Urban Mobility and Spatial Justice: Prospects for Non-motorized Mobility in Nairobi

Dorcas Nthoki Nyamai

Faculty of Spatial Planning

TU Dortmund University

Dortmund, Germany

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Supervisor:

Prof. Dr. Sophie Schramm, Chair, International Planning Studies, Faculty of Spatial Planning, TU Dortmund University, Dortmund, Germany.

Co-Supervisor:

Prof. Dr. Caleb Mireri, Department of Environmental Planning and Earth Science, Kenyatta University, Nairobi, Kenya.

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DECLARATION

I, Dorcas Nthoki Nyamai, hereby declare that the work presented in this Dissertation entitled **Urban Mobility and Spatial Justice: Prospects for Non-motorized Mobility in Nairobi** is entirely my own. I further declare that this work has not been submitted, in whole or in part, for any degree or qualification to any other institution. All sources used or referred to have been properly and rightfully acknowledged according to the research and ethical requirements of the Technical University of Dortmund, Germany

Affidavit

I, Dorcas Nthoki Nyamai, declare that the PhD Dissertation titled ***Urban Mobility and Spatial Justice: Prospects for Non-Motorized Mobility in Nairobi*** provided herewith is a true and authentic representation of my original doctoral research. I affirm that I am the rightful author of the Dissertation.

Any external sources or material used in the research and writing of this Dissertation are duly cited and referenced in accordance with the ethical standards and research requirements of the TU Dortmund University.

I take full responsibility for the accuracy and authenticity of the information presented in this document.

Dorcas Nthoki Nyamai

23.01.2024, Dortmund, Germany

Abstract

This research investigates the relationship between mobility and justice in the context of Nairobi. Deriving from Amartya Sen's notion that justice addresses remediable injustices, the study explores justice as a dynamic concept influenced by diverse cultures, political ideologies, and philosophical paradigms. Spatial planning is taken as a canvas for these philosophical debates, manifesting in the spatial distribution of resources.

Justice in relation to mobility is invoked and performed in various ways. This is based on the premise that space not only contains resources that can be distributed but also consists of individuals who are highly mobile within that space, and whose perceptions play a pivotal role in shaping the concept of justice in relation to mobility.

Mobility, as a key element, plays a pivotal role in addressing spatial inequalities, as it facilitates access to the resources that are spatially disjointed. The intersection of mobility and justice unfolds in the streets and neighbourhoods, where spatial planning decisions impact infrastructure provision and access to services and opportunities. Spatial planning and power dynamics contribute to unequal capabilities for movement, shaping accessibility, and connectivity within the city. The policies governing mobility become instrumental in defining rules that either enhance or restrict individuals' access to resources, economic opportunities, and overall well-being.

The research contends that spatial planning, mobility, and human interactions collectively shape spatial inequalities or justice outcomes. Various actors within the city space play a crucial role in shaping systemic dimensions of justice, and citizen engagement is vital for inclusive decision-making.

Focussing on non-motorized mobility, this research builds on previous studies that address the necessity of prioritizing of the mobility needs of the most vulnerable as a strategy for advancing justice in urban mobility. This research advocates for equitable access to transportation resources, emphasizing the importance of including the perspectives and lived experiences of citizens in the pursuit of a just mobility landscape.

In Nairobi, a focus on motorized mobility has subtracted from the advancement of the modes of mobility used by the majority especially the most vulnerable, with a discernible outcome of injustices. Planning for motorized mobility has historically been at a higher level of consideration although a much larger percentage of the population travels on foot. The technical engineering design that lacks integration of social aspects of mobility has presented challenges in provision of safe non-motorized infrastructure, enduringly dismissing non-motorized mobility as a valid mode of mobility.

Through a four- dimensional framework that includes space, mobility, individual characteristics and time, this research explores how spatial injustices in Nairobi's mobility landscape unfold and are made manifest. Viewed from this perspective, the organization of space and the prioritization of the mobility needs of the most vulnerable present a notable way in which spatial justice unfolds and is understood.

The distinctive mobility challenges experienced in Nairobi, ranging from the financial barriers associated with unaffordable public transit to inadequate and unsafe infrastructure that results in heightened risks and misfortunes among pedestrians collectively underscore the injustices prevalent in the city's mobility landscape. The foundational principles of fairness for the most vulnerable in society therefore become compromised.

Effectively addressing these challenges necessitates deliberate and concerted actions. Investing in non-motorized mobility is crucial for creating a safer and more just mobility environment. Civic education also plays a pivotal role, in raising public awareness about regulations and mobility rights. By actively engaging with these multifaceted challenges, Nairobi can take significant strides toward rectifying injustices in its mobility landscape and creating a more inclusive and equitable urban environment.

