

New Bearings on Justice in Urban Mobility

A Case Study of North-West Delhi

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New Bearings on Justice in Urban Mobility: A Case Study of North-West Delhi

by

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To Apu

who would chew this for food without thought

THESIS CERTIFICATE

This is to certify that the thesis titled **New Bearings on Justice in Urban Mobility**, submitted by **NISHANT SINGH**, to the Indian Institute of Technology, Delhi, for the award of the degree of **DOCTOR OF PHILOSOPHY**, is a bona fide record of the research work done by him under our supervision. To the best of our 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 for the award of any degree or diploma.

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No journey is a solo act, or so they say.

And while I've spent a good portion of my life pretending that I'm some kind of misunderstood lone wolf, the truth is, this thesis—and, well, me—is the product of every relationship, every conversation, every hand that's pulled me out of the quicksand when I was stuck. People who walked with me, carried me, sometimes shoved me forward when I wanted to give up, that made this journey what it is.

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To all of you, and to the many unnamed but not forgotten—this exists because you were there.

Nishant

ABSTRACT

This thesis, "New Bearings on Justice in Urban Mobility," proposes a new relational framework to understand and address inequalities in urban transport. Traditional theories of transport justice often focus on accessibility and economic aspects of mobility but lack a comprehensive view of the social and institutional factors that shape mobility patterns and opportunities. This thesis offers a broader approach, integrating three frameworks—the Capability Approach, Critical Realism, and Critical Urban Theory—to develop a "relational theory of urban mobility justice" that captures the complex, context-dependent interactions between individuals, their environments, and societal structures.

The relational framework shifts the focus from infrastructure alone to the social relations that drive mobility inequalities, recognising that urban mobility is deeply influenced by socio-economic conditions and power dynamics that tend to marginalise lower-income groups and minorities. For instance, the Capability Approach emphasises how mobility capabilities depend on access to resources and social support. Critical Urban Theory highlights how neoliberal policies favor car-centric infrastructure that excludes affordable, collective transport. Together, these perspectives reveal how mobility justice must address both material and relational barriers to movement.

To ground the theory empirically, this study draws on data from over 1400 individuals in North-West Delhi, with a focus on low-income households and under-resourced neighborhoods. Statistical modeling, including a multilevel generalised linear model, reveals how mobility capabilities are shaped by individual, household, and neighborhood factors. Findings show that lower-income women face compounded challenges due to limited financial resources, safety concerns, and restricted access to transit, illustrating how mobility capability is a product of both personal and structural influences. Regression analysis indicates significant disparities across demographic and socio-economic groups: middle-income groups are more likely to have mobility capability, while individuals from marginalised caste groups face up to 65 percent lower odds of possessing such capability. This suggests that, beyond resource availability, social status and structural discrimination significantly limit mobility opportunities.

The study also identifies patterns in mobility through the concepts of rhythmicity, modality, and strain. "Rhythmicity" explores how mobility is often constrained by economic and social roles, such as caregiving, which limits travel options for women and lower-income individuals. "Modality" examines how limited transport options compound social inequalities, as those with access to diverse modes of transport have greater autonomy. "Strain" captures the economic pressures faced by low-income households, who may spend up to 60 percent of their income on transportation, making mobility an issue of financial strain rather than convenience.

Latent class analysis further uncovers three value-based mobility groups: Pragmatic Functionalists, who support balanced, practical mobility solutions; Automobile Individualists, who prioritise private vehicle use and resist restrictive policies; and Socially Engaging Communitarians, who favour environment-friendly, inclusive policies. These groups illustrate how social attitudes shape mobility preferences and highlight the need for transport policies that account for these varied principles of valuation. A multilevel Generalised Linear Model (GLM) with a binary logistic outcome—examines mobility capability as a function of personal and contextual factors, including demographic indicators, resource availability, and activity types. This model is designed to capture the probabilistic likelihood of an individual possessing the capability to travel for various purposes, such as work, maintenance, or recreation. By framing mobility capability in this way, the GLM provides a relational view where individual agency and structural constraints are intertwined.

