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The People-City-Transport conference aims at strengthening the interdisciplinary approach to studying urban mobility, including behavioural, sociological, environmental and technical perspectives. The conference will encourage knowledge transfer among the specialised disciplines and contribute to building competencies and capabilities to address current urban mobility issues.

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People – City – Transport 2023: Book of Extended Abstracts

Event organised by Jan Bittner, Yussuf Zachar, Jakub Vorel, Veronika Sindlerova
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PREFACE

Ladies and gentlemen,

I am opening a new doctorate conference, People-City-Transport, to support doctorate students and young researchers in their initial scientific research activities. The presence of participants from numerous countries—Estonia, Sweden, Italy, the United Kingdom, China, Poland, Norway, and the Czech Republic—indicates that young researchers want to build international and cross-disciplinary relationships. Teleconferencing makes such networking easier nowadays: about half of the presenters will present via the Internet.

The conference is organized by the Department of Spatial Planning at the Faculty of Architecture in Prague. The department is involved in a number of research activities in the fields of quantitative analysis of urban systems, urban economy, and spatial planning. It has joint research and education activities in transport modelling and smart cities with partners from the Faculty of Transportation Sciences.

The name of the conference is People-City-Transport. I will clarify what we mean by those three terms.

The first term, people, refers to the behaviour of individuals and how their behaviour translates into transportation demand.

We typically consider transport a special activity that differs from other non-transport, stationary activities. Traditional transport models consider non-transport activities as exogenous and fixed in the short term, which does not help analyze transport demand. Imagine how many considerations we have to make before executing a trip to some activity. We have to consider the importance of the activity in terms of the benefits and costs of realizing or not realizing the activity, the timing of the activity, the linkage to other activities and the possibility of shifting the activity in time. We also consider using the telecommunication of information instead of the transportation of our bodies. Then, there are various constraints in our decision-making, such as duties concerning other people, which implies the need to coordinate our activities with others. The available means of transportation and monetary as well as non-monetary travel costs also play a significant role in our decision-making. Then, there are also our characteristics, such as health, values, preferences, risk perception, and risk aversion. In the end, the transport activity does not necessarily need to be considered a means, but as an end, it can be viewed as just a recreational or social activity with no other derived purpose.
The point is that to understand people's mobility, we have to consider the whole activity system, in which transport and non-transport activities are interdependent and cannot be isolated from each other.

The second term in the conference name is city, which refers to urban aspects of mobility. The social, economic, and environmental impacts of urban traffic are unequally distributed across space, time, and society. One solution proposed by planners is a city of short distances, where the proper density and mix-use are expected to increase demand for more sustainable means of transport. However, this ideal model has its economic and social limits. We will have several presentations on this topic today.

We can conceive urban structure as a physical, fixed container for activities. The street becomes a contested space in which motorized traffic clashes with other activities. Unfortunately, electrification and automation of transport do not make the street bigger; therefore, we need to find more robust solutions to the spatial arrangement of traffic in public spaces. We will hear about this topic from our first guest speaker in a while.

The last term in the conference name is transport, which primary points to transport means, infrastructure, and technology. We should critically assess the impacts of new technology on both people and cities. For example, do autonomous vehicles encourage urban sprawl, increase traffic in the streets, increase social segregation, and weaken territorial communities and place identity? Or just the opposite?

I am glad that the following presentations will tackle many of the mentioned topics, and I am looking forward to an interesting discussion.

Finally, thank you for joining us and sharing your research, expertise, and time with us. I want to thank especially Jan Bittner, who is the main person behind the conference and also Veronika Šindlerová and my colleagues in the Department of Spatial Planning, and I hope you will enjoy the conference.

Jakub Vorel

Head of Department of Spatial Planning
Faculty of Architecture
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KEYNOTE SPEAKERS

THE POSITIVE UTILITY OF TRAVEL AND TRAVEL SATISFACTION

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SHARED SPACES & SUSTAINABLE MOBILITY

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WHAT MAKES PUBLIC TRANSPORT A PUBLIC SPACE?

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Keywords: Public transport, public space, daily mobilities, care mobilities, fare evasion.

1. Introduction

Similar to walking down a city street or sitting in a public park, when travelling on buses, trams or metros, passengers share enclosed spaces with a variety of users, experience conflictual or convivial encounters, and interact with the materialities of the built environment [1]. The daily journeys and the environments they move through affect the passengers and, conversely, the passengers shape and create the spaces they move in and through [2]. Through these often-neglected experiential and lived aspects of public transport, I trace definitions of public space. Although the literature on public space in urban theory and sociology is diverse, when discussing public space in contemporary European cities we usually think of streets, squares or parks. It is only in recent scholarship in the social sciences and humanities that public transport has been analysed and recognised as a public space [3, 4].

Thus, this study examines the interpretation of public transport as a public space. To understand transport related social-inequalities, I contrast the provision and planning of public transport with the daily experiences of its users. To conduct my analysis, I investigate the daily mobility habits of passengers in Tallinn (Estonia) and Brussels (Belgium). Specifically, I focus on individuals' encounters with various strangers and their surroundings, as well as how they navigate transportation spaces and restrictive infrastructures, and adapt their mobility practices to appropriate urban space(s). I argue that through observing everyday practices and experiences on a bodily level, we can identify features of public transportation that categorise it as a relational and processual public space that is shaped by reconciliations of disparities, the creation and sharing of knowledge, and the prevailing social or formal rules of conduct.

I position this research at the intersection of social justice research, public space literature, and the New Mobilities Paradigm. The latter emerged from a critique of prior transport studies for their quantitative and a-mobile approach and transport planning and engineering for their technocratic focus [5]. Seeking broader empirical and interdisciplinary approaches to studying interconnected (im)mobilities across scales, scholars have delineated three dimensions of mobility: mobility as an empirical matter or pure movement, mobility as representation, and mobility as a constituent of existence that encompasses mobility practices, experiences, or lived instances [6].

2. Materials and methods

This study draws on insights from three primarily qualitative case studies. A first mixed-method study was conducted after the outbreak of the COVID-19 pandemic in collaboration with colleagues from the PUTSPACE project ("Public Transport as Public Space in European Cities!"). We conducted an online survey (n = 2 164) and 49 semi-structured interviews with passengers in

various European cities with the aim to analyse personal mobility experiences, public transport atmospheres, and disparities in usage or avoidance, before and after the pandemic. Secondly, I conducted ethnographic observation studies in Brussels' metro stations and online communities, along with 27 interviews with passengers who frequently travel without buying or validating tickets, to analyse their experiences of mobility constraints and fare evasion practices. Thirdly, I recruited 22 passengers with various care responsibilities for an iterative travel-diary and interview study. In this research, I focused on the experiences of diverse mobility constraints according to a time-geography approach and the impact of fares and infrastructures on passengers' mobility practices.