Overall, the linkage between justice and urban mobility emerges as inherently dynamic and context-specific, reflecting a practical, lived reality deeply influenced by the social, cultural, and economic contexts in which individuals navigate their daily lives. This perspective highlights the crucial significance of taking into account the specific context and the real-life experiences of individuals when formulating and implementing policies and initiatives related to justice, particularly within the realm of urban mobility. Recognizing the multifaceted nature of justice in this context is essential for promoting inclusivity, addressing historical imbalances, and fostering sustainable urban development that truly meets the diverse needs of the community.

I Introduction

"What moves us reasonably enough is not the realization that the world falls short of being completely just but that there are clearly remediable injustices around us which we want to eliminate". Amartya Sen, The Idea of Justice, 2009.

Justice as a concept, idea, theory, experience or as depicted in other iterations, is subject to continuous investigation within scholarly circles, political discourses of urban governance and planning, and diverse socio-cultural constellations. This dynamic exploration has given rise to various ontologies of justice. Across different societies, cultures, historical epochs, political landscapes, academic disciplines and philosophical paradigms, distinct interpretations of justice have emerged, often revealing points of convergence and intersection. Cultures worldwide have woven their unique societal fabrics, each thread contributing to a distinctive understanding of justice. From indigenous practices deeply rooted in communal values (c.f. Omenya, 2020) to modern societies shaped by legal frameworks, the varied cultures present a broad spectrum of viewpoints on what constitutes a just society. Political ideologies and philosophical paradigms shape how justice is conceptualized and implemented within the structures of governance, stimulating thoughtful reflection and debate on the ethical dimensions of justice. It is within the urban architecture, zoning regulations, and urban development initiatives that the philosophical debates on justice are expressed in spatial planning.

Social justice constitutes one of these ontologies that has been subject to theoretical scrutiny for many decades. In the social justice theory, prominent scholars have offered distinct views each proposing unique frameworks for understanding fairness and equity. In his seminal contribution, 'A Theory of Justice' (1971), John Rawls introduces a hypothetical scenario of invoking fairness in society. He envisions a situation where individuals, situated behind a 'veil of ignorance' make fair decisions for the wellbeing of all in society without knowledge of their personal characteristics or social positions. Guided by rational decision-making, they adhere to two fundamental principles: the principle of liberty, permitting social and economic inequalities only if they benefit the least advantaged, and the difference principle which prioritizes maximizing benefits for the least advantaged in society.

This scenario has however been challenged by authors such as Amartya Sen, whose 'Idea of Justice' (2009) argues that the diverse cultures in society produce varied social perspectives hence rational choice is therefore not always guaranteed. Within the intricacies of human decision-making, reason and emotion play intertwined and nuanced roles, leading to a spectrum of outcomes across different cultural contexts. Furthermore, spatial planning in postmodern times, calls for a meticulous consideration of contextual differences, both within and between varied urban settings, as well as an in-depth examination of the diverse situations experienced by city inhabitants. This suggests a departure from static, top-down approaches towards dynamic, context-sensitive and bottom-up

strategies that can accommodate and respond to the evolving dynamics of postmodern urban life (Harvey, 2002).

Juxtaposed with Rawls' egalitarian perspective, wherein the needs of society's most vulnerable are ideally the centre of decision-making processes, Sen's framework emphasizes the evolving nature of inequalities. In his view, societal disparities are not static or universally defined; they evolve over time and manifest in diverse ways. Amidst the changing landscape of individual circumstances and societal differences, Sen views justice as a fluid and adaptable concept that seeks to address the multifaceted realities of individuals. This view recognizes that societal needs and norms are subject to change. Therefore, continuous examination and adjustment of policies and practices is necessary to ensure that they remain relevant and effective in promoting fairness within the ever-changing socio-economic situations.

In addition to societal differences, geographical differences also play a role in the nature of inequalities. Edward Soja's spatial justice theory (2013) highlights the crucial role of spatial organization in perpetuating or challenging social inequalities. He contends that the organization and arrangement of space exerts a profound influence on the lived experiences of individuals and communities. In his perspective, spatial configuration plays a pivotal role in shaping the way people perceive, interact in and navigate their surroundings. Space influences social interactions, access to resources and the overall quality of life for individuals. This means that the synergies between justice and spatial planning manifest in the streets and neighbourhoods – everyday spaces – where people interact and reside. Spatial planning, therefore, with its regulatory frameworks and design interventions, directly influences the accessibility, safety, and inclusivity of these public spaces. Neighbourhoods and streets, as microcosms of urban life, become the areas where justice is either realized or denied. Spatial planning decisions impact infrastructure, public services, livelihood opportunities and housing, profoundly influencing the quality of life of city inhabitants.

