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PUBLIC ATTITUDES TOWARDS TRAVEL DEMAND MANAGEMENT (TDM) STRATEGIES IN LAHORE, PAKISTAN IMPORTANCE OF LIFESTYLES, SOCIAL AND TRAVEL RELATED BELIEFS

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PUBLIC ATTITUDES TOWARDS TRAVEL DEMAND MANAGEMENT (TDM) STRATEGIES IN LAHORE, PAKISTAN: IMPORTANCE OF LIFESTYLES, SOCIAL AND TRAVEL RELATED BELIEFS

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ABSTRACT

This study aims to identify the factors to be important in the acceptability of travel demand management (TDM) strategies using the framework of theory of planned behaviour. A questionnaire survey was conducted in Lahore, and influence of lifestyles and attitudes on acceptability of TDM strategies investigated. Eight strategies were categorized into three classes i.e. pull strategies (public transport improvement, office/campus transport, tele-work), push strategies (road and gasoline tax, parking charges), and psychological strategies (education and awareness programs, traffic information). Results of structural equation modelling revealed that personality traits, travel attitudes, perceived behavioural control, and intentions are significant determinants of people's attitudes towards TDM strategies. This study shows the interdependencies among TDM strategies, and suggests that integrated approach is required in implementing different strategies. Structural comparison depicts that heterogeneity for lifestyles and attitudes exists across different mode users, and structural model of car users has good representation of overall combined model. This study implicates that proper attention should be given to individual's lifestyles, social, and travel attitudes in incorporating TDM strategies in Lahore as well as cities of other developing countries.

Keywords: TDM, acceptability, travel behaviour, lifestyles, Attitudes, Lahore

INTRODUCTION

The rapid increase in urban population and vehicle ownership and its usage has resulted urban transportation problems in developing countries. Mobility is an important element of a community and it is mainly dependent on automobile in most of the developing countries. Similar to other cities, rapidly growing population and traffic demand have resulted chronic traffic congestion on road network in Lahore city. It is the second largest city of Pakistan with almost 8.65 million population and area about 1792 Km^2 (JICA, 2012). Number of vehicles is increasing at an alarming rate i.e. 17 % per annum and major reasons of increase are the absence of an efficient public transport and banking leasing policy. Changing lifestyles, status symbol, and low ownership and usage cost of automobile are also the contributing factors. Lahore city has great potential of mass transit development considering the number of trips generated due to high-density development in the inner zone. Population density varies from 450 persons to 100 persons per hectare in inner and outer zone respectively (JICA, 2012). However, transport policies are mostly developed just considering the benefits of automobile users, which impose greater external cost to most of the population. Moreover, lacking of technical, financial, and institutional resources, energy and environment problems demand the implementation of demand side measures along with supply side. Travel Demand Management (TDM) measures are considered as effective tools in influencing the travel behaviour and have significant impact on reduction in travel time and cost, and convenience of travel options (Garling *et al.* 2002). TDM strategies are mainly classified into two categories i.e. push measures, aiming to reduce the advantages of car use (e.g. increase in fuel and road taxes, etc), and pull measures where alternative travel choices are provided (e.g. improved public transport, vanpooling) (Steg and Vlek, 1997). Another classification includes hard measures such as road pricing, parking charges, new public transport service and soft measures as workplace travel plans, personalized travel planning, public transport marketing, and travel awareness campaigns (Garling and Fujii, 2006).
Now-a-days, most of the cities are facing problems of designing appropriate set of policy measures in order to achieve proper standard of urban mobility. It is believed that for successful implementation of TDM strategies, it is essential to explore the potential of appropriate TDM strategies in advance in a specific region. Policies that promote cheaper travel choices will be effective for a major portion of residents in developing countries (Litman, 2004). It is vital to promote such policies, which should reduce advantage of car use and increase benefits of public transport usage (Garling, and Schuitema, 2007). TDM measures such as education and behaviour change initiatives, promotion of tele-working and flexible work hours, support for ridesharing, and public transport improvement would reduce the vehicle trip through psychological effects and by providing variety of alternatives. Imposing vehicle ownership and usage related taxes (registration tax, parking charges and road tax) might discourage both car ownership and usage (Faiz *et al.* 1990).

