

Generating Multimodal Transfer Hubs and Level-of-Service (LOS)
Matrices to Integrate MaaS into Activity-based Models

Supplementary material

HAJOUJ, Mohammed; KNAPEN, Luk; ADNAN, Muhammad; JANSSENS, Davy;
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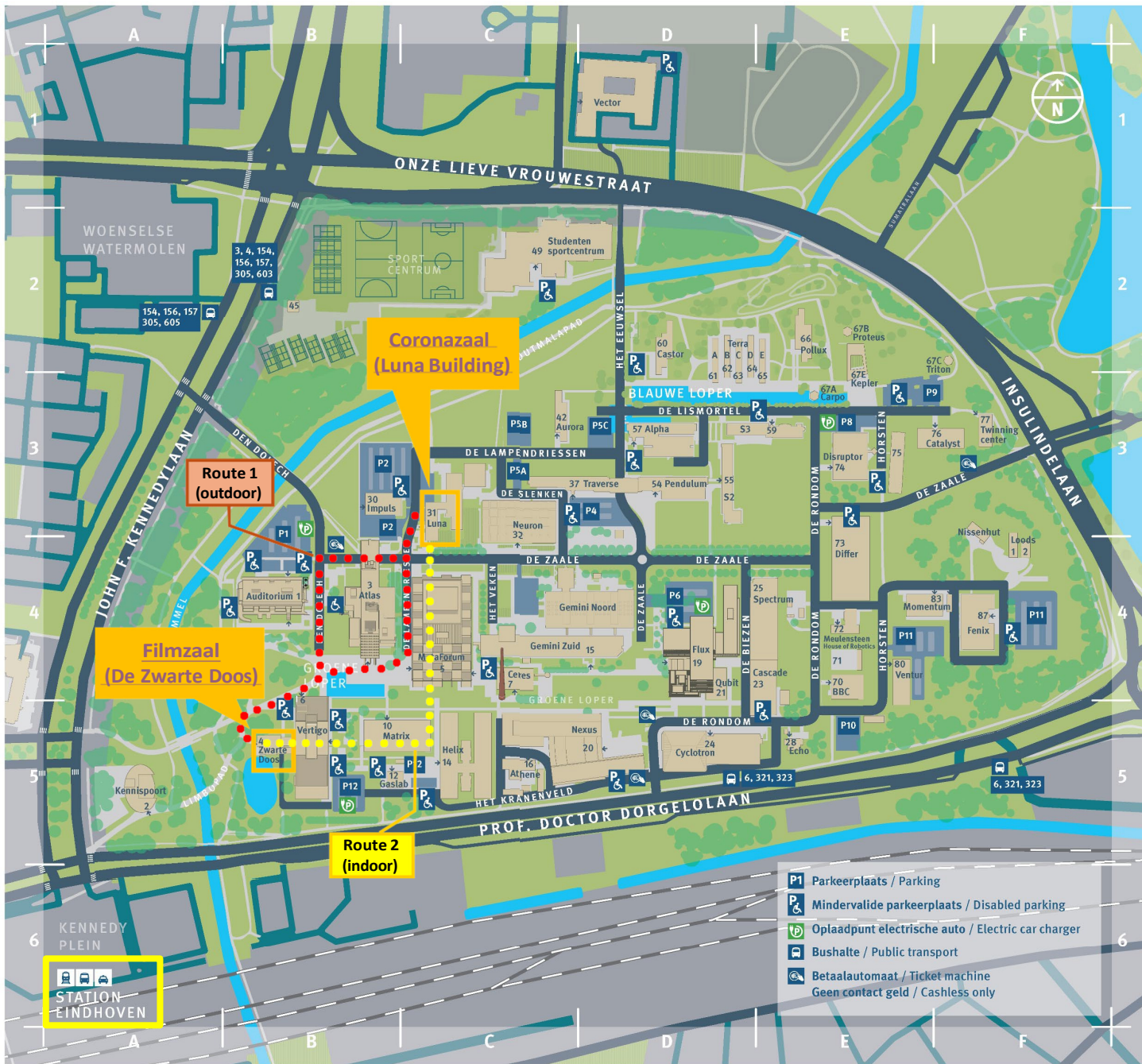
Interdisciplinary Perspectives on Travel Demand Dynamics