The organization of space often creates a core and a periphery resulting in the uneven clustering of resources in some places more than others (Martens and Bastiaanssen, 2019). Based on this view, mobility becomes crucial in facilitating access to these resources that are spatially distributed. This forms the basis of this study which recognizes that mobility, although itself not subject to distribution, plays a critical role in advancing equity within space. Additionally, space not only contains resources that can be distributed or redistributed but also consists of individuals, whose movements, actions and interactions constantly modify the urban form. These individuals also make up communities with diverse characteristics, capabilities, cultures and lived experiences, generating various needs and giving rise to unpredictable social and spatial outcomes (Sen, 2009; Soja, 2013). In such a dynamic setting, diverse visions and ideals coexist and compete, while different actors exert influence and engage in negotiations

that lead to either equitable or inequitable outcomes (Marx, et.al., 2022). Spatial justice is therefore an outcome of actions, interactions and movements of individuals within space and the space itself, a manifestation of the dynamics that produce and reproduce injustices (Dikeç, 2009). This research therefore considers the interlinkage between spatial planning, mobility and human interactions as dimensions that collectively impact and shape the unfolding of spatial equalities or inequalities. Spatial planning shapes the physical environment, influencing land use and determining the distribution of resources and opportunities within a given geographical area. It also determines how individuals interact with each other and how power dynamics are negotiated and expressed. Mobility, encompassing modes of transportation and accessibility becomes a conduit through which the decisions of spatial planning are translated into the everyday experiences of individuals. By understanding these interlinkages, this study aims to uncover the mechanisms through which spatial inequalities are sustained and to offer insights that can inform approaches to more equitable and inclusive planning for urban space and mobility.

Central to these interlinkages is the role that institutions play in shaping systemic and structural dimensions of justice or injustice (Rawls, 1971). In Sen's view (2009), an integral part of the pursuit of justice involves an ongoing and deliberate interrogation of the decisions made by various actors. Given the diversity of cultures and lived experiences, varied interpretations of what constitutes fairness emerge and compel the need for citizen engagement in decision-making processes. Within the framework of the 'Just City' concept, Susan Fainstein (2010) places emphasis on citizen engagement and democracy as inclusive approaches that incorporate the diverse perspectives, needs and aspirations of communities and result in equitable outcomes. In this context, a just city upholds transparency, accountability and participation in shaping policies and urban spaces that are equitable and reflect the diverse and inclusive needs of those who inhabit them. The pursuit of justice therefore extends beyond the mere establishment of institutions and involves an ongoing and deliberate inclusion of the needs and perspectives of the marginalized (Sen, 2009).

The exploration of justice in the context of urban mobility by various scholars advocates for the prioritization of the mobility needs of the most vulnerable in society. This exploration delves into intricate dynamics of spatial planning, and individual capabilities, recognizing that not all individuals have equal access to transportation resources and hence emphasizes the need to address disparities and promote inclusivity (Dong, 2018; Nyamai and Schramm, 2022; Pereira et.al, 2017; Sheller, 2018). The scholars argue for a fundamental shift in focus towards those who face most challenges and limitations in accessing mobility options, specifically the poor and those with disabilities. Within this framework, access to mobility options is not uniform and requires implementing policies and infrastructural changes that specifically cater to the needs of the vulnerable groups. This approach entails providing sufficient resources, including material, spatial, infrastructural and financial resources, to ensure equitable access to transportation

(Martens, 2016) but also including the perspectives and lived experiences of citizens in providing affordable, safe and inclusive mobility systems (Nyamai, 2023).

Moreover, spatial planning and the power dynamics governing mobility in cities contribute to unequal capabilities for movement among city inhabitants (Sheller, 2018). Spatial planning, as a mechanism for organizing and controlling the use of land, resources and infrastructure development either facilitates or impedes the accessibility and connectivity of different areas within the city. The allocation of resources, prioritization of infrastructure projects, and the formulation of policies related to mobility are all shaped by political decisions. These power dynamics, intertwined with policy formulations, highlight the complex landscape in which mobility and justice intersect. Policy formulations, as instruments of governance, become key in defining rules and norms that govern mobility. These policies reflect the prevailing power structures since the decisions related to mobility infrastructure and investments are often influenced by the priorities of those with the authority to shape and implement policies.

The intersection of mobility and justice becomes evident in how these policies either enhance or restrict the ability of individuals to access necessary resources and advance their livelihoods. For example, transportation policies that prioritize motorized modes and allocate inadequate resources to non-motorized modes of mobility perpetuate disparities in accessibility, especially for marginalized groups. The consequences of such policies extend not only to physical mobilities but to economic opportunities, social interactions, and overall wellbeing.

By closely examining the interplay between mobility, spatial dynamics, social processes and power structures, this research highlights that mobility is not merely a technical or logistical issue but is inherently linked to questions of fairness and equity. It aims to unravel the complexities that that contribute to spatial injustices in urban mobility. The linkage between spatial justice and mobility unfolds across various layers, intricately interwoven with the influence of politics and external actors in governance, planning and management of urban infrastructure. Political structures, policies and governance frameworks significantly impact the allocation of resources and overall design of urban spaces. Decision-makers, whether elected officials or those with influence in planning and policy circles, have the capacity to prioritize certain interests over others. This is further elaborated in Chapter 4, where a temporary change in the governance structure of Nairobi led to the prioritization of non-motorized infrastructure development, albeit for limited period. The patterns of spatial justice in urban mobility reflect the intentional or unintentional choices made within political circles. The heterogeneity of space introduces an additional layer of complexity, giving rise to multifaceted challenges and opportunities for justice in urban mobility.