3. Results

Based on the research findings, I conclude that public transport is not only a liberal or communal public space where planning norms and individual experiences collide. In contrast to previous literature that idealise public space as open and accessible to all or as a space for conviviality and civic encounters [7], I propose additional dimensions of publicness to include visibility, codes of conduct, deviance and resistance. Accordingly, publicness appears not as a fixed or inherent characteristic of a static space, but rather as a process influenced by multiple publics, agencies and individual biographies. Consequently, public transport is a dynamic public space shaped by practices of negotiating difference, experiencing deviance and appropriating space. Hence, I deem public transport a valuable yet under-researched topic for analysis. In exploring public transport, it is evident that encounters with deviance and mobility constraints experienced by marginalised and, at times, criminalised transport users reveal exclusionary governance. Moreover, these occurrences offer an understanding of how city residents perceive accessibility to public spaces and facilities in light of socio-economic growth strategies, urban sprawl, land use and transport policies.

Acknowledgements

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INVESTIGATING SOUNDSCAPE PREFERENCES, EVALUATION, AND THEIR ROLE IN ADVANCING URBAN MOBILITY

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Keywords: Soundscape preferences, sound masking, acoustic comfort, virtual reality simulations, urban sound categorization.

1. Introduction

The intersection of urban mobility and sensory experience is a critical consideration in contemporary urban design and architecture [1]. This research delves into the realms of soundscape perception, evaluation, and sound masking, exploring their profound influence on the quality of urban environments [2]. By incorporating these auditory elements into the discourse of urban mobility, my research aims to contribute to a more holistic approach that enhances the overall well-being and livability of cities [3]. In the intricate dance of urbanisation and human progress, cities have emerged as the epicentres of modern civilization. As these sprawling metropolises continue to evolve, the very essence of urban life undergoes profound transformations. The contemporary urban experience is an amalgamation of sights, sounds, and sensations, shaping our daily routines and impacting our well-being in ways often overlooked but undeniably significant [4]. Within this evolving urban landscape, the concept of urban mobility, with its focus on the movement of people and goods within cities, has become a central concern in urban design and architecture [5]. This research embarks on a journey to investigate the nexus of urban mobility and the sensory dimension of our cities, with a particular emphasis on soundscape preferences, evaluation, and their pivotal role in advancing urban mobility.

The phenomenon of urban mobility is emblematic of our era, where an increasing number of people are drawn to cities, seeking opportunities and a vibrant urban lifestyle. It encompasses the ways in which individuals navigate these complex urban ecosystems, from daily commutes to leisurely strolls, and it is intricately linked to the quality of life and well-being of urban dwellers [6]. As urbanisation accelerates globally, the challenges associated with urban mobility have grown more pressing. Traffic congestion, environmental concerns, and the need for efficient and sustainable transportation systems have spurred innovative approaches to reimagining urban mobility. Amid these transformations, it is imperative that we do not overlook the sensory experiences that accompany urban mobility, as they play a significant role in shaping our urban lives [5]. Urban mobility is not merely a matter of moving from point A to point B; it is an experience deeply intertwined with the sensory fabric of the city [5]. Every journey through the urban landscape is accompanied by a symphony of sounds, some soothing, some jarring, and some that go unnoticed but leave an indelible mark on our subconscious [1]. These urban soundscapes are dynamic and ever-changing, reflecting the pulsating rhythm of city life. The sounds of footsteps on bustling sidewalks, the hum of traffic, the echoes of conversations in public spaces all contribute

to the sonic tapestry of the city. Our individual perceptions and preferences regarding these urban soundscapes influence our sense of place, our comfort, and even our mental and physical health [7].

As we delve deeper into this intricate relationship between urban mobility and soundscape preferences, we are guided by a set of fundamental research questions:

1. Contextual Variability and Sound Masking: How does the contextual variability in different urban environments affect the effectiveness of sound masking techniques within the context of urban mobility?
2. Subjective Experiences and Preferences: How can researchers capture and analyse the subjective experiences and individual preferences related to sound masking effectiveness in the context of urban mobility?
3. Challenges and Solutions: What are the challenges involved in integrating sound masking techniques into urban mobility solutions, and how can these challenges be overcome?

2. Materials and methods

My research employs a multidisciplinary methodology that encompasses urban sound categorization, virtual reality (VR) simulations, and participant feedback.The research commences with an essential step systematic urban sound categorization. This involves the meticulous classification of urban sounds based on specific criteria. Among the criteria considered are the intensity levels of sounds and their proximity to their sources. This categorization is critical as it lays the foundation for understanding the complex auditory landscape of the city. By categorising sounds, the research aims to create a comprehensive database that will be used in subsequent stages of the investigation.

Urban sound categorization is pivotal in discerning the various components that constitute the urban soundscape. It allows researchers to identify distinct sound profiles associated with different urban environments, from bustling city centres to quieter residential neighbourhoods.

This, in turn, provides valuable insights into how the soundscape varies across urban contexts and influences the effectiveness of sound masking techniques in enhancing acoustic comfort during urban mobility. A VR simulation, set in the dynamic urban centre of Prague, offers various scenarios, each incorporating soundscapes that simulate sound masking techniques and urban design variations relevant to urban mobility. Participants' experiences and perceptions are captured through evaluations, surveys, and interviews.

3. Expected outcomes

1. Enhanced Acoustic Comfort and Privacy in Urban Mobility: My findings provide valuable strategies for improving acoustic comfort and privacy in urban mobility solutions by integrating sound masking techniques.
2. Optimal Sound Masking Strategies for Urban Mobility: I identify sound masking strategies that are best suited for different urban mobility contexts, taking into account factors such as noise sources, transport modes, and cultural preferences.
3. Quantifiable Assessment of Sound Masking Benefits: I establish evaluation frameworks to assess the impact of sound masking on individuals' experiences, well-being, and performance in urban mobility scenarios.

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CAN THEORY OF PLANNED BEHAVIOR PREDICT THE EFFECT OF BUILT ENVIRONMENT ON WALKING BEHAVIOR?

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Keywords: Theory of planned behavior, objective measure, walking, built environment.

Walking is not only the most basic and sustainable means of transport [1, 2], but it is also recognized for its physical and mental health [3–7] and economic benefits [8, 9]. Based on the outcome variable of the study, walking/pedestrian studies can be put into two main groups: walkability and walking behavior, since they are rarely studied together. Walkability (measured usually at the neighborhood level) can be broadly defined as "the extent to which the built environment is pedestrian friendly and enables walking" [10]. Walkability studies focus on the built environment (specifically the infrastructure and amenities from a pedestrian point of view), whereas walking behavior studies focus on the people walking (i.e., the walkers or pedestrians) or the act of walking. In this study, we focus on walking behavior (and its multiple dimensions and measures).