Acceptability of Travel Demand Management Strategies

The acceptability of TDM strategies is important to evaluate that whether a specific strategy will effectively change travel behaviour of commuter or not (Schade, 2003; Thorpe, *et al.* 2000). In different studies, push measures perceived low acceptance from public compared

to pull measures (Schlag, *et al.* 2000, Bhattacharjee, *et. al.* 1997; Thorpe, *et al.* 2000). However, commuters normally perceive pull measures to be more suitable, even push measures often estimated to influence car use decrease largely (Steg & Vlek, 1997). It is vital to explore the factors influencing the acceptability and success of policy measures. Studies in developed countries have shown different factors to be important in the acceptability of measures e.g. pro-environmental intentions, problem awareness, personal norm, individual freedom in mode choice, situational factors, value orientation and environmental beliefs, (Schade & Schlag, 2003, Steg 2003, Eriksson, *et al.* 2006; Jakobsson *et al.* 2000). In developing countries, few studies provide the evidence of impact of socio-economic factors such as income, education, and gender on acceptance and effectiveness of TDM measures (Bhattacharjee, *et. al.* 1997; Pradono *et al.* 2009; Pkusumantoro, *et al.* (2009). Other important features need to consider in policy making concerning about transport is the current and changing nature of society, lifestyle patterns and travel attitudes that generate diversified travel demands (Beirao and Cabral, 2007), and instrumental factors seem to play an important role such as feelings of power, freedom, status, and superiority (Steg, 2005). It is believed that lifestyle strongly influences the individual's travel behaviour (Bin and Dowlatabadi, 2005; Hildebrand, 2003; Tranter and Whitelegg, 1994). In some studies, different attitudes have been found to influence individual's behaviour significantly (Dobson, *et al.* 1978; Prillwitz and Barr, 2011; Anable, 2005). Similarly, personality characteristics have also been found to have some impacts on travel behaviour (Prevedouros, 1992). Cao and Mokhtarian (2005a, b) state that travel related strategies are likely to be affected by attitudes, personality, and lifestyles. Therefore, this study included lifestyles and attitudinal aspects of travel behaviour such as value of money, personality traits, community oriented travel attitudes, attitudes towards public transport and travel preferences in case of congestion.

Objectives and Outline of Paper

From perspective of developing countries, it is important to explore the significant factors in the planning stage that contribute to the acceptability and success of policy measures. A better understanding of the role of changing lifestyles and travel behaviour can support successful implementation of policy measures. Designing a questionnaire for grasping user's preferences in order to make some significant inferences is a critical task in developing countries due to low literacy and response rate. Reliability of data is a major issue when questionnaire include items relating to lifestyles, attitudes and stated preferences, and special attention is required in designing questionnaire and conducting survey. Therefore, this study aims to design a questionnaire survey in order to evaluate the people's attitudes towards the selected TDM strategies considering lifestyles, attitudes, and intentions. It is assumed that those strategies would be appropriate that aim to reduce private vehicle trips, provide alternatives to car, and influence travel behaviour through awareness and information. The selected TDM strategies in this study are classified into three categories i.e. psychological or soft strategies (traffic education and awareness, traffic information), pull strategies (tele-work, public transport improvement, office/ campus transport) and push strategies (parking charges, road tax and fuel tax). The acceptability of strategies was evaluated using structural equation modelling tools and under the framework of Theory of Planned Behaviour (TPB). Initially, factor analysis has been conducted to factorize the

lifestyles and attitudes into three latent variables, and then these factors have been used to construct the structure of acceptability. This paper is organized in the following manner. Section 2 describes the research methods. Respondent's socio-economic characteristics and opinions to lifestyles, attitudes, intentions and TDM strategies are presented in section 3, whereas structures of people's attitudes towards TDM strategies has been described in section 4. Last section summarizes the conclusions and implications of this study.

RESEARCH METHODS

Modelling Framework

It has been hypothesized that attitudes and lifestyles are likely to affect individual's attitudes towards TDM strategies. The community and congestion oriented travel attitudes are expected to have positive relationship with TDM strategies. Status and personality oriented factors may have negative association with specific travel reducing strategy. However, different attitudes and lifestyles may affect the consideration of each strategy differently. Theory of planned behaviour (TPB) has been used as a frame of reference to formulate the framework of people's attitudes towards TDM strategies. The TPB (Ajzen, 1991) is a hedonic model of human motivation assuming that people avoid punishments and seek rewards. According to this theory, travel behaviour is supported by rational evaluation of behavioural outcomes. The sum of perceived positive and negative outcomes determines the first factor of this theory i.e. attitude towards the behaviour. Social or subjective norms are considered as second factor influencing behavioural intentions, which mean behaviour under social pressure. The TPB also realizes the significance of various situational constraints on individual travel behaviour and adaptation process to a specific behaviour. Perceived behavioural control (PBC) is the third important factor in TPB, which means individual's ability to perform given behaviour. It is believed that PBC also has direct impact on behaviour. Many researches in transportation have applied the framework of TPB in different aspects such as determination of driver's decision to speed (Warner and Aberg, 2006), determination of ecological impact of mobility behaviour (Hunecke *et al.* (2007), underlying factors of sustainable travel behaviour (Prillwitz and Barr, 2011), Anable (2005) identifies the travel behaviour segments using this theory, and Cao and Mokhtarian (2005a, b) identify the determinants of individual travel behaviour.