In the capability model, factors like age, caste, and purpose of travel emerge as significant. For example, middle-aged respondents (ages 25-45) are significantly more likely to report mobility capability, with odds ratios indicating over 200 percent higher likelihood compared to other age groups. This finding points to age-related variations in mobility that reflect life-stage needs and available resources. Additionally, marginalised caste groups (OBC, SC/ST) exhibit lower capability odds, with reductions of 64 percent and 65 percent, respectively, signalling structural barriers related to socio-economic background. The analysis also identifies travel purposes with varying capability associations. Maintenance-related travel (e.g., grocery shopping, medical visits) shows a nearly fourfold increase in capability odds compared to work-related travel, suggesting that basic necessities motivate and are more feasible for daily mobility. In contrast, recreational travel is associated with a 24 percent reduction in capability odds, indicating that mobility for leisure is less accessible or valued in the study.

population.

The capability-resource link in this study shows that resource access does not automatically translate into greater mobility capability. For example, car ownership is associated with a 42 percent reduction in mobility capability odds (OR=0.58, p=0.18). Though it is not statistically strongly significant but it confirms that owning a car alone does not guarantee higher mobility. This finding questions the idea that private vehicles inherently enhance mobility and suggests that practical factors—such as adaptability, supportive infrastructure, and ease of use—are essential for translating resources into actual mobility benefits. Similarly, while public transit is crucial for accessibility, its mere presence does not significantly boost mobility capability, possibly due to inconsistent service quality and limited reliability across regions.

The thesis also critically examines the impact of large-scale transport projects, using the Delhi Metro as a case study. While the metro has been promoted as a solution to congestion, its construction displaced communities and disrupted local economies reliant on proximity-based mobility. Many residents of Durga Basti, a displaced area, were forced to move farther from economic centres, increasing travel costs and time burdens. This study argues that the metro project illustrates how neoliberal transport policies prioritise capital gains over social equity, often to the detriment of low-income groups without political influence. Applying critical realism, the analysis traces these injustices to broader economic and institutional structures that shape urban mobility, emphasising the need for transport policies that consider social equity.

Overall, this thesis proposes a new and relational approach to urban mobility justice, emphasising policies that address structural inequalities and support a transport ecosystem that meets diverse socio-economic needs. The relational framework demonstrates that mobility justice cannot be achieved solely through infrastructure but requires addressing the social and economic contexts that shape mobility. This approach aims to create urban environments where all residents can move freely, without social or economic constraints.

KEYWORDS: Urban Mobility Justice, Relational Theory, Capability Approach, Critical Realism, Critical Urban Theory, Socio-economic Disparities, Transport Planning, Delhi

सारांश

यह थीसिस, "शहरी गतिशीलता में न्याय पर नए प्रभाव," शहरी परिवहन में असमानताओं को समझने और संबोधित करने के लिए एक नया संबंधपरक ढांचा प्रस्तावित करता है। परिवहन न्याय के पारंपरिक सिद्धांत अक्सर गतिशीलता की पहुँच और आर्थिक पहलुओं पर ध्यान केंद्रित करते हैं, लेकिन गतिशीलता पैटर्न और अवसरों को आकार देने वाले सामाजिक और संस्थागत कारकों के व्यापक दृष्टिकोण का अभाव होता है। यह थीसिस एक व्यापक दृष्टिकोण प्रदान करती है, जिसमें तीन ढाँचों को एकीकृत किया गया है - क्षमता दृष्टिकोण, आलोचनात्मक यथार्थवाद और आलोचनात्मक शहरी सिद्धांत - "शहरी गतिशीलता न्याय का संबंधपरक सिद्धांत" विकसित करने के लिए जो व्यक्तियों, उनके वातावरण और सामाजिक संरचनाओं के बीच जटिल, संदर्भ-निर्भर अंतःक्रियाओं को पकड़ता है। संबंधपरक ढांचा केवल बुनियादी ढांचे से ध्यान हटाकर उन सामाजिक संबंधों पर केंद्रित करता है जो गतिशीलता असमानताओं को बढ़ावा देते हैं, यह पहचानते हुए कि शहरी गतिशीलता सामाजिक-आर्थिक स्थितियों और शक्ति गतिशीलता से गहराई से प्रभावित होती है जो निम्न-आय समूहों और अल्पसंख्यकों को हाशिए पर डालती है। उदाहरण के लिए, क्षमता दृष्टिकोण इस बात पर जोर देता है कि कैसे गतिशीलता क्षमताएँ संसाधनों और सामाजिक समर्थन तक पहुँच पर निर्भर करती हैं। आलोचनात्मक शहरी सिद्धांत इस बात पर प्रकाश डालता है कि कैसे नवउदारवादी नीतियाँ कार-केंद्रित बुनियादी ढाँचे का पक्ष लेती हैं जो किफ़ायती, सामूहिक परिवहन को बाहर करती हैं। साथ में, ये दृष्टिकोण बताते हैं कि गतिशीलता न्याय को आंदोलन के लिए भौतिक और संबंधपरक बाधाओं दोनों को कैसे संबोधित करना चाहिए।