This study seeks to unravel the intricate dimensions of spatial justice in urban mobility by examining the mobility landscape in Nairobi, Kenya's capital. This involves scrutinizing the spatial distribution of mobility infrastructure, the accessibility of mobility options within the city and how the spatial arrangements impact various user groups. Nairobi, like many other urban centres in Africa, is characterized by diverse

socioeconomic and spatial disparities that influence the mobility experiences of the city's inhabitants. Investigating these disparities within the spatial justice framework involves examining how factors such as income levels, residential locations, social demographics, historical development and infrastructure policies intersect with existing mobility patterns.

In Nairobi, nearly half of the commuter population relies on active mobility, primarily walking, as their main mode of travel (Odhiambo, 2021) for trips to school, work, shopping and journeys back home (County Nairobi, 2014). This prevalence of walking is largely influenced by unaffordability of paratransit options (Nyamai, 2022). Paratransit, commonly known as matatu[1], is the second most used mode of mobility in the city accounting for about one-third of daily trips (Kamau and Manga, 2020). Private car use accounts for about 13% of the commuter trips while cycling accounts for 1% (Odhiambo, 2021). Despite the ubiquity of active travel, Nairobi's planning and policy-making heavily favour the promotion of motorized mobility over non-motorized modes (Khayesi et.al., 2010). Equity is not adequately integrated into the city's overall infrastructure planning and policy development (Mitullah, 2017). A small fraction of the annual transport budget is allocated to improving non-motorized modes of transport compared to motorized modes with significant implications for the majority who use non-motorized modes. As a result, the mobility of those who use non-motorized modes is riddled with uncertainties that derive from inadequate infrastructure.

The safety of pedestrians is a pressing concern, with road crash records consistently highlighting pedestrians as the primary victims each year. Pedestrians in Nairobi predominantly belong to low-income groups, where walking is not merely a choice but the only affordable option. Regrettably, the tragic consequences of road crashes often involve the loss of breadwinners or key contributors to the family income, exacerbating poverty in already vulnerable households. (Nyamai, n.d). These distressing outcomes further highlight the need to address mobility in Nairobi as a matter of justice.

II. Research Questions

To systematically examine the intricate association between urban mobility and spatial justice the research formulated key guiding questions.

Overarching research question:

> How do spatial injustices manifest within the urban mobility landscape of Nairobi, and what are the underlying dynamics shaping these manifestations?

Sub-research questions:

[1] Paratransit in Nairobi is provided by private entities operating minivans and buses that are commonly known as matatu. The words *matatu* and *paratransit* and at times *public transport* (with reference to the respondents' views) are used interchangeably in this research.

a.) How does the spatial development of Nairobi contribute to the intricate production of spatial injustices within the city's mobility landscape?

b.) To what extent do historical patterns and path dependencies contribute to the perpetuation of spatial injustices within Nairobi's mobility landscape, and how have these historical factors shaped the current disparities?

c.) What are the distinctive mobility patterns of the diverse social groups in Nairobi, and how do these groups encounter and perceive spatial injustices within the mobility landscape?

d.) How has the governance and political structure influenced the progression of spatial (in)justice in the realm of urban mobility in Nairobi?

e.) What risks and misfortunes are experienced by non-motorized commuters in Nairobi, and how are these experiences indicative of spatial injustices?

f.) How might the concept of spatial justice be operationalized to address challenges and improve equity in urban mobility in Nairobi?

III. Research Design

To address each of the research questions, the study applied a four-dimensional framework. These dimensions which include spatial, modal and temporal dimensions as shown in Figure 1 provide a structured lens for the assessment of how injustices in urban mobility unfold and are made manifest.