Workshop Honoring Professor Harry Timmermans

Workshop Program on 2 December 2025 (online access to presentations via [Teams](#))

| | |
|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8:40 – 9:00 | Meet up in Coronazaal, Luna, TU/e (coffee & tea in front of Coronazaal) |
| 9:00 – 9:10 | Welcome & opening speeches (Dean & Unit Chair) |
| 9:10 – 10:40 | Thinking about drastic changes: The case of the e-bike-city (invited talk) Kay Axhausen |
| Interdisciplinary perspectives Moderator: Astrid Kemperman | Enhancing large language models performance in modeling travel satisfaction using cognitive dissonance theory Donggen Wang |
| | A theoretical framework for a behavioral simulation game on multimodal decision-making in MaaS Claire Anderson |
| | Connecting green patches and urban lives: Integrating ecological connectivity, citizen access, and participatory insights in urban greenway planning Qi Han |
| | Consumer scheduling of experiential activities in shopping centers Harmen Oppewal (online) |
| | 10:40 – 11:00 |
| Activity-based modeling Moderator: Geert Wets | Measuring visit durations in multiple shopping spaces using sparse street-view image data Wei Zhu |
| | Unraveling disparities in people’s activity space patterns at a national scale using mobile location data in the US Tanhua Jin |
| | Automated travel behavior extraction of urban road users from dynamic drone footage Muhammad Waqas Ahmed |
| | Group-specific benefits of eVTOL: An activity-based model for assessing location accessibility and transport equity Xiao Fu (online) |
| | Generating multimodal transfer hubs and level of service (LOS) matrices to integrate MaaS into activity-based models Tom Bellemans |
| 12:15 – 13:15 | Lunch (1 hour) in Hubble Community Café, TU/e |
| Choice modeling Moderator: Eric Molin | Mathematical models of spatial choice behavior: From data processing to conceptualising reality Larry Lucardie |
| | Latent class models and the “no preference” option in stated choice experiments Aloys Borgers |
| | Modeling the choice of household-level MaaS Tao Feng |
| | Enhancing travel choice modeling with Weibit: An alternative to Logit models Sunghoon Jang (online) |
| | The value of distance in tourists’ destination choice Eric Molin |
| 14:30 – 15:00 | Walk to Filmzaal, De Zwarte Doos, TU/e (coffee & tea next to Filmzaal) |
| Theoretical frameworks Moderator: Aloys Borgers | The relationship between the built environment and loneliness. Literature review, photovoice interviews and conceptual model Pauline van den Berg |
| | From smart technology to AI automation: What makes retailing intelligent? Eleonora Pantano |
| | Unpacking joint activity-travel behavior modeling: A comprehensive review from household dynamics to wider social networks Jinhee Kim |
| | Urbanimmunology Junyi Zhang (online) |
| | Short break (5 min) |
| Panel discussion (1 st person is chair) | Interdisciplinary research directions Soora Rasouli, Eleonora Pantano, Donggen Wang, Bert van Wee |
| | Making impactful research in the new era Theo Arentze, Caspar Chorus, Tao Feng, Kay Axhausen |
| | Harry's mentorship (lessons and stories) Frank Witlox, Peter van der Waerden, Anna Grigolon, Ifigenia Psarra, Jinhee Kim |
| | 18:15 – |

Navigation map and short abstracts with coauthors are attached below.



Buildings

| | MAP | NUMMER | | MAP | NUMMER |
|--------------------|-----|--------|------------------------|-----|--------|
| Alpha | D3 | 57 | Matrix | B5 | 10 |
| Athene | C5 | 16 | MetaForum | C4 | 5 |
| Atlas | B4 | 3 | Meulenstein | | |
| Auditorium | B4 | 1 | House of Robotics | E4 | 72 |
| Aurora | C3 | 42 | Momentum | F4 | 83 |
| BCC | | | Neuron | C4 | 32 |
| Reststoffencentrum | E4 | 70 | Nexus | C5 | 20 |
| Carpo | E2 | 67A | Nissenhut | F4 | |
| Cascade | D4 | 23 | Pendulum | D3 | 54 |
| Castor | D3 | 60 | Pollux | E2 | 66 |
| Catalyst | E3 | 76 | Proteus | E2 | 67B |
| Ceres | C4 | 7 | Qubit | D4 | 21 |
| Cyclotron | D5 | 24 | S2 | D3 | 55 |
| Differ | E4 | 73 | S3 | D3 | 59 |
| Disruptor | E3 | 74 | Spectrum | D4 | 25 |
| Echo | E5 | 28 | Studenten sportcentrum | C2 | 49 |
| Fenix | F4 | 87 | Terra A-B-C-D-E | D2 | 61 |
| Flux | D4 | 19 | Traverse | C3 | 37 |
| Gaslab | B5 | 12 | Triton | E2 | 67C |
| Gemini | C4 | 15 | Twinning center | F3 | 77 |
| Helix | C5 | 14 | Vector | D1 | |
| Impuls | B3 | 30 | Ventur | E4 | 80 |
| Kennispoort | A5 | 2 | Vertigo | B5 | 6 |
| Kepler | E2 | 67E | Zwarte Doos | B5 | 4 |
| Loods 1, 2 | F4 | | | | |
| Luna | B3 | 31 | | | |