In this study, three latent factors were identified from lifestyles and attitudes through factor analysis. Structural equation modelling (SEM) techniques was used to construct the structure of public attitudes towards strategies. In many researches, SEM tools have been used to evaluate the influence of lifestyles, attitudes, norms, freedom, and fairness and other factors on travel behaviour as well as attitudes towards TDM strategies and environmental supportive policies (Eriksson *et al.* 2006; Golob, 2003; Golob and Hensher, 1998; Dobson *et al.* 1978). Other studies include two latent variables model of support for public transport and institutional reforms in public transport planning (Levine *et al.* 1999), five latent variables model to examine causality among acceptance of road pricing, behavioural intention of car use reduction, and feelings related to fairness and personal freedom (Jakobsson *et al.* 2000), driver's speeding behaviour (Warner and Aberg, 2006), determinants of moral obligation of car use reduction and acceptance of car use restriction (Choocharukul *et al.* 2006)

Questionnaire Design and Survey

Seeking the objectives of this study, a questionnaire was designed. Part one of questionnaire included personal and travel information of respondents i.e. gender, age, income, education, occupation, vehicle ownership, trip frequency by different modes and for different trip purposes. Travel pattern with different modes and for different trip purposes was asked using the following scale; never, a few times a year, a few times a month, 1-2 days a week, 3-4 days a week, and 5-7 days a week. Perceptions to lifestyles, attitudes, behavioural intentions, and selected TDM strategies were asked in part two and three respectively. All the stated questions of last two parts were evaluated using four-point Likert scales i.e. strongly disagree, somewhat disagree, somewhat agree and strongly agree. In this study, it was assumed that 4-point ordinal scales are appropriate considering a questionnaire survey in developing country, simplicity of respondents and reliability of data in grasping the actual behaviour. Sense of different social values, living preferences, personality and status matters, and community/family related travel attitudes and preferences in travelling under certain conditions are the main motives in the selection of various lifestyles and attitudes. The questionnaire also included statements related to use of the public transport under certain parking restrictions. The detail of all the questions related to part two is given in Table 2. Two statements were asked on personal intention 'to do not use/reduce usage' of private vehicle in order to reduce traffic congestion and negative effects on environment as presented in Table 3. The eight TDM strategies were selected seeking to increase the usage cost of car, providing alternative travel options to car, behaviour change through psychological measures and feasibility of implementation in Lahore. The respondents were asked to report their opinion on each strategy based on whether they support to a specific strategy in reducing the traffic congestion and environmental problems or not. In case of fuel taxes, carbon tax only on gasoline was included considering the social impacts of tax on other fuels e.g. diesel, because increase in tax on diesel may result increase in price of living goods. Other fiscal strategies include willingness to pay road taxes for the improvement of traffic conditions, and support to increase parking charges at work sites. The strategies, intentions to do tele-work, and participate in organization and institution based transport services were selected keeping in view current and future potential. Currently, some of the organizations and institutions are providing transport for their employees and home-based work for skilled workers. Only low to lower middle-income people use such transport, whereas upper middle to high income people still prefer to use their private vehicle. The willingness was asked to participate in traffic education and awareness programs, and use public transport in case of better mode e.g. bus lanes or rail mass transit. Opinion was asked on the provision of advance traffic information to relieve traffic congestion in the city.

This questionnaire was designed to target current and potential car users. The intentions involved in including the opinion of potential car users are the high rate of car ownership and usage in the last decade due to low ownership and usage cost. It has become easy for middle-income people to buy a car using banking leasing policy. In addition, free parking or very low parking fee at most of the commercial and business areas encourages the use of private vehicle especially car. Other main objective of this survey was to target daily commuters, and get mix of different mode users. This survey was conducted in Lahore during September 2011 with the help of graduate students of university. The students were

instructed about the contents of questionnaire and trained for survey methods. The main target groups were included students, employees of organizations and people related to commercial and business sector. It was conducted at thirteen different locations in Lahore. Initially, questionnaire was checked for concreteness and clarity of sentences and wording through one-day pilot survey. The survey locations were assigned to students, and self-completion (by respondents) and interview approaches were used in survey deeming the literacy level of respondents. It was assured to take interview from those respondents whose literacy level was low. The respondents were selected randomly at each location and total 1,000 questionnaires were used.