सिद्धांत को अनुभवजन्य रूप से आधार देने के लिए, यह अध्ययन उत्तर-पश्चिम दिल्ली में 1400 से अधिक व्यक्तियों के डेटा पर आधारित है, जिसमें कम आय वाले घरों और कम संसाधन वाले पड़ोस पर ध्यान केंद्रित किया गया है। एक बहुस्तरीय सामान्यीकृत रैखिक मॉडल सहित सांख्यिकीय मॉडलिंग से पता चलता है कि कैसे गतिशीलता क्षमताओं को व्यक्तिगत, घरेलू और पड़ोस के कारकों द्वारा आकार दिया जाता है। निष्कर्ष बताते हैं कि कम आय वाली महिलाओं को सीमित वित्तीय संसाधनों, सुरक्षा चिंताओं और पारगमन तक सीमित पहुँच के कारण जटिल चुनौतियों का सामना करना पड़ता है, यह दर्शाता है कि कैसे गतिशीलता क्षमता व्यक्तिगत और संरचनात्मक दोनों प्रभावों का एक उत्पाद है। प्रतिगमन विश्लेषण जनसांख्यिकीय और सामाजिक-आर्थिक समूहों में महत्वपूर्ण असमानताओं को इंगित करता है: मध्यम आय वाले समूहों में गतिशीलता क्षमता होने की अधिक संभावना है, जबकि हाशिए पर रहने वाले जाति समूहों के व्यक्तियों को ऐसी क्षमता रखने की 65 प्रतिशत कम संभावना का

सामना करना पड़ता है। इससे पता चलता है कि संसाधन उपलब्धता से परे, सामाजिक स्थिति और संरचनात्मक भेदभाव गतिशीलता के अवसरों को काफी हद तक सीमित करते हैं।

अध्ययन लयबद्धता, तौर-तरीके और तनाव की अवधारणाओं के माध्यम से गतिशीलता में पैटर्न की भी पहचान करता है। "रिदमिसिटी" इस बात की पड़ताल करती है कि किस तरह से गतिशीलता अक्सर आर्थिक और सामाजिक भूमिकाओं, जैसे कि देखभाल, के कारण बाधित होती है, जो महिलाओं और कम आय वाले व्यक्तियों के लिए यात्रा के विकल्पों को सीमित करती है। "मोडैलिटी" इस बात की जांच करती है कि किस तरह से सीमित परिवहन विकल्प सामाजिक असमानताओं को बढ़ाते हैं, क्योंकि परिवहन के विविध साधनों तक पहुँच रखने वालों के पास अधिक स्वायत्तता होती है। "स्ट्रेन" निम्न आय वाले परिवारों द्वारा सामना किए जाने वाले आर्थिक दबावों को दर्शाता है, जो अपनी आय का 60 प्रतिशत तक परिवहन पर खर्च कर सकते हैं, जिससे गतिशीलता सुविधा के बजाय वित्तीय तनाव का मुद्दा बन जाती है।

अव्यक्त वर्ग विश्लेषण आगे तीन मूल्य-आधारित गतिशीलता समूहों को उजागर करता है: व्यावहारिक कार्यात्मकवादी, जो संतुलित, व्यावहारिक गतिशीलता समाधानों का समर्थन करते हैं; ऑटोमोबाइल व्यक्तिवादी, जो निजी वाहन के उपयोग को प्राथमिकता देते हैं और प्रतिबंधात्मक नीतियों का विरोध करते हैं; और सामाजिक रूप से संलग्न समुदायवादी, जो पर्यावरण के अनुकूल, समावेशी नीतियों का पक्ष लेते हैं। ये समूह दर्शाते हैं कि सामाजिक दृष्टिकोण गतिशीलता वरीयताओं को कैसे आकार देते हैं और परिवहन नीतियों की आवश्यकता को उजागर करते हैं जो मूल्यांकन के इन विभिन्न सिद्धांतों को ध्यान में रखते हैं। बाइनरी लॉजिस्टिक परिणाम वाला एक बहुस्तरीय सामान्यीकृत रैखिक मॉडल (GLM) - व्यक्तिगत और प्रासंगिक कारकों के एक फ़ंक्शन के रूप में गतिशीलता क्षमता की जांच करता है, जिसमें जनसांख्यिकीय संकेतक, संसाधन उपलब्धता और गतिविधि प्रकार शामिल हैं। यह मॉडल किसी व्यक्ति के पास काम, रखरखाव या मनोरंजन जैसे विभिन्न उद्देश्यों के लिए यात्रा करने की क्षमता रखने की संभाव्य संभावना को पकड़ने के लिए डिज़ाइन किया गया है। इस तरह से गतिशीलता क्षमता को तैयार करके, GLM एक संबंधपरक दृष्टिकोण प्रदान करता है जहाँ व्यक्तिगत एजेंसी और संरचनात्मक बाधाएँ आपस में जुड़ी होती हैं।