Theory of planned behavior (TPB) is a social cognition model that proposes that human behavior is guided by three kinds of considerations: behavioral, normative, and control beliefs. That is, the decision to perform or not perform a behavior is based on ones attitude, subjective norm, and perceived behavioral control. While TPB is being increasingly applied to travel behavior studies, the studies focus mainly on motorized means of transport. Pedestrian studies from the behavioral point of view, especially those based on TPB are not only a few but also measure walking and the built environment subjectively, have very generic measures of TPB constructs that do not account for built environment and measure perceived neighborhood built environment (instead of the built environment along the route). Pedestrian studies from the urban planning point of view, on the other hand, focus on the relationship between built environment and walking. Though objectively measured, they often do not consider the individual or psychological aspects, due to which they have been criticized for physical determinism [11].

The aim of this study is to develop a detailed understanding of the psychological and environmental factors that affect individuals walking and the interaction between them. Further two main research questions were developed:

- How does the objectively measured built environment along the walking route affect walking behavior?
- How do psychological and environmental factors interact to affect walking behavior?

Data was collected in the autumn of 2021 in Umeå, Sweden using a smart-phone app in the form of GPS-based travel data (i.e. distance, time, location, activity) and survey questions (i.e.,

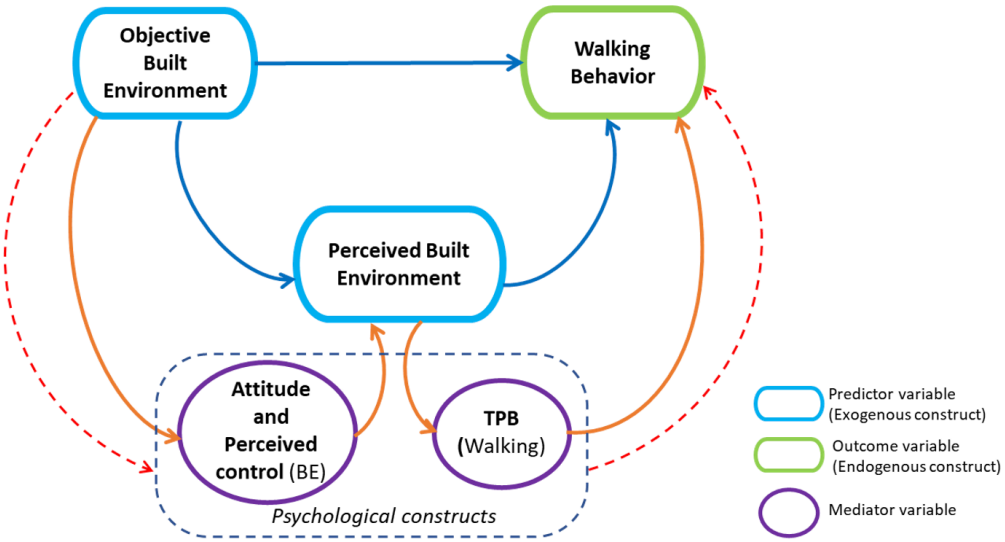

Figure 1. Conceptual framework.

demographic data, perceived built environment and psychological constructs of TPB). 84 individuals provided 3949 trip data, of which 30% were walking trips. Objective built environment data was collected from various national and municipal databases.

Firstly, we developed a conceptual framework to analyze the interaction between walking, built environment (objective and perceived), and TPB constructs (Figure 1), based on existing literature from urban planning and travel behavior fields. While McCormack et al. [12] argue that "much of the research to date has focused mainly on what associations exist, rather than examining how and under which circumstances the built and social environments determine physical activity" (pg. –) it is also true of walking. Our conceptual framework helps us explore the "what" along with the "how and under which circumstances" questions related to walking behavior.

In addition to objectively measuring both walking and built environment, we measured attitude towards and perceived control over both the behavior (i.e., walking) and the built environment. While belief-related questions pertaining to built environment have been asked in some cycling studies, they have not been systematic or consistent [13, 14]. Therefore, we developed a TPB questionnaire that distinctly measures both behavioral and environmental factors at the individual and trip levels, based on existing literature from both urban planning and travel behavior fields.

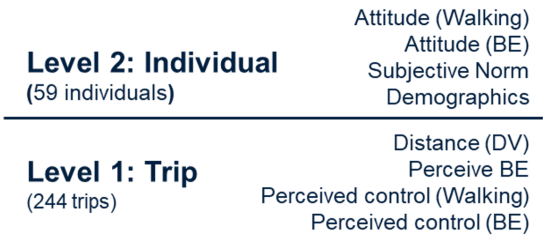

Figure 2. Hierarchical/multilevel data.

Secondly, we apply this model to analyze walking behavior in Umeå, Sweden. Statistical and spatial analysis is carried out on data collected in the autumn of 2021. Multilevel analysis needs to be conducted as the data collected is in two levels: individual and trip level (Figure 2). Two-

level random intercept regressions were conducted for each individual variable at level 2 and two-level random coefficient regressions were conducted for each individual variable at level 1, with distance per trip being the dependent variable. With respect to attitude towards walking:

- How much people like walking compared to other modes of transport had significant negative correlation
- Reason people like to walk had significant positive correlation to "for economic reasons" only
- Barriers to walking had significant positive correlation to "physical environment"

With respect to attitude towards the built environment and subjective norm, no statistically significant correlations to distance were found. With respect to demographic characteristics, size of household and access to car have significant negative correlations whereas gender, Age, education, income, license, mobility level, activity level, and health condition produced no significant results. With respect to perceived built environment, "short and direct connection to destination" had significant negative correlation whereas "room for walking on the walking path" had a significant positive correlation to walking distance. With respect to perceived control over walking, the total control has a significant positive correlation to walking distance, but none of the individual variables had any significant correlations. With respect to perceived control over built environment, none of the variables had any significant correlations to walking distance.

Due to the complexities of the multilevel data, only the statistically significant results from the regression models would be included in the multilevel structural equation models to evaluate relationships between the constructs in the conceptual model.

Thus, this paper makes an important methodological contribution towards using TPB to analyze the correlation between objectively measured walking and built environment that would assist urban planners and designers to develop better pedestrian environments, while accounting for the individuals beliefs and perceptions of the built environment.

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TEMPORAL DISPLACEMENT AND SPATIAL UNBINDING OF COMMUTE IN THE CASE OF THE BRNO METROPOLITAN AREA

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Keywords: Commuting, commuting changes, temporal displacement, spatial unbinding, spatio-temporal rhythms, Brno.