Departments

| | BUILDING | MAP | NUMMER |
|----------------------------------------------|-----------|-----|--------|
| Applied Physics | Flux | D4 | 19 |
| Biomedical Engineering | Vector | D1 | |
| Chemical Engineering and Chemistry | Helix | C5 | 14 |
| Department of the Built Environment | Vertigo | B5 | 6 |
| Eindhoven School of Education | Cascade | D4 | 23 |
| Electrical Engineering | Flux | D4 | 19 |
| Industrial Design | Atlas | B4 | 3 |
| Industrial Engineering & Innovation Sciences | Atlas | B4 | 3 |
| Mathematics and Computer Science | MetaForum | C4 | 5 |
| Mechanical Engineering | Gemini | C4 | 15 |
| Darcy-lab | Gemini | C4 | 15 |

Thinking about drastic changes: The case of the e-bike-city

Kay Axhausen
ETH Zürich, Switzerland

Abstract

Travel behaviour research and its associated platforms to generalise its insights and to forecast its changes currently limit themselves to small scale change, in line with the small scale nature of today's policies. The last time that the field had to face truly large scale change it ignored the second and third order impacts, i.e. basic and oversized parking and road provision in the 1950's and 60's. Today we face the challenge of large scale change due to reconstruction and reorganisation necessary for achieving "net zero" greenhouse gas emission.

The talk will present the e-bike-city, as one possible scenario in the context. It implements a reorganisation of current urban street space, in which 50% of the car-dedicated road space is handed over to the small-modes. We implemented this for the city of Zürich and simulated it using the current MATSim approach.

The talk will reflect the limitations of the current approach and will outline the required capabilities to avoid repeating the mistakes of the 1950's of ignoring longer term second and third order impacts.

Enhancing large language models performance in modeling travel satisfaction using cognitive dissonance theory

Pengfei Xu, Donggen Wang
Honk Kong Baptist University, Hong Kong SAR, China.

Abstract

Large language models (LLMs) have demonstrated substantial potential in travel behavior modeling, encompassing tasks such as next-location prediction, daily activity generation and mobility simulation, among others. A critical barrier to realizing this potential, however, lies in the misalignment between LLMs and human decision-making. Despite this challenge, limited attention has been given to leveraging behavioral theories to guide the reasoning processes of LLMs and thereby mitigate such misalignment. To address this gap, we propose a novel prompting approach that incorporates the cognitive dissonance theory to enhance LLMs performance in modeling travel satisfaction. Using household travel survey data from Shanghai, China, we conduct experiments with pre-trained LLMs from the Qwen, GPT and Llama series. The results indicate that theoretical contexts are at play in aligning LLMs, which significantly improves zero-shot prediction accuracy. The performance gains disappear when the theoretical contexts are replaced by meaningless tokens, suggesting that the improvement is not a mere artifact of additional computational overhead from longer prompts.

Moreover, the increased feature importance of the preferred travel mode across all LLMs indicates a shift in model behavior. This study highlights the value of classical behavior theories in aligning LLMs, thereby offering a promising avenue for future research.

A theoretical framework for a behavioral simulation game on multimodal decision-making in MaaS

Claire Anderson, Valeria Caiati, Soora Rasouli
Eindhoven University of Technology, the Netherlands

Abstract

This conceptual paper proposes a theoretical framework for a behavioral simulation game examining transport mode choice within a Mobility-as-a-Service (MaaS) environment. MaaS, a digital platform integrating multiple public and private transport modes, aims to reduce private car ownership by connecting individuals to a wider range of transport options. However, the scarcity of real-world MaaS implementations has limited empirical understanding of its effects on travel behavior.