क्षमता मॉडल में, आयु, जाति और यात्रा के उद्देश्य जैसे कारक महत्वपूर्ण बनकर सामने आते हैं। उदाहरण के लिए, मध्यम आयु वर्ग के उत्तरदाताओं (25-45 वर्ष की आयु) में गतिशीलता क्षमता की रिपोर्ट करने की संभावना काफी अधिक है, जिसमें ऑड्स अनुपात अन्य आयु समूहों की तुलना में 200 प्रतिशत से अधिक संभावना दर्शाता है। यह खोज गतिशीलता में आयु-संबंधी भिन्नताओं की ओर

इशारा करती है जो जीवन-चरण की ज़रूरतों और उपलब्ध संसाधनों को दर्शाती है। इसके अतिरिक्त, हाशिए पर पड़े जाति समूहों (ओबीसी, एससी/एसटी) में कम क्षमता बाधाएं दिखाई देती हैं, जिनमें क्रमशः 64 प्रतिशत और 65 प्रतिशत की कमी आई है, जो सामाजिक-आर्थिक पृष्ठभूमि से संबंधित संरचनात्मक बाधाओं का संकेत है। विश्लेषण में अलग-अलग क्षमता संघों के साथ यात्रा के उद्देश्यों की भी पहचान की गई है। विश्लेषण में यात्रा के उद्देश्यों को भी अलग-अलग क्षमता संघों के साथ पहचाना गया है। रखरखाव से संबंधित यात्रा (जैसे, किराने का सामान खरीदना, चिकित्सा यात्रा) कार्य-संबंधित यात्रा की तुलना में क्षमता बाधाओं में लगभग चार गुना वृद्धि दर्शाती है, जो यह सुझाव देती है कि बुनियादी ज़रूरतें प्रेरित करती हैं और दैनिक गतिशीलता के लिए अधिक व्यवहार्य हैं। इसके विपरीत, मनोरंजक यात्रा अक्षमता बाधाओं में 24 प्रतिशत की कमी से जुड़ी है, जो यह दर्शाता है कि अध्ययन में अवकाश के लिए गतिशीलता कम सुलभ या मूल्यवान है।

इस अध्ययन में क्षमता-संसाधन लिंक दर्शाता है कि संसाधन पहुँच स्वचालित रूप से अधिक गतिशीलता क्षमता में तब्दील नहीं होती है। उदाहरण के लिए, कार स्वामित्व गतिशीलता क्षमता बाधाओं में 42 प्रतिशत की कमी ($OR=0.58$, $p=0.18$) से जुड़ा है। हालाँकि यह सांख्यिकीय रूप से बहुत महत्वपूर्ण नहीं है, लेकिन यह पुष्टि करता है कि अकेले कार का मालिक होना उच्च गतिशीलता की गारंटी नहीं देता है। यह निष्कर्ष इस विचार पर सवाल उठाता है कि निजी वाहन स्वाभाविक रूप से गतिशीलता को बढ़ाते हैं और सुझाव देते हैं कि व्यावहारिक कारक - जैसे अनुकूलनशीलता, सहायक बुनियादी ढाँचा और उपयोग में आसानी - संसाधनों को वास्तविक गतिशीलता लाभों में बदलने के लिए आवश्यक हैं। इसी तरह, जबकि सार्वजनिक परिवहन पहुँच के लिए महत्वपूर्ण है, इसकी मात्र उपस्थिति गतिशीलता क्षमता को महत्वपूर्ण रूप से नहीं बढ़ाती है, संभवतः असंगत सेवा गुणवत्ता और क्षेत्रों में सीमित विश्वसनीयता के कारण।