The author requested that his contribution not be published in the book of extended abstracts.

TIME-SPACE MOBILITY WITHIN PRAGUE'S SUBURBS

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Keywords: Suburbanization; mobile phone data, mobility, Prague Metropolitan Area; time geography.

1. Introduction

Urban areas around the world are experiencing dynamic changes in population distribution and commuting patterns. Understanding these shifts is essential for effective urban planning and development. This extended abstract presents an analysis of commuting to work and services in the suburban zone of Prague, focusing on the utilization of mobile phone location data to identify commuting flows, temporal variations, and mobility relations. Through the creation of synthetic maps, this study aims to provide insights into the evolving urbanization processes in the Prague Metropolitan Area, particularly highlighting the impact of tangential commuting.

2. Methodology

To investigate commuting patterns in the suburban zone of Prague, we utilized mobile phone location data. This rich source of information allowed us to identify and analyze commuting flows throughout the day, with a particular emphasis on two distinct timeframes representing varying proportions of commuting purposes. Additionally, we introduced a hierarchical classification of mobility relations to categorize and understand the nature of these flows.

3. Results

The findings of this study yield several significant outcomes. Firstly, we delineate the local centers within the suburban zone of Prague and their associated commuting areas. This spatial analysis helps us identify the hubs of economic and social activity.

Secondly, our analysis reveals distinct patterns of human activities when comparing the two identified timeframes. This temporal dimension provides valuable insights into how urban areas function at different parts of the day, emphasizing the importance of adaptable urban planning strategies.

Our research highlights the ongoing deconcentration of functions within the Prague Metropolitan Area, which signifies a shift in the urbanization processes. The identified growth of autonomy in Prague's hinterland suggests that suburban areas are becoming more self-sufficient and less dependent on the city center. This phenomenon has broader implications for urban areas in Central and Eastern Europe (CEE), which are still undergoing phases of suburbanization.

This study makes a significant contribution to the theoretical understanding of the role of mobility in contemporary metropolitan areas. By examining commuting patterns and their temporal variations, we provide a nuanced perspective on the evolving dynamics of urbanization.

Our findings offer insights that can be applied to other CEE cities currently experiencing similar transformations

4. Research highlights

- A total of 53 focal points for peripheral commuting were detected within the Prague Metropolitan Area.
- The delineation of commuting zones exposes their fluctuating nature as the role of these focal points shifts throughout the day.
- The dispersion of employment opportunities and services has resulted in a degree of self-sufficiency in the surrounding regions.
- We introduced a hierarchical categorization of mobility connections.
- The sociogeographical regionalization approach was adapted to leverage mobile phone location data.

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PRACTICES AND TECHNOLOGIES OF SOCIAL DISTANCING ON MILAN'S PUBLIC TRANSPORT

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Keywords: Public transport, social distancing, urban atmospheres, rhythms, practices.

Rhythmic dispositions: practices and technologies

When boarding buses, trams, or subway trains, we enter a specific level of interaction: face-to-face interaction or, more precisely, the interaction within the carriage. Carriage interaction refers to a form of interaction that encompasses not only individuals paired up, as suggested by the term "face-to-face," or small groups, but all actors, actresses, and actants on public transportation within the intimacy of the carriage. In this case, social position [1, 2] assumes a material significance and becomes a collective resource. However, in this case, the focus moves from the structure of the relational forms to the practices and technologies adopted in carriage interaction, where power is embodied [3] within the interaction dynamics. This presentation offers an overview of different rhythmic dispositions that emerged from the Milanese fieldwork on public transport, where general and specific practices and technologies of social distancing can be recognised.

We need to rethink public transport from a different perspective. Instead of defining it as a "special place in the city with unique characteristics," it can be rather seen as a complex urban form that, as suggested by Navarini and Colombo [4] in "I Confini Dentro la Città" when referring to Milans central station, encompasses places of transit and stationing, meeting and dwelling, as well as spaces for work and research. In essence, the practices associated with public transportation in Milan are, first and foremost, urban practices that must be contextualised within the various frames of meaning, which the actors themselves attribute to the travel experience through their interactions. These practices should, therefore, be analysed as crystallisations of specific urban processes that converge, overlap, blend, and separate in this context. Distance on public transportation extends beyond being merely a category for studying actors and their relationships; it allows us to define the metaphysics of public transportation, shaping the relationships between different urban narratives and experiences.

The core issue is that the urban public transportation system, as revealed by the study of the Milanese case, is deeply rooted in the urban experience to the extent that it transcends its mobility service purpose and assumes more multifaceted and complex characteristics. It is interesting to note how these service arrangement modalities (or dispositions), resulting from the generalisation of various distancing (and proximity) practices and the application of distancing (and proximity) technologies, translate into rhythmic arrangements. The rhythms of the metropolitan city and its inhabitants do not always coincide [5], and social distance can, therefore, appear in the form of temporal distance. Passing, staying [4, 6], returning, and living are the main dispositions that emerged: they have different rhythms and temporalities that characterise the practices from which they are abstracted.

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IS THE MIXED USE CITY OF SHORT DISTANCES EQUALLY SHORTER FOR EVERYBODY? EVIDENCE FROM THE UNIVERSE OF CZECH COMMUTERS?

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The author requested that his contribution not be published in the book of extended abstracts.

SHORTCOMINGS OF COMMUNITY PUBLIC FACILITIES IN THE WALKABLE 15-MINUTE LIFE CIRCLE CONCEPT - A CASE STUDY IN KARAMAY, CHINA

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Keywords: 15-minute city, walkable city, accessibility, public facilities.

1. Introduction

The concept of the life circle was initially used to explore the interactive relationship between residents' behaviors and living spaces, primarily gaining popularity in Asian countries such as Japan, South Korea, and China [1]. A functional neighborhood environment should facilitate residents' easy access to public services on foot. After Shanghai concretely translated this concept into the "15-minute Life Circle" [2], various cities have implemented "15-minute Life Circle" planning. These plans aim to organize various types of public facilities within 5–15 minutes walking distance, creating a pedestrian-friendly and age-friendly environment. This study takes the central area of Karamay city as an example to identify the shortcomings of the neighborhood environment regarding public facilities.

2. Materials and methods

2.1. Materials

1. ***POI data***
   The POI data for public facilities include kindergartens, primary schools, junior high schools, community health centers, elderly day care centers, neighborhood committees, administrative offices, cultural facilities, sports facilities, and green spaces. This data is primarily sourced from the internet.
2. ***Urban road network data***
   The urban road network data is obtained from transportation departments and includes main roads, side roads, and pedestrian pathways within residential areas.
3. ***Residential land use data***
   The residential land use data is sourced from the "Third National Land Survey." In this study, the data are utilized to characterize population distribution.