RESULTS AND ANALYSIS

Distribution of Respondent's Socio-economic Characteristics

A total 631 useable samples were obtained, which represented a return rate of 63.1%. The share of female respondents is 23.3% in sample, which is less compared to total share of population. This is, because female do not drive motorcycle and bicycle, and do not work in commercial sectors. Sample shows that 64.6% respondents have education bachelor or above, which is higher than actual literacy rate. This is due to presence of car and potential car users in sample because they belong to medium to high-income class, and thus, education level increases with the increase of income. Sample represents a good mix of different mode users and occupations. The share of different modes follows as car (25.5%), motorcycle (35.5%), public transport (16.8%), auto-rickshaw (7.1%), office/campus transport (5.9%), and walk/bicycle (9.2%). Almost 83.5% of respondents have trip frequency 5-7 days a week and 10.6% 3-4 days a week, which indicate that collected samples nearly represent daily travellers. A cross-analysis was conducted between modal share and vehicle ownership. Initially, sample was segmented for vehicle ownership i.e. no vehicle, only motorcycle, car and motorcycle, and only car. The results of cross analysis as given in table 1 depict that car and motorcycle owners prefer to use their private vehicle instead of other modes. From this analysis, sample was segmented into four classes based on mode dependency and captivity of choice i.e. car users including auto-rickshaw, motorcycle users, public transport users including office/campus transport and non-motorized modes users.

Table 1: Distribution of modal share (frequent travel mode) across vehicle ownership (%)

Vehicle ownership	Car	Auto-rickshaw	Motor cycle	Office/ campus transport	Public bus	Public Wagon	Qingqi	Walk/ Bicycle
No vehicle	0.0	6.59	2.20	7.69	29.67	14.29	13.19	26.37
Only motorcycle	0.82	8.20	57.79	5.33	8.20	4.92	5.33	9.43
Car and motorcycle	42.49	4.15	39.90	7.77	1.04	0.00	0.52	4.15
Only car	72.82	10.68	3.88	2.91	0.97	2.91	2.91	2.91

Factor Analysis for Lifestyles and Attitudes

A factor analysis was conducted for lifestyles and attitudes, and three factors extracted as presented in Table 2. These factors were named considering the tendencies associated with observed variables of each factor, and concept of TPB i.e. personality traits (PT), travel attitudes (TA)-(community and congestions oriented travel attitudes) and perceived

behavioural control (PBC)-(perceived ability to change schedule due to others, and interact with unknown people, and control over shorter travel time in travelling). The Cronbach's alpha values for PA, TA, and PBC are .59, .64, and .52 respectively. Average response was also calculated for perceptions to lifestyles and attitudes as presented in Table 2. Results indicate that respondent's preferences are high for 'to change lifestyles with the change of income', and 'it is better to have a car'. Similarly, high preference is given to live near to work place and to shorter travel time. However, cheaper fare has lower priority over shorter travel time. Most of the respondents have attitudes of ride sharing with family members and friends for commuting. The preference to change route is higher compared to mode change in case of traffic congestion. This is due to high share of car and motorcycle users in the sample, as it is easy for them to change route in case of traffic congestion. The last four questions were only asked from car and motorcycle users. It looks that some of the car and motorcycle users have willingness to use public transport if certain parking restrictions are imposed.

Table 2: Average response and factor loadings for lifestyles and attitudes

Factors	Description of lifestyles and attitudes	Mean	FL
Personality traits (PT)	I am very keen to change my lifestyle with the change of income	3.17	.51
	I prefer to live near to my work/business/study place	3.31	.44
	It is better for me to have a car	3.35	.43
	Mode or mean of transportation affects my personality image	2.96	.37
Travel attitudes (TA)	I prefer to change travel route in case of traffic congestion	3.28	.62
	I prefer to walk or use bicycle for a trip length of 1-2 km	2.90	.53
	I like ride sharing with my friends/colleagues going to work/study trip	3.03	.46
	I prefer ride sharing with my family members going to work/study trip	3.09	.45
	I prefer to change mean of transportation in case of traffic congestion	2.81	.39
Perceived behavioural control (PBC)	Shorter travel time is the priority	3.24	.68
	It disturbs me if I am forced to change in my routine due to others	3.07	.55
	I avoid to interact with unknown people in travelling	2.74	.39
Cheaper fare is the priority		3.02	---
Use of private vehicle (car or motorcycle) increases work efficiency		3.36	---
It is acceptable for me to use public transport for short trips like 3-5 km		2.57	---
It is acceptable for me to use public transport if parking is not available		2.72	---
It is preferable for me to use public transport if parking fee is very high		2.59	---
I would use private vehicle even if other modes offer shorter travel time		2.66	---

Note: FL: factor loadings, --- relationships were not determined with the extracted factors.

Factor Analysis for TDM Strategies and Intentions

A confirmatory factor analysis was conducted to confirm the factors, and estimate the factor loadings of indicators. The Cronbach's Alpha values for factors of intention, soft, pull and push strategies are .73, .60, .54 and .64 respectively. These results are presented in table 3. The results reveal that people's intentions 'to do not use/reduce usage' of private vehicle are higher for environmental reasons compared to traffic congestion, however, factor loading is higher for reduction of traffic congestion. Psychological measures and better mode of public transport in pull measurers have highest average score among all strategies. The strategies

of intentions to use organization or institutional based transport service, and do tele-work have moderate support from respondents. Fiscal or push strategies have obtained lowest score from the respondents. In evaluating the strategy of carbon tax on gasoline, respondents considered the social impacts of increase in fuel price.