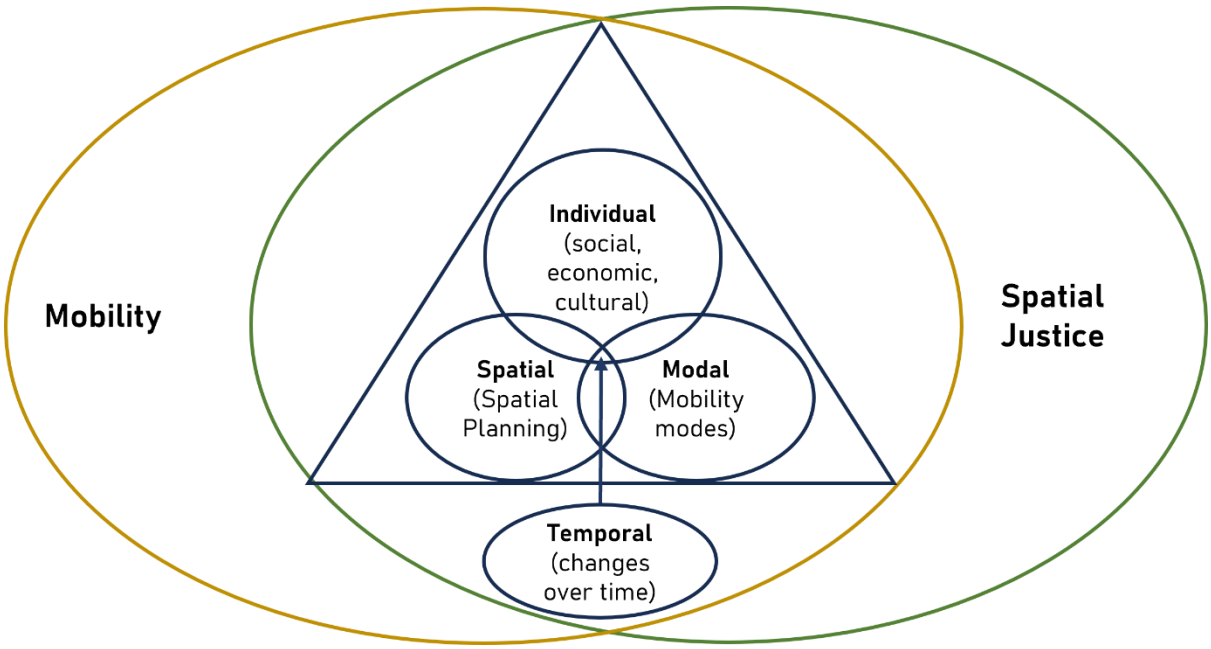

Figure 1: Four-dimensional framework guiding the study of the linkage between urban mobility and spatial justice. Source: Author's

The **spatial dimension** takes into account the intricacies of spatial planning in urban areas, focussing on the deliberate organization and distribution of resources within the physical space. Essentially,

spatial planning shapes the landscape of urban areas, influencing how and where resources and services are located. As articulated by Martens and Bastiaansen (2019), any urban development inherently creates a centre and periphery, leading to the clustering of key functions and services in specific areas. This clustering defines accessibility for individuals based on their residential locations. Those situated in closer proximity to the central cluster experience more favourable accessibility to essential functions, leading to disparities for those residing in peripheral areas. Deliberate spatial planning therefore becomes a crucial factor in understanding and addressing spatial injustices within the broader context of urban mobility

The **modal dimension** in the context of this research refers to the various means or modes that enable individuals to obtain access to different services and resources. This dimension acknowledges the diversity of modes of mobility and their impact on and individual's mobility experience. This research places an emphasis on the investigating non-motorized modes of mobility which encompass walking and cycling. These modes hold particular relevance in the urban context, contributing to sustainable mobility solutions. However, a holistic understanding of injustices within mobility necessitates a dual examination encompassing both non-motorized and motorized modes in order to comprehensively understand the challenges of individuals in accessing essential services and resources. By examining the availability, affordability, safety, and efficiency of both motorized and non-motorized modes, the research aims to uncover the injustices that exist within the broader mobility landscape. Availability addresses the presence and accessibility of modes of mobility considering factors such as infrastructure and planning. Affordability explores the financial accessibility of the existing modes of mobility while safety analyses the potential risks and challenges associated with some modes of mobility, especially non-motorized modes. Lastly, efficiency examines how well these modes meet the everyday mobility needs of users in terms of time and convenience.

The **individual dimension** interconnects intensively with both the modal and spatial dimensions, and encompasses various social, cultural and economic characteristics of individuals. Factors such as income, gender, age, religion, employment status, physical capabilities, residential choices and education levels collectively shape an individual's ability to access essential places and to take advantage of opportunities necessary for enhancing one's wellbeing. For instance, individual's physical capabilities, economic resources or cultural considerations may determine the individual's choice of non-motorized or motorized modes. Similarly, residential choice and spatial planning impact how people are able to access certain locations. An individual's decision on where to reside may be influenced by economic factors or even safety considerations. This choice in turn influences the proximity of essential services and opportunities. In addition, income levels may affect the affordability of motorized mobility options while gender dynamics may influence the perceptions of safety and

security. Recognizing and understanding the interplay of these diverse characteristics is therefore crucial for developing inclusive and equitable mobility systems that cater to the varied needs and experiences of individuals.The **temporal dimension** considers the factors that perpetuate spatial injustices in urban mobility. It recognizes that neglect or prioritization in the development of certain modes of mobility over time creates persistent inequalities that expose individuals to significant risks and misfortunes in their daily mobilities. The dimension investigates the trajectory of decisions, policies and investments made in the past and their impact on the current state of mobility infrastructure, accessibility and the distribution of resources. Consequences of past decisions continue to shape the present, affecting the daily experiences of individuals in the city. Addressing these historical path dependencies is crucial for developing strategies that rectify existing injustices and prevent their perpetuation in future mobility planning and development.