2.2. Methods

There are various methods for assessing the walkability of public facilities, with researchers from different disciplines favoring different analytical approaches. Buffer analysis [3–5] and walk score

[6–8] aare more commonly used in urban planning. On the other hand, network analysis [9, 10] and path planning methods [11, 12] are preferred in human geography.

Gravity models [13–16] and 2SFCA methods [17–21] are increasingly popular due to their consideration of supply capacity, demand scale, and distance decay effects, which help in accurately assessing the actual travel costs for residents.

After comparing the applicability and calculation accuracy of these methods, this study has selected the network analysis method. This approach considers facilities as starting points and calculates the proportion of residential land area reachable by walking within a specified time frame (Table 1). It enables examination of the match between facility distribution and residents' demand, facilitating adjustments in facility location and land use layout. However, this method does not account for differences in population size among areas with varying building densities or residents' varying willingness to walk as distances increase.

Service zone	Walking time	Walking length	Walking speed
5–minute level	5 min	350 m	70 m min^{-1}
10–minute level	10 min	700 m	70 m min^{-1}
15–minute level	15 min	1 050 m	70 m min^{-1}

Table 1. Walking time and length in different levels.

2.3. Technical approach

This study is mainly carried out in the following steps: 1) Utilizing network POI data and conducting on-site research to acquire spatial locations of public facilities in the research area; 2) Constructing a GIS spatial information database by integrating POI data, traffic network data, and residential land use data; 3) Analyzing the spatial location of facilities using network analysis with ArcGIS 10.4; 4) Matching service areas with residential land use and calculating the walkable coverage ratio and the degree of spatial matching between supply and demand of facilities.

3. Results

3.1. The walkability of public facilities

The walkability of public facilities varies according to their functions, levels, and locations, primarily manifested in three aspects (Figure 1): medical and cultural facilities exhibit better walkability compared to educational and elderly care facilities, 15–minute facilities are more walkable than those within a 5-minute range, and facilities in old urban areas surpass those in new urban areas.

3.2. The spatial mismatch of supply and demand

The mismatch between spatial supply and demand for facilities in the region is relatively high (Table 2). The mean values of the matching degrees between facilities within 5-15 minute living circles are 0.5, 0.4, and 0.3, indicating that only about 50 %, 40 %, and 30 % of the service zones of facilities align with residential land use. This insufficient spatial supply-demand matching results in lower actual utilization efficiency of facilities, leading to a combination of resource wastage and inadequate coverage of facilities.

Figure 1. Walkable coverage of public facilities: (A.) Research region, (B.) Three main areas, (C.) Medical facilities, (D.) Kindergartens, (E.) Primary schools, (F.) Middle schools, (G.) Daycare centers, (H.) Administrative offices, (I.) Community centers, (J.) Cultural facilities, (K.) Sports facilities, (L.) Green spaces.

Type	Level (min)	Walkable coverage ratio (%)				Spatial match of supply and demand			
		Avg.	Old town	New town	H-T zone	Avg.	Old town	New town	H-T zone
Medical facilities	15	68	78	63	36	0.3	0.3	0.4	0.2
Kindergarten	5	15	15	17	4	0.5	0.4	0.6	0.3
Primary school	10	35	42	28	20	0.4	0.4	0.4	0.4
Middle school	15	40	51	31	12	0.3	0.4	0.4	0.1
Daycare center	5	29	35	24	22	0.5	0.4	0.5	0.4
Administrative facilities	15	26	31	25	–	0.4	0.4	0.4	–
Community center	10	73	75	72	61	0.4	0.4	0.4	0.3
Cultural facilities	10	66	59	75	61	0.3	0.4	0.4	0.2
Sports facilities	10	53	62	48	23	0.3	0.4	0.2	0.1
Green space	5	63	60	77	25	0.3	0.3	0.3	0.1

Table 2. Evaluation results of various indicators for facilities.

4. Conclusions

The study suggests that the primary shortcomings of public facilities at the neighborhood level include education and elderly care facilities, facilities within a 5–minute radius, and those located in urban fringe and high-tech areas. Additionally, there is an issue of low efficiency in the allocation of facilities due to spatial mismatch between supply and demand.

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RELATION BETWEEN ACCESSIBILITY OF LOCAL AMENITIES AND RESIDENTIAL TRANSPORT BEHAVIOUR IN PRAGUE SUBURBS

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Keywords: Suburbs, transport, local amenities, urban planning, built environment, Prague.

1. Introduction

Researchers across the globe have been scrutinising the built environment and transport relations for the last two decades [1]. Such works mostly focus on regional levels in the US or Western European regions [2], whereas in the Czech Republic, there is a significant lack of research in this particular field. Moreover, the Czech urban and transport planning discourse is still based on a traditional modernistic approach, failing to contain already well-defined and well-known challenges. In the context of Prague, one of the main challenges lies in the car dependency of suburban residents [3]. Therefore, the starting point of the thesis was to examine ways of reducing transport volume and car dependency in the suburbs through means of spatial planning. Since Czech spatial planning mostly concerns the local municipal level through Municipal Land-use Plans, the location of civic amenities was chosen as a perfect representative. Thus, the thesis aims to verify the influence between the accessibility of local amenities and the travel behaviour of Prague suburban residents.

2. Contribution

The contribution presents intermediate working outcomes of the dissertation thesis. The work is based on quantitative analysis of transport diaries (containing activities, destinations, transport modes, and socio-economical attributes) combined with GIS data on the built environment, location of amenities and transport infrastructure (see Table 1) [4].

The first part of the contribution defines the research questions and establishes a methodology framework to answer the questions.

The framework is based on the Activity-Based Modelling (ABM) approach [5], focusing on individuals participating in activities spread across the space at a specific time. The method is described and extended into a hierarchical diagram of partial factors. Individual parts of the diagram are categorised, and interrelationships are described (see Figure 1).

The third part of the contribution presents the application of ABM framework to the second, central research question by regression modelling. Prague suburban residents' travel survey dataset (N = 453 respondents, 3 339 trips) is described and visualised (see Figure 2).

Components of linear regression are defined and discussed (see Table 2).

Attention is paid to interdependencies between independent-control variables, especially heavily correlated socio-economic and transport behaviour, causing a high volume of distortion in

Research question	Hypothesis	Methodology
Does the accessibility of local amenities influence residential transport patterns in the Prague Metropolitan Region?	Accessibility of local amenities **decreases** the total volume of residential transport. Accessibility of local amenities **decreases** car share in the residential modal split.	*Regression model; a combination of GIS and questionnaire (+ mobile phone data)*

Table 1. Evaluation results of various indicators for facilities.

preliminary results. The relationship between independent variables (red cells in the dataset structure in Figure 3) is investigated through Component Analysis (CA) [8].