Simulation games are a novel data collection approach that provide a structured, scenario-based environment in which decision-making dynamics can be directly observed. Unlike static stated-preference methods, this approach captures how mode choices evolve as participants learn and adapt over time. This study proposes a naturalistic serious game that simulates three to four weeks of travel activity. By capturing behavioral realism, the serious game examines whether MaaS encourages exploration of new or multimodal travel options by lowering uncertainty and learning costs, and by offering incentives through subscription bundles. Additionally, the study explores whether MaaS can promote a shift toward more sustainable travel behavior. Although developed in the context of MaaS, the framework serves as a flexible tool for behavioral transport research.

Connecting green patches and urban lives: Integrating ecological connectivity, citizen access, and participatory insights in urban greenway planning

Yinuo Zhou, Shahryar Ershad Sarabi, Qi Han
Eindhoven University of Technology, the Netherlands

Abstract

Urban greenways are critical for connecting fragmented habitats and enhancing both ecological functions and human well-being, especially in complex urban environments with competing land-use demands. However, many existing approaches focus only on either ecological connectivity or social needs, often overlooking the combined consideration of biodiversity protection and uneven citizen access. Additionally, the lack of local expert participation can limit the applicability of greenway planning in real-world implementation.

This study proposes an integrated spatial decision-making framework for designing urban greenways that simultaneously supports biodiversity protection and addresses diverse human needs. The framework combines ecological connectivity modeling, population accessibility analysis, and participatory expert insights to guide the identification, prioritization, and improvement of urban greenways.

Results show that the proposed framework, which integrates ecological connectivity with citizen access, significantly improves overall connectivity and better serves urban populations. Moreover, the experts' multicriteria inputs help to identify overlooked issues under local contexts, like functional interruptions and underestimated business zones, that spatial modeling alone would miss. This highlights the framework's strength not just as a planning tool, but as a platform that combines spatial analysis with local knowledge and context. This proposed framework offers a practical tool to design urban greenways that are not only ecologically functional but also socially meaningful and responsive to local needs.

Consumer scheduling of experiential activities in shopping centers

Harmen Oppewal¹, Ari Pramono¹, Benedict G.C. Dellaert²

¹ Monash Business School, Australia

² Erasmus School of Economics, the Netherlands

Abstract

Consumers increasingly visit shopping centers, including shopping malls and downtown shopping precincts, to engage in experiential non-shopping activities. Consequently, shopping center managers need to understand consumer visitation preferences for these non-shopping activities and how they affect consumer store visits within a center. Existing consumer store location choice theory ignores the experiential characteristics of activities. We propose three ways in which consumer experiential activity choices differ from store choices as traditionally conceived. First, experiential activities tend to be discretionary, which means that consumers can choose to add more activities or end their visit at any time. Second, spending time on an experiential activity will represent a benefit instead of only a cost. Third, consumers will prefer to undertake experiential activities in particular, asymmetric orders. We apply our theorizing and present a random utility-based model that allows assessing the role of experiential non-shopping activities when consumers schedule activities for a shopping center visit. Results from an experiment in which participants planned a visit to their downtown area show support for the role of experiential non-shopping activities in determining consumers' activity choices. Simulations demonstrate the relevance of the findings for managerial decisions about activity mixes and activity locations in shopping centers.

Measuring visit durations in multiple shopping spaces using sparse street-view image data

Wei Zhu

Tongji University, China

Abstract

Reliably and efficiently measuring customers' visit durations in shopping streets is a challenging work. This paper proposes a method for measuring the duration using computer vision technology and street-view images. The method identifies specific pedestrians in the images, and estimates the durations of visits to multiple spaces in the shopping street, through the use of a joint hazard model with gamma distributions. The method is validated by simulation and empirical tests using pedestrian behavior data collected from East Nanjing Road, Shanghai, China, over the past two decades. The simulation-based validation demonstrates that the distributions of the visit durations in individual blocks can be accurately estimated, depending on the data quality and quantity. By comparing the visit durations over the years and by pedestrian age, the empirical validation finds that these longitudinal changes and inter-generational differences can be reasonably explained by the development of retail and spatial improvements on the street.