Table 3: Average response and factor loadings of TDM strategies and personal intentions

Factors	Description of items	Mean	FL
Intention	I personally feel responsible 'to do not use/ reduce usage' of private vehicle in order to reduce traffic congestion	2.47	.63
	I personally feel responsible 'to do not use/reduce usage' of private vehicle in order to decrease negative effects on environment	2.77	.57
Soft strategies	Advance traffic information would be helpful to relieve traffic congestion	3.36	.48
	Intentions to participate in traffic education and awareness programs	2.96	.42
Pull strategies	Intentions to do tele-work if there will be an opportunity	2.74	.62
	Intentions to use organization/institution based transport service	2.59	.55
	Willingness to use better mode of public transport like rapid rail mass transit or bus rapid transit	3.20	.47
Push strategies	I support to increase parking charges in order to reduce traffic congestion	2.29	.71
	I support to increase carbon tax on gasoline in order to protect environment from air pollution	2.52	.51
	Willingness to pay road taxes in order to improve traffic conditions in city	2.71	.37

Note: FL: factor loadings, all the correlations were significant at $p < 0.01$,

STRUCTURAL EQUATION MODELING

Different software packages are available for structural equation modelling purpose such as Amos 19.0. Using results of factor analysis initially separate structure of each category of TDM strategies was constructed, and then, a combined structural model constructed of all three categories. At the end, estimates of structural equations for different mode users were estimated for combined model only. Different researchers in the field of statistics have recommended permissible values for parameters of goodness-of-fit of a model. As the ratio of chi-square to the degree of freedom ($\chi 2/DF$) less than 5 indicate a reasonable fit of model (Marsh and Hocevar, 1985), GFI, AGFI, and CFI greater than .90 indicate good fit of model (Bentler and Bonett, 1980; Bentler, 1982), RMSEA less than .08 shows a good fit (MacCallum *et al.* 1996), RMR less than .08 is acceptable (Hu and Bentler, 1999).

Separate models for TDM strategies

Soft or psychological strategies: The modelling results in Fig. 1 (a) show that personality traits (PT) are related negatively with intention, whereas travel attitudes (TA) and perceived behavioural control (PBC) positively. It means people's intentions 'to do not use or reduce use' of private vehicle are affected negatively with the change of personality traits. It implies that people who have high preference for personality traits have less intention to reduce use of private vehicle. On the other hand, congestion and community oriented travel attitudes and perceived control beliefs have positive impact on intention. It means people who have more

concern about traffic congestion and community and strong control over behaviour possess more potential to reduce use of private vehicle. The acceptability of psychological strategies is significantly affected by intention, PT, TA, and PBC. It is found that the TA has direct and mediating effect through intention on acceptability of psychological strategies. It is argued that this model has reasonably good fit in estimating the public attitudes towards soft strategies as $\chi 2/DF < 5$, GFI > .90, AGFI and CFI > .90, CFI ≈ .90, RMR and RMSEA < .08.

Pull strategies: Fig. 1 (b) shows that the TA and intention are related positively to public attitudes towards tele-work, office based transport service and better public transport mode. The PBC has negative influence on acceptability of pull strategies. It means that people who have low control on control beliefs have less intention to accept pull strategies. Model results argue that in order to enhance potential of pull measures in mitigating traffic congestion and environmental problems, first people should have intention of protecting the environment and reducing traffic congestion by reducing car use. The indices of goodness-of-fit parameters argue that this model has good fit in predicting the public attitudes towards pull strategies.

Push strategies: Fig. 1 (c) indicates that the acceptability is positively affected by intention and TA. The TA and PBC have significant direct influence on acceptance of push measures. The TA is positively related with push measures, whereas PBC related negatively, which is same as pull measures. It is argued that for better acceptance of push measures, first people should have intention of 'not using or reduce usage of private vehicle' for environmental and congestion reasons. The indices of parameters of goodness-of-fit are lying nearly within allowable limits; therefore, this model has good fit with the respondent's data.