CA works on the principle of dataset dimension reduction to visualise relations between variables. Two dimensions (Dim) with the highest variance contained (eigenvalues) are put into a correlation circle. In the circle, there are vectors showing direction and magnitude. Each arrow represents one variable. The direction is composed by correlation with Dim1 & Dim2. Variables with similar directions show a similar correlation with Dims and thus are similar. On the other hand, opposite directions show a negative correlation – variables indirect relations. And arrows at the right angle show no relations between variables at all. The arrow magnitude describes the strength of the correlation. Long arrows indicate a strong correlation, whereas short ones indicate a weak. The significance is also described by cos2 colour.

In case of socio-economic CA (see Figure 4), clear correlation was identified unsurprisingly 1) between house size & household income, and 2) between total persons in household & children in household. Also, age is indirectly correlated with number of children in household (older respondents tends to have more children[1]). Education level shows mild connection with age (older respondents may have higher education[1]). Respondents sex appears not to be relevant at all.

In case of travel behaviour CA, correlation was also unsurprising find between driving licence & car use. On top of it, total distance travelled shows moderate correlation with car use, suggesting there is a mild trend of increased mobility by car use. On the other hand, PT use is strongly independent form car use & driving licence ownership (suggesting that responders having driving licence obviously tends to drive, however, it does not prevent them from using PT). House distance to Prague centre is indirectly correlated with PT use (further respondents live, mote PT use), however, both variables are independent to car ownership & usage (frequency of PT use & distance from home to Prague do not mean more car use).

Combining socio-economic and travel CAs together, see Figure 5, reduces overall variance coverage in Dims from 53 % (socio-economic) or 52 % (travel behaviour) to 43 %, meaning the combined correlation plot explains 10 % less data variation. However, most correlation groups identified in previous CAs remain; persons in household & children, driving licence & car use, household size & income. On top of it, driving licence & car usage is extended by education level (more educated responders have driving licence, however, may be strongly disrupted by underage respondents), Household size & income is extended by variable number of cars (higher income means bigger house and owning more cars). Frequency of PT use & total distance travelled still remains indirectly correlated, nonetheless, loses portion of significancy. Conversely, distance from home to Prague becomes insignificant at all. Respondent sex remains isolated with low significancy.

[1] important to remember, that also children are included in the sample

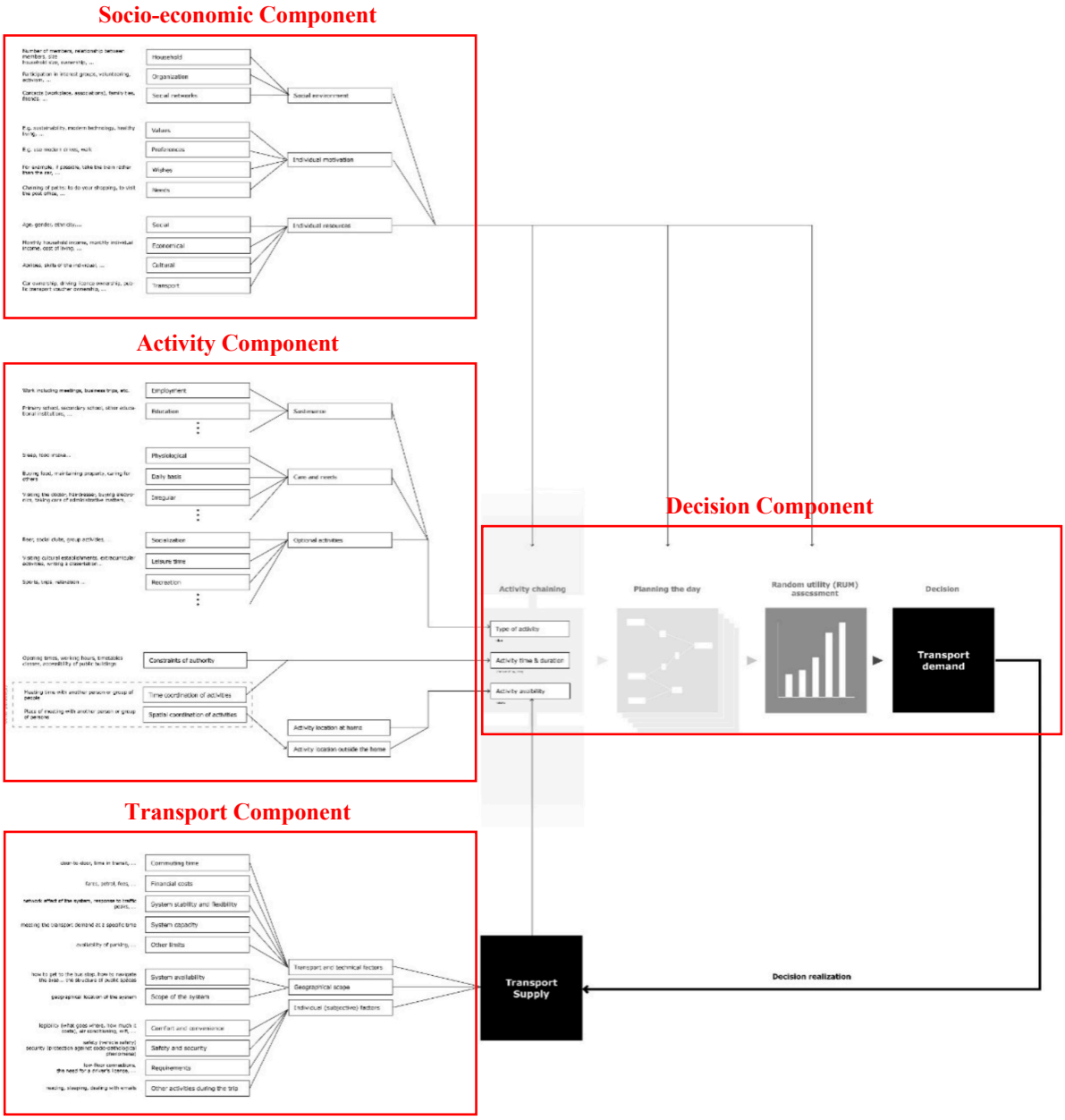

Figure 1. A preview of the ABM diagram, based on [4]: Diagram of factors determining daily residental transport demand.

The CA outcomes shows possible grouping of variables into wider groups and thus avoiding their interdependencies.

The last part of the contribution outlines the next steps, especially quantifying control built-environment variables through 5D methodology (see Table 3) [7] and primary regression outcomes.