Each of these dimensions present varying degrees of complexity and by assessing each dimension, the research aims to contribute nuanced theoretical insights and robust empirical evidence to the discourse on the linkage between mobility and justice, especially within the context of an African city.

IV. Research Area

This study investigates spatial injustices within the mobility landscape of Nairobi. The choice of Nairobi as a case study is influenced by two main criteria. Firstly, that Nairobi is one among two cities in East Africa with an existing non-motorized transport policy and second, that Nairobi bears the highest share of non-motorized transport users within East Africa.

Nairobi, Kenya's capital, developed in the late 19th Century as a railway camp and a resting point for the construction of the Kenya-Uganda Railway (Ogot & Ogot, 2020). From its foundation as a colonial railway quarter on, Nairobi has experienced decades of significant and fragmented urban growth with large disparities in terms of income and access to resources among different population groups (Klopp, 2012). Presently, Nairobi is fully urbanized. The city's urban agglomeration has a significant extension, stretching over more than 20km from the Central Business District (CBD) to the West and over 30km to the East. Development to the south of the CBD is restricted by the Nairobi National Park. The CBD is Nairobi's most historic area where opportunities, services and transportation links tend to cluster. Within the past decade, however, two main areas, west and northwest of the CBD, have developed as clusters of employment opportunities with high concentration of international and government institutions and a mixture of private and public commercial areas. These are the areas of Westlands to the northwest and Upper Hill to the west of the CBD as shown in Figure 2.

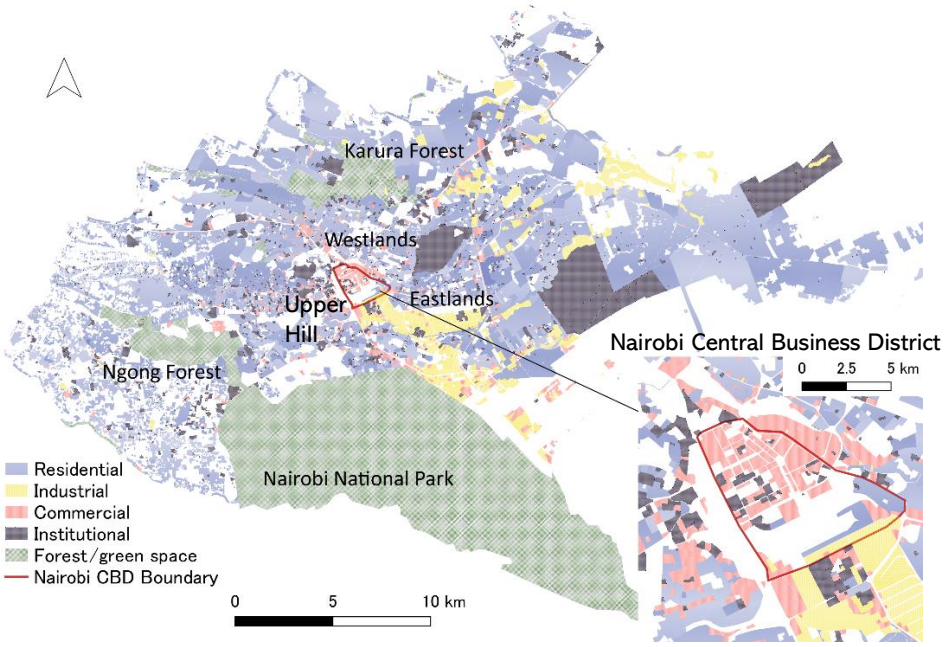

Figure 2: Nairobi city with various land use distributions. Source: Author's

The area of Upper Hill changed use from a low-density residential area to a high-density commercial area, retaining very few residential areas (Njehia, 2015). Westlands is a recently emerging commercial zone with a fair share of residential space; however, changes are anticipated in the coming years given the completion of the Nairobi Express Highway whose aim is to accelerate the growth of Westlands area for business (KeNHA, 2022). Many highly privileged urban residents in Nairobi choose to live in exclusive areas in the periphery, contributing to a distortion of the city's mobility system and land-use patterns to cater for that exclusion.

With regards to urban mobility, Nairobi has approximately 3000km of highway network categorised according to hierarchy of connectivity between international, regional and local borders. Class A corridors connect international boundaries, Class B corridors link various counties and Class C are primary feeder roads that link to Classes A and B and so on. Class M represents the smallest unit in residential neighbourhoods.