थीसिस में दिल्ली मेट्रो का केस स्टडी के रूप में उपयोग करते हुए बड़े पैमाने पर परिवहन परियोजनाओं के प्रभाव की भी आलोचनात्मक जांच की गई है। जबकि मेट्रो को भीड़भाड़ के समाधान के रूप में बढ़ावा दिया गया है, इसके निर्माण ने समुदायों को विस्थापित कर दिया और निकटता-आधारित गतिशीलता पर निर्भर स्थानीय अर्थव्यवस्थाओं को बाधित कर दिया। विस्थापित क्षेत्र दुर्गा बस्ती के कई निवासियों को आर्थिक केंद्रों से दूर जाने के लिए मजबूर होना पड़ा, जिससे यात्रा की लागत और समय का बोझ बढ़ गया। यह अध्ययन तर्क देता है कि मेट्रो परियोजना दर्शाती है कि कैसे नवउदारवादी परिवहन नीतियाँ सामाजिक समानता पर पूंजीगत लाभ को प्राथमिकता देती हैं, जो अक्सर राजनीतिक प्रभाव के बिना कम आय वाले समूहों के लिए नुकसानदेह होती हैं। आलोचनात्मक

यथार्थवाद को लागू करते हुए, विश्लेषण इन अन्यायों को व्यापक आर्थिक और संस्थागत संरचनाओं में खोजता है जो शहरी गतिशीलता को आकार देते हैं, परिवहन नीतियों की आवश्यकता पर जोर देते हैं जो सामाजिक समानता पर विचार करते हैं।

कुल मिलाकर, यह थीसिस शहरी गतिशीलता न्याय के लिए एक नया और संबंधपरक दृष्टिकोण प्रस्तावित करती है, जो संरचनात्मक असमानताओं को संबोधित करने वाली नीतियों पर जोर देती है और एक परिवहन पारिस्थितिकी तंत्र का समर्थन करती है जो विविध सामाजिक-आर्थिक आवश्यकताओं को पूरा करती है। संबंधपरक ढांचा दर्शाता है कि गतिशीलता न्याय केवल बुनियादी ढांचे के माध्यम से प्राप्त नहीं किया जा सकता है, बल्कि इसके लिए गतिशीलता को आकार देने वाले सामाजिक और आर्थिक संदर्भों को संबोधित करने की आवश्यकता है। इस दृष्टिकोण का उद्देश्य शहरी वातावरण बनाना है जहाँ सभी निवासी सामाजिक या आर्थिक बाधाओं के बिना स्वतंत्र रूप से घूम सकें।

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LIST OF ABBREVIATIONS

AMP	Automotive Mission Plan
AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
BRT	Bus Rapid Transit
CT	Census Town
CA	Capability Approach
CLMM	Cumulative Link Mixed Model
DDA	Delhi Development Authority
DIMTS	Delhi Integrated Multi-modal Transit System
DIT	Delhi Improvement Trust
DMRC	Delhi Metro Rail Corporation
DPR	Detailed Planning Report
DTC	Delhi Transport Corporation
DUSIB	Delhi Urban Shelter Improvement Board
EFA	Exploratory Factor Analysis
FOB	Foot Over-bridge
GAMLSS	Generalized Additive Models for Location, Scale and Shape
GLB	Greatest Lower Bound
GLM	Generalised Linear Models
GDP	Gross Domestic Product
GLM	Generalised Linear Models
GPS	Global Positioning System
INR	Indian National Rupee
IRC	Indian Road Congress
IQR	Interquartile Range
JICA	Japan International Cooperation Agency
LCA	Latent Class Analysis
MAD	Median Absolute Deviation

MPD	Master Plan of Delhi
MSPS	Multi-stage Probability Sampling
MTW	Motorised Two-Wheeler
NSS	National Sample Survey
OBC	Other Backward Classes
OTP	One Time Password
PLI	Production-Linked Incentives
PPS	Probability Proportional to Size
SC	Scheduled Castes
SSU	Secondary Sampling Unit
ST	Scheduled Tribes
TOD	Transit-oriented Development
TOI	Times of India
TRIPC	Transportation Research and Injury Prevention Centre
USU	Ultimate Sampling Unit
UT	Union Territory