Unraveling disparities in people's activity space patterns at a national scale using mobile location data in the US

Tanhua Jin^{1,2}, Jun Cao³, Junxue Zhang⁴, Kailai Wang⁵, Long Cheng⁶, Frank Witlox¹

¹ Ghent University, Belgium

² Vrije Universiteit Amsterdam, the Netherlands

³ Southeast University, China

⁴ Jiangsu University of Science and Technology, China

⁵ University of Houston, USA

⁶ Southeast University, China

Abstract

Understanding activity spaces is essential for grasping human mobility patterns, spatial behaviors, and their societal impacts. Existing studies often focus on specific cities or regions, lacking a national-level inquiry into the measurement of activity space patterns. This study aims to uncover regional and socio-demographic disparities in activity space patterns across the US at the national level by utilizing mobile location data. The results reveal regional differences in activity frequency, extensity, and diversity across the contiguous US, providing insightful patterns that underscore regional variations. A Geographically Weighted Regression (GWR) analysis reveals significant sociodemographic differences in activity behavior. Asian populations are more likely to have lower activity frequency, smaller activity extensity, and higher activity diversity. Whites participate in more distant but less frequent activities; African Americans fall in between these groups. High-income groups are more likely to have less frequent daily activities. They are also more likely to travel longer distances for their daily activities. Furthermore, households with high car ownership are more likely to have more frequent, distant, and diverse activities. People living in areas with higher POI density have closer daily activities to home. The spatial analysis further underscores these disparities, revealing localized heterogeneities patterns regarding the effects of the proportions of White/Asian/African/American groups and income levels significantly affecting activity patterns. This research provides valuable insights into aggregated activity patterns and influencing factors at a national scale in the US.

Automated travel behavior extraction of urban road users from dynamic drone footage

Muhammad Waqas Ahmed¹, Muhammad Adnan¹, Muhammad Ahmed², Davy Janssens¹, Geert Wets¹, Afzal Ahmed³, Wim Ectors¹

¹ Hasselt University, Belgium

² NED University of Engineering and Technology, Pakistan

³ University of Leeds, UK

Abstract

Modeling today's transport system is increasingly complex due to the rise of micro e-mobility modes, automated vehicles, and electrification, all of which are linked to the power generation system. The number of fatalities and injuries among (elderly) cyclists has been increasing in recent years, both in crashes with motor vehicles and in single-bicycle crashes. Projections indicate that this upward trend is likely to persist unless it is countered. With the digitalization of our lives, data collection and processing are at an all-time high, and AI can provide key insights. Drones have transformed the mobility sector by offering superior aerial coverage compared to fixed cameras. Recent trends show that combining drones with AI can provide a cost-effective solution for road traffic (safety) data collection. Existing methods rely on complex, computationally intensive feature-matching algorithms, which we aim to improve upon. Our novel approach accurately localizes road traffic using dynamic drone footage without additional corrections. It begins with pixel calibration of the initial frame and utilizes UAV flight logs to adjust homography with drone change in position, altitude and orientation. For detection of bicyclists we employ the YOLO object detection algorithm, synchronizing detection with flight logs to enhance geolocalization accuracy. Experimental results demonstrate that our method effectively detects and localizes a moving bicycle from dynamic drone footage at a 3km path with a mean rolling standard deviation of 0.53 meters, making it efficient and scalable.

Group-specific benefits of eVTOL: An activity-based model for assessing location accessibility and transport equity

Peng Luo¹, Xiao Fu², William H.K. Lam³

¹ Southeast University, China

² Nanjing Normal University, China

³ The Hong Kong Polytechnic University, Hong Kong SAR, China

Abstract

The global opening of low-altitude airspace is accelerating the development of the electric Vertical Take-off and Landing (eVTOL) vehicles. Passenger eVTOL vehicles could reshape residents' activity-travel patterns and impact transport equity. However, research has mainly focused on technical feasibility, with little systematic assessment of socio-economic impacts, particularly equity issues. This study uses the Multi-Agent Transport Simulation (MATSim) platform, reconstructs activity plans using mobile phone signaling data collected in Nanjing, China, and develops an activity-based model to analyze changes in activity-travel behavior and transport equity before and after the deployment of eVTOL vehicles. Travel time and cost effects are calibrated by passenger group to capture socioeconomic differences in eVTOL vehicle usage. The accessibility of activity locations and changes in transport equity are evaluated in the case study. Results reveal significant disparities in the benefits of eVTOL deployment across different groups. High-income and long-distance commuters benefit the most, with notable improvements in both job and healthcare accessibility, while low-income and non-commuting groups gain relatively limited. Overall, eVTOL use remains limited (3.9% of total trips) but shows a notable change on healthcare trips (7.8%), highlighting its advantage in urgent, high-value trips. Residents near vertiports experience greater accessibility gains, underscoring the importance of vertiport location in realizing the benefits of low-altitude mobility.