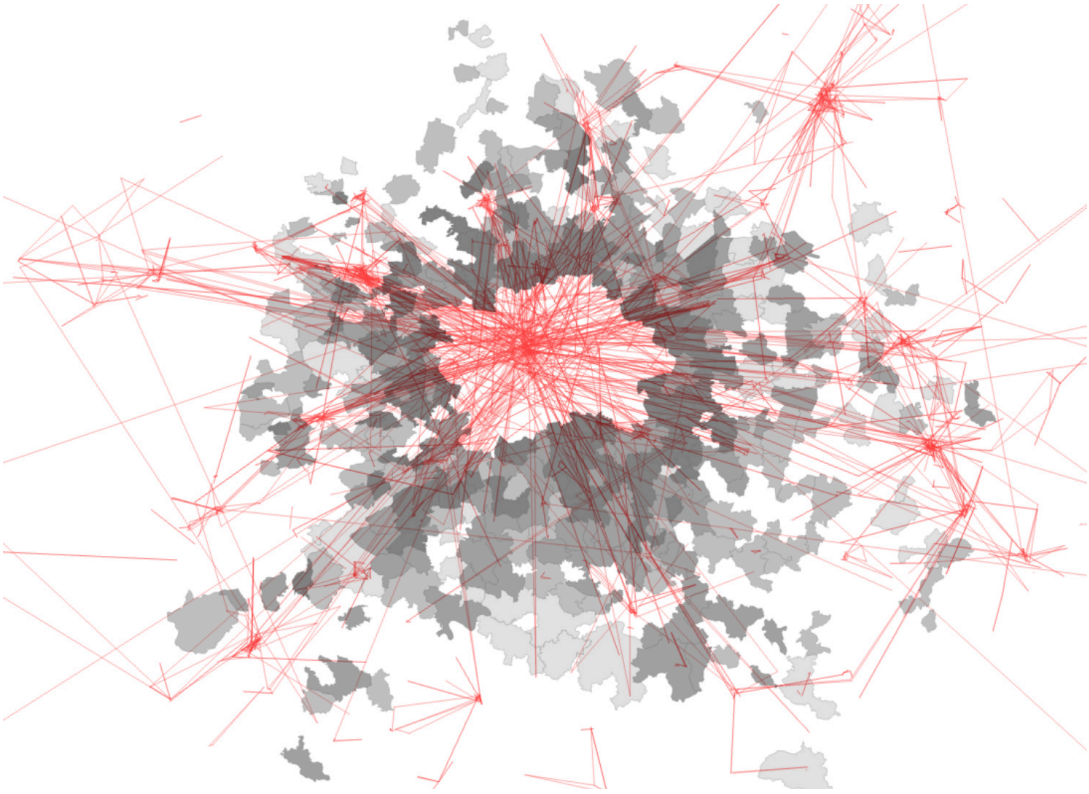

Figure 2. A preview of the dataset (suburban zones grey according to [6]).

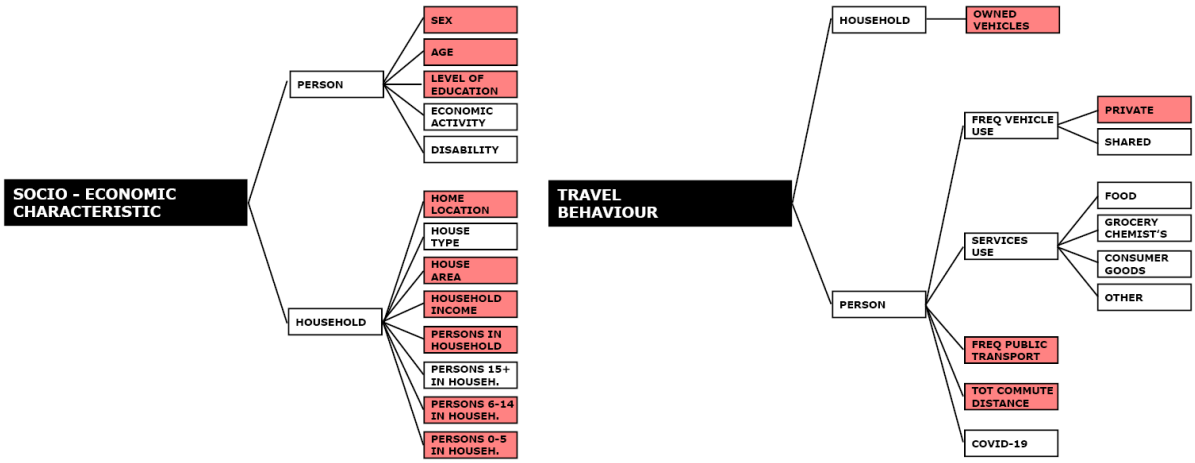

Figure 3. Dataset controls structure (red cells analysed in CA).

3. Conclusions

The contribution presents intermediate progress in the dissertation thesis, focusing on the methodological framework and constructing a regression model based on the transport survey dataset of Prague suburban residents. The main outcome presents quantification of interdependences between control variables, showing potential for grouping and reducing. The next steps are to quantify the built environment on the basis of 5D methodology and to load the model.

Type	Group	Variable
Dependent	Total length of all journeys per day by all means of transport	
	Total length of all journeys per day by car	
Independent	Walking time to the nearest kindergarten	
	Walking time to the nearest primary school	
	Walking time to the nearest medical centre cat. I	
	Walking time to the nearest cultural/community centre	
	Walking time to the nearest post office	
	Walking time to the nearest park or open landscape	
Independent – control	Household	House size
		Household income
		Persons in household
		Children in household
	Demographics	Sex
		Age
		Education
	Economic	Job
	Transport behaviour	Driving licence
		Car use
		PT use
		Cars owned
	Built environment: Density	Residential density in the respondent's residential area
	Built environment: Diversity	Land-use mix in the respondent's residential area
		Job-housing balance in the respondent's residential area
	Built environment: Design	Size of urban blocks in the respondent's residential area
		Street connectivity in the respondent's residential area
		Street redundancy in the respondent's residential area

Table 2. Regression components.

Density	Residential density Jobs density Commercial FAR
Diversity	Land-use Mix Jobs-residents ratio Local amenities count
Design	Street intersections density
Destination accessibility	Cul-de-sac density Jobs within one mile Amenities within one mile
Distance to transit	Closest mass transit stop

Table 3. 5D framework [7].