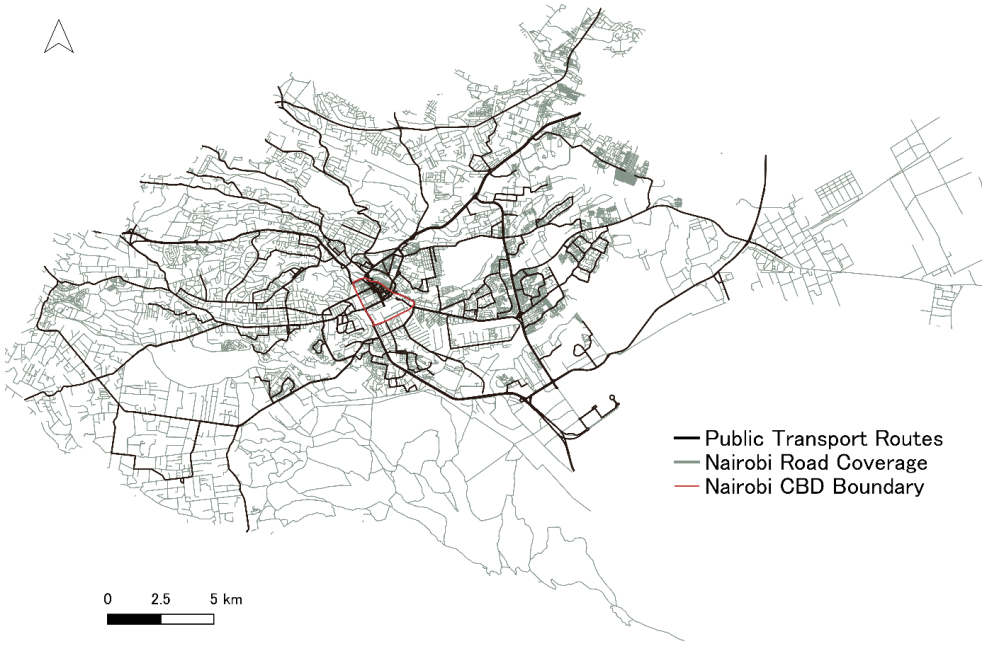

Figure 3: Nairobi's Road network. Source: Author's

As illustrated in Figure 3, the CBD clusters the origin and destination for nearly all the paratransit routes in the city. The paratransit route network indicates a radial pattern resulting from the designated routes funnelled to a restricted set of major highways that mainly include Classes A, B and C. These routes converge to the CBD where the majority of the route interchanges take place.

About 2.2 million trips per day are carried out primarily on foot (Odhiambo, 2021) and these include trips to school, work, shopping and journeys back home (County Nairobi, 2014). The prevalence of walking is largely influenced by unaffordability of paratransit options (Nyamai, 2022). Paratransit is the second most used mode of mobility in the city accounting for about one-third of daily trips (Kamau and Manga, 2020). The radial pattern of the paratransit route network, emerging from the assigned routes by the National Transport and Safety Authority of Kenya (NTSA) prohibits circular mobility throughout the city, reducing the number of places that would be accessible using this mode. Private car use accounts for about 13% of the commuter trips and receives by far the most coverage of road network throughout the city while cycling accounts for 1% (Odhiambo, 2021).

Nairobi grapples with a notable imbalance that favours the promotion of motorized mobility over non-motorized modes despite the ubiquity of active travel (Khayesi et.al., 2010). Presently, equity is not adequately integrated into the city's overall infrastructure planning and policy development (Mitullah, 2017). A small fraction of the annual transport budget is allocated to improving non-motorized modes of transport compared to motorized modes with significant implications for the majority who use non-motorized modes.

V. Data and Methodology

In order to contextualize each of the proposed dimensions the study carried out a progressive analysis. Within the **spatial dimension**, the study applied a spatial assessment of the growth of the city using Geographical Information Systems (GIS). The periodical growth of the city was first assessed to observe changes in urban development over time. Using Landsat imagery, maps of the changes in the extent of the built-up area within five-to-ten years intervals were developed. Starting from the year 1984, which was the oldest year available, the research examined changes over 5- year intervals up to the year 2020. The Landsat scenes of Nairobi were obtained from the United States Geological Survey website (USGS, n.d.). Using QGIS and its Semi-Automatic Classification Plugin for supervised classification of remote sensing imagery, ROI's (Regions of Interest) for the various classes in the imagery were manually created. The details of the assessment are further outlined in the first chapter that looks at the accessibility and mobility using various modes in the city.

To investigate the **individual dimension**, the research applied two methods. Firstly, quantitative assessment of secondary data obtained from various Kenya government websites. The household survey data was obtained from the Kenya National Bureau of Statistics (KNBS), a governmental body that is mandated to collect, analyse, and disseminate statistical data. The KNBS conducts countrywide longitudinal household surveys every 10 years. The study used available data for the periods 2005-2006[2] and 2015-2016 household surveys and filtered out individual mobility data of Nairobi County respondents. The data contained information for approximately 1,200 respondents for the year 2006 and approximately 1,050 respondents for the year 2016. Analysing data from both years allowed for comparison of the changes in the use of various modes of mobility between the two periods. In addition, data from the National Transport and Safety Authority (NTSA) on commuter fatalities from the period 2017 to 2019 was used to analyse the mobility risks that individuals are exposed to as well as the resultant injustices.