Generating multimodal transfer hubs and level of service (LOS) matrices to integrate MaaS into activity-based models

Mohammed Hajouj, Luk Knapen, Muhammad Adnan, Davy Janssens, Tom Bellemans, Geert Wets
Hasselt University, Belgium

Abstract

This study presents a framework for integrating Mobility as a Service (MaaS) into activity-based models by generating multimodal transfer hubs in combination with Level of Service (LOS) matrices. Intermodal transfer hubs enable seamless transitions between transport modes, supporting compound modes (CM) that combine access, main, and egress legs. Using OpenStreetMap and GTFS data, public transport stops are evaluated based on five normalized service indicators: total trips, service hours, peak frequency, unique routes, and night service. Final scores categorize stops as Excellent, Good, or Poor, with only the Excellent and Good categories retained as potential transfer hubs. Isochrone maps identify accessible parking and bike facilities within a 5-minute walk of each hub. Hubs lacking key amenities are excluded. In our first model, each CM involves one relevant transfer hub, near the origin or destination, depending on the mode sequence. Impedance matrices are calculated for the unimodal legs and combined using min-plus algebra to generate multimodal LOS matrices. These impedance matrices for CM are calculated based on readily available data and reflect realistic travel chains, which can be integrated into activity-based models such as ALBATROSS and FEATHERS to enhance mode choice modeling.

Mathematical models of spatial choice behaviour: From data processing to conceptualising reality

Larry Lucardie
Knowledge Values, the Netherlands

Abstract

Mathematical models enable researchers to describe and interpret natural phenomena with remarkable precision. Since the Quantitative Revolution (1950–1970), spatial scientists have increasingly adopted formal, quantitative frameworks to analyse choice behaviour. Two of the most influential modelling frameworks to emerge from this shift are the Random Utility Model and the Spatial Interaction Model. However, the assumptions underlying such mathematical models have drawn criticism for being overly restrictive and unrealistic. By insufficiently accounting for the variability of decision-making, these models risk producing oversimplified representations of spatial behaviour. In response, alternative approaches such as decision plan nets and decision tables have been proposed to model decision processes more flexibly.

The objective of this article is (1) to demonstrate that the assumptions embedded in many formal models—such as fixed classifications and isotropic space—are inherently limiting when confronted with the emotionally driven and context-sensitive nature of human locational decision-making; and (2) to argue that even alternative modelling techniques have limited validity if they continue to rest upon similar foundational assumptions.

A critical review of the deeper implications of the assumptions underlying mathematical models—considered from more fundamental, functional standpoints—can help situate these models more appropriately within the broader landscape of spatial choice analysis. This calls for a forward-engineering approach, in which paradigmatic and conceptual thinking precedes and guides the development of both quantitative and qualitative models. The following sections examine key modelling traditions and outline a conceptual framework for developing more contextually grounded and behaviourally realistic approaches to spatial choice.

Latent class models and the “no preference” option in stated choice experiments

Aloys Borgers
Eindhoven University of Technology, the Netherlands

Abstract

In stated choice experiments, respondents are presented with hypothetical choice situations that typically consist of a limited number of alternatives systematically varying in their attributes. Respondents are asked to select the alternative they most prefer in each choice situation. Often, a so-called “no preference” option is included to accommodate respondents who consider the alternatives in the choice set equally preferable. The utility of this “no preference” option is usually represented by a constant.

The collected choices are commonly analyzed using discrete choice models, such as Latent Class (LC) models. LC models estimate basic multinomial logit models for classes (clusters) of respondents with similar choice behavior. In many applications of LC models, one of the classes tends to be relatively small and to prioritize the “no preference” option.

However, if a respondent chooses the “no preference” option, this indicates that they value all alternatives in the choice set equally. This situation could instead be modeled by defining the dependent variable as equal probabilities across the alternatives and omitting the “no preference” option from the choice set.