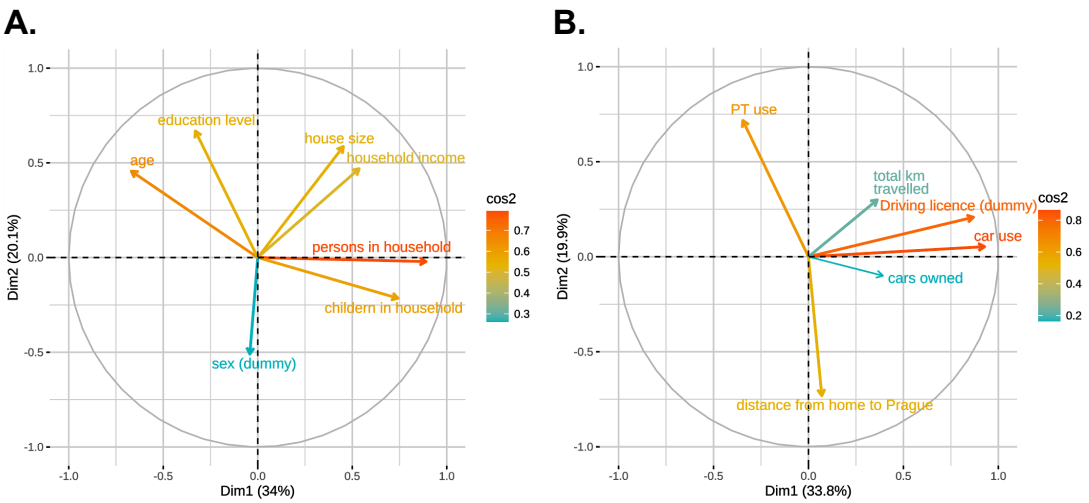

Figure 4. Partial CAs correlations circles: socio-economic controls and travel behaviour. (A.) Socio-economic controls, (B.) Travel behaviour controls.

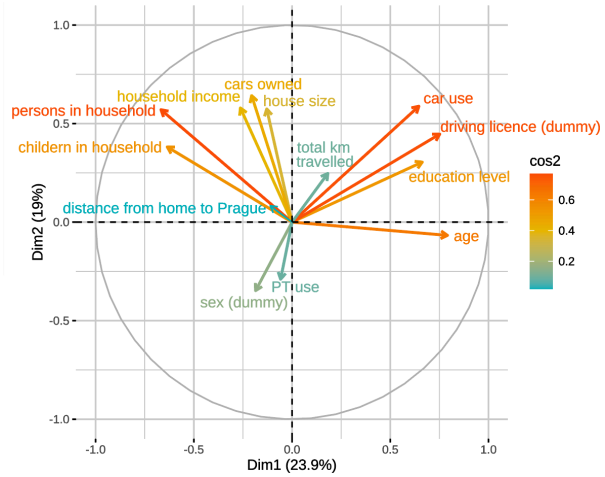

Figure 5. Joined CAs correlation circle.

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EXPLORING THE INFLUENCE OF AIR QUALITY ON TRAVEL BEHAVIOR IN EUROPEAN CITIES: A MULTILEVEL ANALYSIS OF MODAL CHOICES

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Keywords: Travel behavior, homogeneity, multilevel logit model, transport mode choice, air quality, PM10.

According to data published by the IPCC in 2021 [1], human activity has led to a global temperature increase of 1.1 °C compared to pre-industrial levels. In the sixth IPCC summary report [2], anthropogenic net greenhouse gas (GHG) emissions in 2010–2019 reached their highest recorded levels, with approximately 15 % of emissions attributed to the transportation sector. Unlike other sectors such as energy (34 %), industry (24 %), or agriculture, forestry, and land use (22 %), the transportation sector has not witnessed a decrease in the average annual emission growth rate. In the European Union, transportation accounts for one-quarter of GHG emissions, with road transportation alone contributing to 72 % of emissions in 2019. This sector's emissions intensity primarily results from the growing demand for motorized transportation modes [3].

These data underscore the transportation sector's significant contribution to global emissions, particularly concerning urban areas, which accounted for 62 % of global GHG emissions in 2015 and an estimated 67–72 % of total global emissions in 2020 [2]. Reducing emissions in urban transportation is, therefore, a crucial issue.

One effective approach to combat emissions in cities is influencing residents' choice of transportation modes for daily travel. However, before this can be achieved, it is essential to identify the factors that determine travel behavior [4]. Scholarly literature extensively examines travel behavior analysis, with a focus on identifying its determinants over several decades. Much of the research has concentrated on individual cities, seeking to uncover correlations between resident characteristics and their travel mode preferences [5]. While many studies have analyzed the influence of air quality on health and the environment, the relationship between air quality and travel behavior has received less attention [6].

In our investigation, we explore disparities in travel behavior across diverse European cities through the lens of local homogeneity, with an emphasis on the influence of both perceived and measured air quality on travel mode choice. This approach remains relatively rare in existing literature, enabling us to examine distinctions in daily travel mode selection beyond commonly scrutinized factors such as respondent characteristics, travel patterns, or built environmental attributes.

Our study integrates data from the Perception Survey of Quality of Life in European Cities conducted by the European Commission in 2019. This survey includes a representative sample of respondents queried about their most frequently utilized travel mode for daily commuting, encompassing data from 83 cities and approximately 58 000 respondents. We enhance this database with information on the annual mean concentration of particulate matter with a diameter of less

than 10 microns (PM10) in the cities, sourced from the World Health Organization's Ambient (outdoor) air pollution database for 2018.

The data exhibits a hierarchical structure, with respondents clustered within cities and cities further grouped within countries. We employ a multilevel logit model to account for this hierarchical structure and derive robust estimates of parameters elucidating the influence of specific variables on travel mode selection. Three distinct models were estimated to scrutinize the determinants associated with buses, private cars, and bicycles as the most commonly chosen daily travel modes. We also utilize conventional single-level models as a benchmark to assess the significance of local homogeneity.

Our findings align with existing literature regarding the sociodemographic attributes of respondents. Regarding environmental consciousness, neither individually perceived air quality nor noise levels within the urban setting exerted a statistically significant effect on mode choice, except for a positive impact of perceived air quality on the choice of private cars. As perceived air quality cannot be considered an objective measure, we incorporate actual emissions levels in the model using data on PM10 particulate matter concentrations in cities. Our results show that increasing air pollution decreases the probability of choosing bicycles and increases the likelihood of selecting public transport modes, confirming previous findings [7, 8].

In terms of analyzing local homogeneity among diverse cities, we find statistically significant effects at the individual city level, while insignificance prevails at the national level concerning homogeneity. This signifies that behavioral uniformity among respondents is discernible within specific cities but does not extend to the national level. Consequently, this outcome underscores the necessity for individualized analysis of travel behavior within cities and the importance of accounting for city-level clustering in broader investigations of travel behavior. Moreover, the disparities between actual and perceived air quality's impact on travel behavior provide an intriguing setting for further analyses.

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THE ROLE OF ENERGY AND TRANSPORT RELATED BUILT ENVIRONMENT CHARACTERISTICS IN RESIDENTIAL LOCATION CHOICE

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