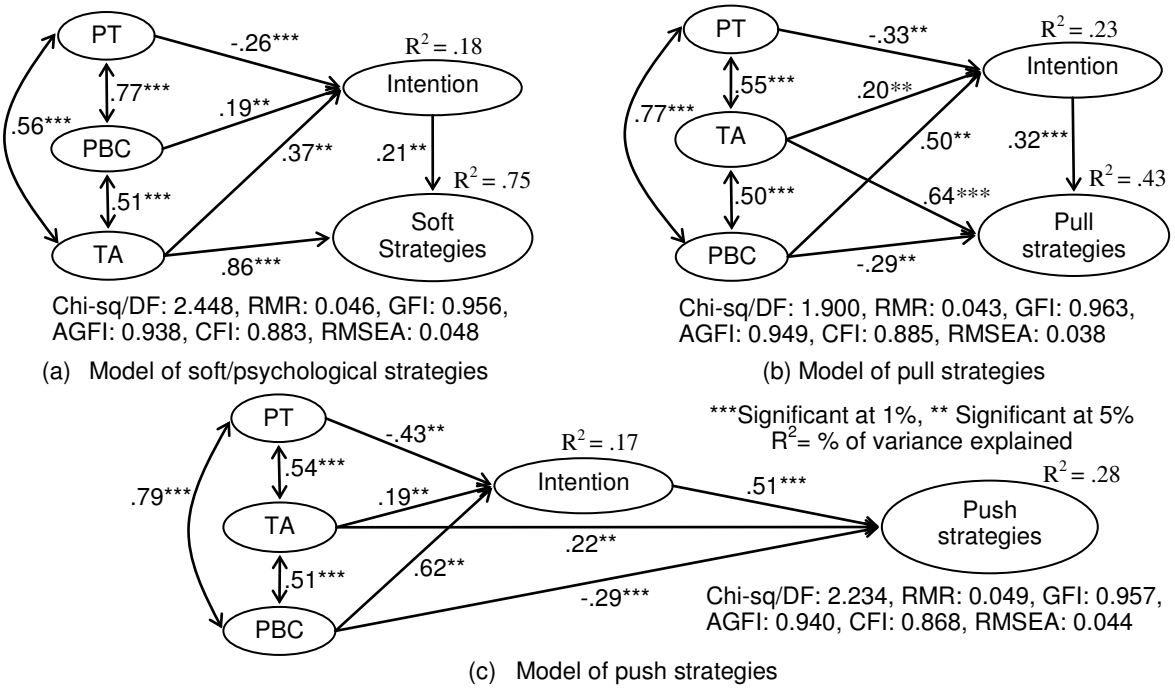
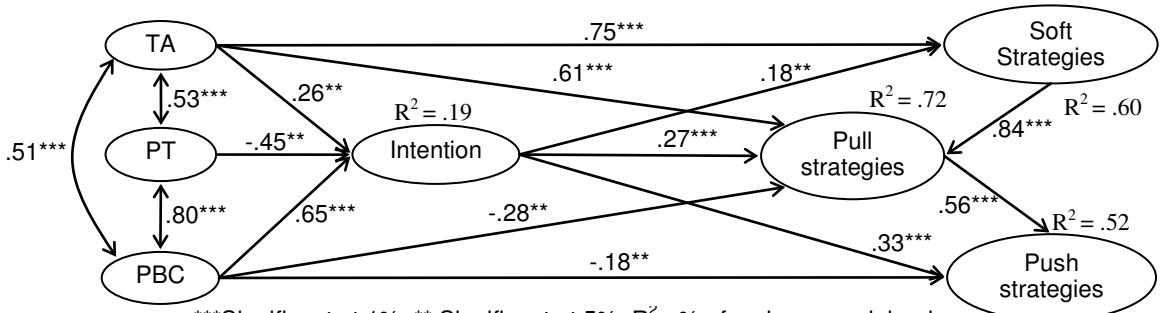


Figure 1– Structural model of soft, pull and push strategies

Combined Structural Model of All Strategies

The combined model helps in understanding the interdependencies among three categories of strategies and their influencing factors collectively. The modelling results in Fig. 2 reveal

that PBC has direct and indirect relationship with push and pull strategies, and TA has direct relationship with psychological and pull strategies. The nature of relationships for structural equations is same as separate models. Combined model predicts significant interdependencies among TDM strategies along with dependence on intention, TA, PT, and PBC. This model tends to explain the process of consideration of TDM measures for practical implementation. As people, generally perceive psychological and pull measures more suitable to implement and push measure less suitable. This model tells that the acceptance of pull measures is dependent on integration of psychological strategies i.e. traffic education and awareness programs, and advance traffic information. Similarly, acceptability of push measures is collectively influenced by integration of pull and psychological measures. This model argues that pull strategies should be implemented in advance of push strategies. The indices of goodness-of-fit parameters are lying within the permissible limits, which indicate that this model has good fit in predicting public attitudes.