Both approaches—an LC model including a “no preference” option as an alternative in the choice set versus an LC model replacing the “no preference” option with equal probabilities for the remaining alternatives—were compared using an existing dataset. The two LC models differed in terms of class composition and estimated parameters. This finding calls for further investigation into the role of the “no preference” option in latent class stated choice models.

Modeling the choice of household-level MaaS

Tao Feng
Hiroshima University, Japan

Abstract

Mobility as a Service (MaaS) research typically focused on individual travel needs through subscription bundles or pay-as-you-go options. However, the potential benefits of household-level mobility services, e.g., group discounts or member-specific mobility options, on MaaS adoption remain underexplored. This study proposes an innovative household-level MaaS analysis framework in which individuals assess both their own and their partner's mobility offerings to make household-level MaaS decisions. Using data from a dedicated stated choice experiment conducted in 2023, we develop a choice model grounded in sacrifice theory to capture the decision-making mechanisms within multi-member households. Results show that respondents are generally willing to subscribe to household-level MaaS, and the inclusion of a voluntary sacrifice parameter significantly improves model performance. This study contributes to the current MaaS research by theoretically expanding the analysis focus from the individual to household level, incorporating individual-specific mobility services within multiple-person households. It also opens new avenues for modelling group decisions and provides first-hand insights for policymakers and service operators to promote MaaS adoption in multi-member households.

Enhancing travel choice modeling with Weibit: An alternative to Logit models

Sunghoon Jang
The Hong Kong Polytechnic University, Hong Kong SAR, China

Abstract

This presentation introduces a Weibit choice models as a powerful alternative to traditional Logit choice models in transportation research. Traditional Logit choice models, based on the Gumbel distribution and additive utility, suffer from limitations like the independent and identically distributed (IID) assumption, which struggles with fixed alternative variances. A key advantage of Weibit choice models is their ability to accommodate non-identical variances, better reflecting the heterogeneity in travelers' evaluations of alternatives. This leads to an asymmetric response to utility differences and elasticities that depend on the utility itself. By providing closed-form probability expressions while relaxing some restrictive assumptions of Logit models, Weibit models are computationally efficient and highly applicable for complex transportation planning. This paper elucidates key differences in model properties through graphical comparisons and illustrative applications. Empirical results from a joint mode-and-destination choice for last-mile travel context show that Weibit models provide a more accurate representation of choice behavior.

The value of distance in tourists' destination choice

Eric Molin¹, Marlou Ceha², Toon Zijlstra³

¹ TU Delft, the Netherlands

² Post NL, the Netherlands

³ KIM, the Netherlands

Abstract

Air travel for holidays has increased significantly, posing serious environmental challenges due to rising emissions linked to travel distance. Encouraging tourists to choose destinations closer to home could reduce this impact, but it is unclear how distance influences destination choice. Distance is associated with reaching attractive holiday destinations, but also with increased travel time and travel costs. This study investigates how tourists trade off distance against these correlated attributes, and thus whether distance itself holds intrinsic value.

A stated choice experiment was conducted with a convenience sample of 254 Dutch tourists, who selected among hypothetical long-distance holiday options varying in distance, travel time, costs, total expenditures, and attractiveness. Additionally, a rating experiment measured how destination features—such as holiday type, weather, temperature, familiarity, and cultural distance—affect perceived destination attractiveness.

Results from multinomial logit and latent class choice model show that distance had little intrinsic value once travel time, costs and destination attractiveness are accounted for. The small tourist group that values distance seems to like sightseeing and relaxing holidays in culturally diverse tropical destinations. We conclude that the often-suggested positive value of physical distance is mainly caused by variables correlated with distance. Destination attractiveness, however, strongly influences choices, even within a narrow attractiveness range. These findings suggest that promoting nearby but appealing destinations could reduce environmentally harmful long-distance travel.

