# THE ROLE OF SOCIO-PSYCHOLOGICAL FACTORS IN INFLUENCING TRAVEL BEHAVIOUR: CASE STUDY, DELHI

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*by*


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*to the*

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# Certificate

This is to certify that the thesis entitled "**The Role of Socio-psychological Factors in Influencing Travel Behaviour: Case Study Delhi**" being submitted by **Mr. Sandeep Gandhi** to the Indian Institute of Technology Delhi, India, for the award of the degree of **DOCTOR OF PHILOSOPHY**, is a record of original bona fide research work carried out by him. Sandeep has worked under my guidance and supervision.

To the best of my knowledge, the thesis has reached the requisite standard. The material contained in this thesis has not been submitted, in part or in full to any other university or institute for the award of any degree or diploma.

Dated: October 2019

**(Prof. Geetam Tiwari)**

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Sandeep Gandhi

# Abstract

With increasing use of private motorized modes for meeting growing travel demand, cities are faced with problems of accidents, emissions, congestion and an overall reduction in the quality of life. In developing countries like India, public transport provides affordable mobility to a majority of population which lacks access to private motorised modes. This underlines the importance of promoting these modes in Indian cities. However current efforts by planners and policy makers to limiting private transport use and to increase public transport ridership in cities like Delhi, have met with little success. This highlights the need to better understand commuter travel behaviour and the factors that affect them.

Inclusion of socio-psychological variables, along with currently popular socio-material variables, is considered one of the potential means of better explaining travel behaviour. This research uses literature review to develop a hypothetical construct of an enhanced model of travel behaviour for Delhi, India using 21 socio-psychological and 5 socio-material variables. This construct has been tested using 'structural equation modelling' in Lisrel 10.0, for four different travel modes in Delhi, i.e. Car, Motorized Two Wheeler, Metro and Bus.

Model outputs suggest that different predictor variables are significant in explaining travel behaviour for different modes. Socio-psychological predictor variables contribute almost entirely, while socio-material predictor variables alone have negligible contribution in explaining the variance of use behaviour for different travel modes in Delhi. The standard model which uses only currently popular socio-material independent variables, overestimates the contribution of such variables in explaining the variance of the dependent variable. This overestimation is controlled by the presence of socio-psychological variables, thereby contributing to a more accurate behaviour prediction. Analysis of contribution by different variables in explaining behaviour (in the socio-psychological model) suggests that 'journey specific habits' have a significant contribution in explaining variance of mode use behaviour for all travel modes. This suggests that for increasing public transport ridership, planning and policy measures for disincentivising private motorised vehicle use are as important as those for incentivising public transport use.

# सार

बढ़ती यात्रा की मांग को पूरा करने के लिए निजी मोटर चालित साधनों के बढ़ते उपयोग के साथ, शहर दुर्घटनाओं, उत्सर्जन, यातायात में अवरोध और जीवन की गुणवत्ता में समग्र कमी की समस्याओं का सामना कर रहे हैं। भारत जैसे विकासशील देशों में, सार्वजनिक परिवहन बहुसंख्यक आबादी को सस्ती गतिशीलता प्रदान करता है जिसके पास निजी मोटराइज्ड मोड तक पहुंच का अभाव है। यह भारतीय शहरों में इन तरीकों को बढ़ावा देने के महत्व को रेखांकित करता है। हालाँकि, निजी परिवहन उपयोग को सीमित करने और दिल्ली जैसे शहरों में सार्वजनिक परिवहन राइडरशिप को बढ़ाने के लिए योजनाकारों और नीति निर्माताओं के वर्तमान प्रयासों को थोड़ी सफलता मिली है। यह कम्प्यूटर यात्रा व्यवहार और उन्हें प्रभावित करने वाले कारकों को बेहतर ढंग से समझने की आवश्यकता पर प्रकाश डालता है।