***Significant at 1%, ** Significant at 5%, R^2= % of variance explained
Chi-sq/DF: 2.383, RMR: 0.054, GFI: 0.936, AGFI: 0.917, CFI: 0.884, RMSEA: 0.047

Figure 2– Combined model of TDM strategies

Estimation of Combined Model Parameters for Different Mode Users

The combined model developed in previous section was used to make structural comparison among different mode users. Based on results as described in section of distribution of respondents socio-economic characteristics sample was divided into three categories i.e. car users (204), motorcycle users (224) and green travellers (203) (public transport and non-motorized modes). This approach was adapted to make a comparative sample size across three groups. Only standardized estimates of structural equations and indices of goodness-of-fit parameters were compared. It was assumed that variability in indicators across three groups could be judged from structural equations. The results of three structural models are presented in Table 4. The signs of estimated structural equations of car user's model are same as model in Fig. 2. In motorcycle users model TA and PT have negative relationship with intention. The TA of motorcycle user's model also results negative impact on acceptance of pull measures. The signs of other structural parameters are same as overall model but significance of estimated parameters is less in comparison to car user's model. The relationship between PBC and pull strategies is positive in the model of green travellers, which is opposite to overall model. Similarly, the relationship between intention and pull strategies has opposite sign to base model. The indices of goodness-of-fit parameters for car users model are chi-sq/DF=1.884, RMR =.084, GFI=.857, AGFI=.834, CFI=.715, RMSEA=.066; motorcycle users model chi-sq/DF=1.802, RMR =.077, GFI=.882, AGFI=.846,

CFI=.717 and RMSEA=.06 and green travellers model chi-sq/DF=1.967, RMR =.088, GFI=.858, AGFI=.816, CFI=.711 and RMSEA=.069. By comparing results of these models with base model in terms of signs of estimated parameters and their significance as well as indices of goodness-of-fit parameters, it can be argued that the structural model of car users has good representation of overall public attitudes towards TDM strategies.

Table 4: Standardized estimates of structural equations for models of three mode users segments

Co-relations/ Structural equations	Car users (N=204)	Motorcycle users (N=224)	Green travellers (N=203)
PT <---> TA	.56**	.43	.58**
PT <---> PBC	.86**	.78**	.71**
TA <---> PBC	.54**	.47	.53**
PT ----> Intention	-.85	-.23	.43**
TA ----> Intention	.12	-.67	-.20
PBC ----> Intention	1.06	.93	.14
Intention ----> Soft strategies	.25**	.29**	.34**
Intention ----> Pull strategies	.52**	.18	-.12
Intention ----> Push strategies	.84**	.34**	.30**
TA ----> Soft strategies	.82**	.79**	.85**
TA ----> Pull strategies	.61**	-.57	.19
PBC ----> Pull strategies	-.37**	-.39	.28
PBC ----> Push strategies	-.41**	-.17*	-.29**
Soft strategies --> Pull strategies	.32	.79**	.69**
Pull strategies --> Push strategies	.29*	.53	.57**

Note: ** significant at 5% and * significant at 10%, N: number of samples in each group

DISCUSSION AND CONCLUSIONS

This study evaluates the public perceptions and attitudes towards selected TDM measures. Provision of advance traffic information in relieving the traffic congestion is found most favourable strategy. In this context, some conventional type real-time traffic information sources need to provide that should be helpful both for low and highly educated travellers such as traffic radio and variable message signs. As most of people have willingness to use public transport in case of better mode, therefore, public transport needs to develop on priority basis that should be capable to keep existing users and attract potential users (auto users). In-short term road based public transport such as bus rapid transit and in long-term rail based transport system need to develop in order to deal with rising travel demand, and reduce use of private vehicle. Traffic education and awareness programs need to initiate on priority basis as traveller's education and awareness is vital in minimizing the traffic problems. These programs should be initiated both at basic education level (e.g. inclusion of traffic education in curriculum at school level) and before issuing of driving license. In addition, the provided traffic information sources such as traffic radio can also be used to educate the people about traffic problems and their alternative solutions as well as traffic rules. Results imply that there is potential of tele working among people and it can be helpful in reducing the use of private vehicle. In this context, government should create some

opportunities by making essential for the organizations to keep some quota for such activities, and make public aware about these working opportunities through marketing and awareness programs. Organizations and institutions based transport service for employees can be effective in reducing the traffic congestion as most of the travellers have intentions to use. Considering potential of this service, it is suggested to make compulsory for all organizations and institutions to provide transport service for their employees. It is also suggested to impose parking restrictions on private vehicle usage along with provision of this service and public transport improvements. A simple type urban toll or pricing schemes can be imposed as people have willingness to pay road taxes in order to use uncongested roads. A differential type fuel pricing structure (fuel pricing based on vehicle type) is suggested considering the social impacts of increase in taxes and environmental problems. Increase in parking charges at work sites is found least favourable strategy. However, it is believed that parking restraints have more potential to make modal shift; therefore, it is suggested to impose parking charges both at commercial and business areas.

