the moral obligation of people in using public transport or reducing the use of private car.

It is found that people who have high positive attitudes on social/aesthetic dimensions of private car may reject the selected mobility restrictions on car use and given incentives of public transport. Moreover, these positive attitudes dominate over feelings of moral obligation for use of public transport. It means these social/aesthetic dimensions of private car tend to lower the potential usage of improved public transport, and acceptance of fiscal and land use restrictions on use of private vehicle. Similarly, positive attitudes on personal orderliness of private car tend to reduce the use of public transport. It is also found that people who belong to middle-high income class have willingness to accept mobility restrictions on car use and public transport incentive even they possess positive attitudes on instrumental attributes of private car. These findings implicate that social and personal dimensions of transportation modes have more significance in determining the mode choice behavior, and acceptance of TDM measures (fiscal restrictions and land use policies). Therefore, it is suggested to give equal importance to social/aesthetic and personal dimensions in improvement or development of public transport system along with instrumental attributes. In other words, the service quality of public transport in Lahore city should be competent enough to private car in all aspects. Moreover, image of public transport need to improve from perspective of auto users for effective change of travel behavior. For this purpose, different motivation and social marketing programs or soft TDM policies can be incorporated.

This study identified a new variable "personal orderliness" of attitudinal aspects of transport modes that has significant implications on people's intentions towards public transport considering situational constraints, instrumental incentives of public transport and moral obligation. It is also found that local and social attitudinal aspects of people of concerned city such as privacy, respect in the society in using specific transport mode, friendliness and gracefulness of modes, and individual's situational constraints are significant decisive factors in mode choice behavior.

Different people may perceive different transport modes differently, and attitudes and intentions of different modes users may be different. It is suggested to evaluate the attitudes and intentions of different groups of travel market using segmentation approach. It would help in making effective improvements in public transport system. In addition, it is required to evaluate the attitudes of people towards public transport after opening of BRT line because it may result change in attitudes and intentions of public, and acceptance of mobility restrictions on car use. Future studies also need to focus on presenting public transport improvement scenario with different levels of fiscal measures. For this purpose, 'experimental design' approach needs to incorporate.

The extracted transportation policies for public transportation improvement in this study have some limitations in their implementation as the sample size is small and conducted survey focused only on response of some specific group of travel market. Careful attention is required for the consideration of the derived policies in this study. In addition, Stated Preference (SP) survey approach was applied in this paper and this approach suffers from different biases, including justification and policy biases (Bhattacharjee *et al.*, 1997), and people's behavior may be different from stated intentions (Ben-Akiva and Morikawa, 1990). Therefore, there is a need of post study after implementation of any policy measure to check actual behavior of commuters. The findings of this study would provide guidelines for transport planners and authorities in considering appropriate attributes for public transport improvements, and other TDM measures.

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