The relationship between the built environment and loneliness. Literature review, photovoice interviews and conceptual model

Pauline van den Berg

Fontys University of Applied Sciences, Eindhoven, the Netherlands

Abstract

Worldwide, a third of all adults is suffering from feelings of loneliness, with a peak at young adulthood (15-25 years old). Loneliness has serious consequences for mental and physical health and should therefore be urgently addressed. Recently, it is increasingly recognised that the built environment has a significant impact on loneliness. However, the mechanisms and pathways through which characteristics of the built environment and feelings of loneliness are linked, are not sufficiently understood. The I BELONG project (Interventions in the Built Environment targeting Loneliness in youNG adults), aims to gain insight into the mechanisms and pathways linking characteristics of the physical living environment and loneliness among young adults, using multiple research methods, e.g. systematic review, photo elicitation study and group model building. Results indicate that characteristics of the built environment (e.g. green space, trees, benches, walkability, housing, amenities) affect feelings of loneliness through three pathways: (1) Behaviour-based pathways, which shape opportunities for social and physical activity; (2) Experience-based pathways, which influence emotional and cognitive responses to the environment; and (3) Exposure-based pathways, which determine levels of exposure to physical, social, and environmental risk or protection factors. Several key knowledge gaps and directions for future research are also highlighted.

From smart technology to AI automation: What makes retailing intelligent?

Eleonora Pantano¹, Nikolaos Stylos¹, Charles Dennis²

¹ University of Bristol, UK

² University of Newcastle, UK

Abstract

Since its first conceptualization, an increasing number of scholars have turned their attention to smart retailing as sub theme of the broader smart city investigating its development as a framework to approach smart shopping channels, omnichannel retailing, new set of smart consumer services, and luxury retail business models, driven by in-store specific technologies with superior characteristics. Across multidisciplinary approaches, a variety of studies further redefined and applied the concept of smart retailing influencing research for decades.

However, huge progresses in AI allowed additional developments in the concept of smart retailing, by embracing the most advanced technologies and functionalities not available at the moment of the first concept development. Therefore, the revised question can be *what is intelligent for retailing?*

Drawing upon the concept of smart retailing (Pantano and Timmermans, 2014), our work shows how smart retailing can be revisited in light of the new features and functionalities of AI and autonomous systems, extending the traditional core elements related to organizational level and selling activities. The concept of intelligent retailing goes beyond the application of new technologies to the retail process, by embedding a superior level of “smartness” related to the intelligent technology.

Unpacking joint activity-travel behavior modeling: A comprehensive review from household dynamics to wider social networks

Seyeon Park, Jinhee Kim

Yonsei University, Republic of Korea

Abstract

People often do not make travel decisions independently, yet much of the existing literature assumes rational individual choice. This review places joint activity–travel behavior at the center of analysis, moving beyond individual-level approaches to consider interaction and negotiation within both household and social network contexts. Household-based studies, enabled by data structures that observe all members simultaneously, have advanced by incorporating interdependencies into models. By contrast, social network–based studies, often relying on small-scale egocentric surveys, have struggled to capture such correlations and typically treated relational attributes only as explanatory variables. Agent-based, optimization, and simulation approaches have modeled interactions more explicitly, but their reliance on synthetic data limits their ability to represent dynamic, repeated processes of negotiation and coordination. Future research should develop innovative data collection methods that capture relationships beyond households, design models that reflect the dynamic nature of negotiation, and integrate spatial outcomes into broader analytical frameworks. This study underscores joint activities as socially embedded core processes, thereby providing a theoretical foundation for extending travel behavior research beyond the individual and household to broader social networks.

Urbanimmunology

Junyi Zhang
Southeast University, China

Abstract

Urbanimmunology is an interdisciplinary field of study that focuses on exploring how cities and societies can build and enhance their capacity to withstand and adapt to various disruptions. Drawing inspiration from the human immune system, it identifies nine key principles: Critical Dependency, Avoidance, Tolerance, Adaptation, Regulation, Coordination, Diversity, Robustilient Regeneration, and Coherence. These principles form the conceptual foundation for translating immune system functions into strategies for urban and social development. Together, they provide a comprehensive framework for designing urban and societal systems that are not only equipped to address current challenges but are also agile and responsive to future uncertainties. By applying these principles, cities and communities can more effectively navigate environmental, social, and systemic pressures—striking a balance between growth, sustainability, and resilience. In the presentation, the speaker will showcase diverse applications of Urbanimmunology across sectors such as renewable energy, risk management, underground space and logistics, spatial interference hazards, border towns, the low-altitude economy, transport-energy integration, health promotion, and integrated urban development, among others. This speech is based on two forthcoming books by Zhang J. (2025), to be published by Springer: *Urbanimmunology: Rethinking Cities and Society through Immunological Principles* and *Urbanimmunology: Shielding Cities and Society through Transportation*.