The SEM results depict that PT, TA, and PBC are significant determinants of intention (reduce usage of private vehicle) and acceptability of TDM strategies. Based on modelling results, it is argued that TDM strategies need to implement deeming the lifestyle pattern and attitudes of target group of travel market. This would help in achieving the objectives of a specific policy measure effectively. Modelling results also argue that for better acceptance of TDM strategies, first people should have personal intention of 'not using or reduce usage' of private vehicle for reduction in traffic congestion and environmental problems. The results of combined models revealed that interdependency exists between selected strategies. The acceptability of pull measures is dependent on acceptability and effectiveness of psychological measures. Similarly, the acceptance and effectiveness of push measures is significantly dependent on effectiveness of pull and soft measures. The structural comparison among three mode users segments reveals that heterogeneity exists for lifestyles and attitudes among three types of travellers, and the model of car users has good representation of overall people attitudes towards TDM strategies. Based on results of separate and combined modelling a generalized framework of TDM strategies and their influencing factors is proposed as shown in Fig. 3. It would help in drawing the appropriate measures based on individual's lifestyles, socio-economic factors, beliefs, attitudes, and intentions in order to mitigate traffic congestion, and reduce environmental problems. This framework explains that once people have intentions to reduce congestion and environmental problems by reducing use of private vehicle, then they would accept alternative travel options in better way. It is suggested that intentions and soft strategies are inter-related with each other, as intentions can affect to participate in traffic education and awareness programs and vice versa. Similarly, implementation of pull and push measures can affect people's intention to use car. This model explains that soft measures can be used to promote the alternative travel options to private vehicle users by highlighting the benefits to the public associated with each measure. This would help in getting the higher acceptance from public for fiscal measures and higher attraction for pull measures. Furthermore, study results implicates that integrated approach is required in implementing the various strategies e.g. integration of public transport improvement with strict parking control measures would help in achieving the policy objectives effectively. In other words, policies should be adapted in both sequential way and somehow simultaneously depending upon nature of policy and

objectives to be obtained. Finally, model points out the change in travel behaviour and pattern as result of effectiveness of TDM strategies.

It is believed that combined TDM measures have more influence on travel behaviour compared to individual measures (Eriksson *et al.* 2010; Steg, 2003; Steg and Vlek, 1997). Therefore, it is recommended to evaluate the public attitudes towards packages of measures considering lifestyles and attitudes. This study recommends the detailed evaluation of motorcycle user's attitudes towards policy measures because current motorcycle users would most probably be the potential car users. This study implicates that the TPB can be used as frame of reference in formulating the attitudes towards policy measures in developing countries. However, it may be applicable more if questionnaire items are designed considering its theoretical background. In addition, the proposed framework can be used as reference for developing countries in understanding the attitudes of people towards policy measures. The findings of this study would be helpful for planners and policy makers in implementing suitable strategies for mitigation of traffic congestion.

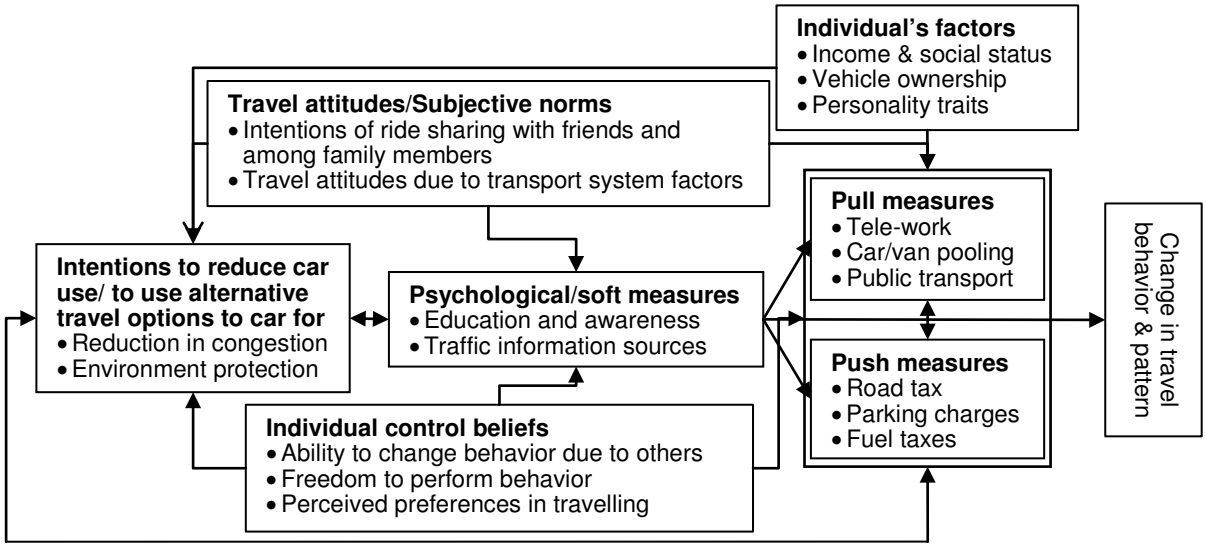


Figure 3 – A generalized framework of TDM strategies and their influencing factors

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