वर्तमान में लोकप्रिय सामाजिक-भौतिक चर के साथ-साथ सामाजिक-मनोवैज्ञानिक चर को शामिल करना, यात्रा के बेहतर व्यवहार के संभावित साधनों में से एक माना जाता है। यह शोध 21 सामाजिक-मनोवैज्ञानिक और 5 सामाजिक-भौतिक कारकों का उपयोग करते हुए दिल्ली, भारत के लिए यात्रा व्यवहार के एक उन्नत मॉडल के काल्पनिक निर्माण को विकसित करने के लिए साहित्य की समीक्षा का उपयोग करता है। लिस्रेल 10.0 में दिल्ली में चार अलग-अलग यातायात साधनों, यानी कार, दो पहिया वाहन, मेट्रो और बस के लिए 'स्ट्रक्चरल समीकरण मॉडलिंग' का उपयोग करके इस निर्माण का परीक्षण किया गया है।

मॉडल के नतीजों का सुझाव है कि अलग-अलग यातायात साधनों के लिए यात्रा व्यवहार की व्याख्या करने में विभिन्न पूर्वानुमानकर्ता कारक महत्वपूर्ण हैं। सामाजिक-मनोवैज्ञानिक पूर्वसूचक कारक लगभग पूरी तरह से योगदान करते हैं, जबकि सामाजिक-भौतिक भविष्यवक्ता कारकों का अकेले दिल्ली में विभिन्न यात्रा साधनों के लिए उपयोग व्यवहार के विचरण को समझाने में नगण्य योगदान है। मानक मॉडल जो केवल वर्तमान में लोकप्रिय सामाजिक-भौतिक स्वतंत्र चर का उपयोग करता है, आश्रित कारकों के विचरण को समझाने में ऐसे कारकों के योगदान को कम करता है। इस गलत अनुमान को सामाजिक-मनोवैज्ञानिक कारकों की उपस्थिति द्वारा नियंत्रित किया जाता है, जिससे एक अधिक सटीक व्यवहार भविष्यवाणी में योगदान होता है। व्यवहार की व्याख्या करने में विभिन्न कारकों द्वारा योगदान का विश्लेषण (सामाजिक-मनोवैज्ञानिक मॉडल में) बताता है कि सभी यातायात साधनों के लिए साधन उपयोग व्यवहार के विचरण को समझाने में सम्बंधित यात्रा विशिष्ट आदतों का महत्वपूर्ण योगदान है। इससे पता चलता है कि सार्वजनिक परिवहन के यात्री बढ़ाने के लिए, निजी मोटर वाहन के उपयोग को काम करने की योजना और नीतिगत उपाय सार्वजनिक परिवहन उपयोग को प्रोत्साहित करने के उपायों जितने ही महत्वपूर्ण हैं।

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## List of Abbreviations

| Abbreviations | Explanations |
|---|---|
| ANOVA | Analysis of variance |
| Beh. | Behaviour |
| CFI | Comparative fit index |
| 'CostV' | Continuous independent variable of observed or reported cost |
| df | Degrees of freedom |
| 'DistV' | Continuous independent variable of observed or reported distance |
| DWLS | Diagonally weighted least squares |
| EMGB | Extended model of goal directed behaviour |
| GFI | Goodness of fit index |
| HM | Hybrid model |
| Hypothesized MTB | Hypothesized model of goal directed behaviour |
| ICLV | Integrated choice and latent variable (model) |
| Km | Kilometre |
| Lisrel | Linear structural relations (structural equation modelling software) |
| MGB | Model of goal directed behaviour |
| ML | Maximum likelihood |
| MTW | Motorized two wheeler |
| N or n | Number of responses or sample size in a data set |
| No. | Number |
| PNFI | Parsimony normed fit index |
| RFM | Response frequency measure |
| RMSEA | Root mean square error of approximation (index) |
| RP | Revealed preference (survey) |
| SD | Standard deviation |
| SEM | Structural equation modelling/model |
| SP | Stated preference (survey) |
| SRMR | Standardized root mean residual (index) |
| Sq.Km. | Square kilometre |
| TIB | Theory of interpersonal behaviour |
| 'TimeV' | Continuous independent variable of observed or reported time |

| | |
|---|---|
| TPB | Theory of planned behaviour |
| TRA | Theory of reasoned action |
| ULS | Unweighted least squares |
| ULSMV | Unweighted least squares mean and variance adjusted |
| UVA | Underlying variable approach |
| WLS | Weighted least squares |