A second step involved a qualitative approach that explored the perceptions of justice among Nairobi's urban commuters and how they relate justice with urban mobility. Structured interviews involving 65 participants were conducted between October and December 2021 to understand how various commuters in Nairobi related justice to their daily mobilities and how they envisioned a just mobility system. This provided a starting point to identify and address how injustices in Nairobi's urban mobility system unfold and are understood by the users themselves. The perspectives collected in the study

[2] The final year of completion of the surveys i.e. 2006 and 2016 appear as the years of reference within the first chapter.

represent important points from which efforts towards achieving a more equitable mobility system can begin.

For the **modal dimension**, the study begun by investigating the existing modes of mobility in Nairobi. The data was obtained from the KNBS household survey data as well as the Climate Data Knowledge Network (CDKN) who have carried out analysis of mobility in Nairobi. The data for the paratransit route network was developed by the Digital Matatus Team that consisted of a collaboration between the University of Nairobi School of Computing and Informatics, Centre for Sustainable Urban Development at Columbia University, and the Civic Data Design Lab at the Massachusetts Institute of Technology. The team developed transit data for Nairobi, collecting data for the various matatu stops using a phone-based tracking application that also relied on the knowledge of the regular users of the various routes (Williams et.al, 2015). The data culminated in the design of a matatu transit map for the city which is publicly accessible (Digital Matatus Project, 2015). The research used this database to carry out a network analysis of the paratransit route network. Centrality measures were used to observe the varying degrees of spatial influence that some areas within the network exert on others and how this affects the functioning of the entire network. The detailed network analysis is explained further in the methodology section of Chapter 1.

The analysis of the **temporal dimension** was carried out in two ways. Firstly, the research investigated the history of mobility in Nairobi, focussing on walking from the colonial period to contemporary times. Three time frames were developed to guide the historical assessment of walking in Nairobi. The first period, called the *early period* took into account the colonial period between 1899 to Kenya's independence in 1963. The period after independence to the year 2019 formed the second part of the research period referred to as the *recent past*. The third part, *contemporary development* considered the current developments for non-motorized mobility. The research relied on historical texts and data from the KNBS. Further description of the methodology is outlined in Chapter 2. Secondly, the temporal dimension investigated the mobility risks that non-motorized users are exposed to using panel data from 2015 to 2018 obtained from the National Transport and Safety Authority of Kenya (NTSA). The database contained information about the road crash victims including the date and time the crash occurred. This enabled analysis of both the period and the year in which most crashes occurred in order to provide targeted interventions for reducing the related risks. A more in-depth method is explained in Chapter 5.

Overall, these different types of analysis helped to unpack the complexity of spatial justice in relation to urban mobility and to advance the understanding of the relationship between the two concepts.

From here on, the chapters are structured as follows: The first chapter highlights the ways in which the spatial development of Nairobi contributes to the intricate production of spatial injustices within the city's mobility landscape. The findings of the study indicate the challenges produced by the mono-centricity of Nairobi city. The central business district not only clusters vital services and opportunities but is also an origin and destination of nearly all of the public transportation routes, resulting in longer journeys and weakening the resilience of the public transport network.

The second chapter focusses on non-motorized mobility, specifically walking as a ubiquitous mode of mobility in Nairobi. Through a historical analysis, the chapter evaluates the connection between walking and spatial justice within the four-dimensional framework and highlights the historical path dependency that has marginalized walking in favour of motorized transportation. Despite the large number of pedestrians throughout the development of Nairobi, urban planning has historically prioritized motorized mobility, leading to spatial injustices where pedestrians are exposed to more risks of fatal road crashes due to inadequate infrastructure. Walking has remined a persistent mode of mobility and other form of motorized transport sort of infringe, restrict, replace and try to alter the patterns of ever-existing walking.

The third chapter explores the perceptions of justice and just mobility among Nairobi's inhabitants. Through sixty-five in-depth interviews with commuters in Nairobi this research reveals that individuals' everyday experiences not only present a multifaceted connection between justice and mobility but also shape which specific facet of justice takes precedence in one's consciousness. Notably, affordability of public transit, police misconduct, safety of non-motorized users, neglect of traffic regulations and ensuing impunity are some of the prominent ways in which injustices within Nairobi's mobility system are made manifest.

The fourth chapter focusses on cycling as another mode of non-motorized transport. It discusses the relatively uncommon practice of cycling in Nairobi which saw increased promotion due to governance changes, infrastructure development and activism. A noteworthy outcome of the governance change was the establishment of cycling infrastructure in the central business district, implemented by the Nairobi Metropolitan Services (NMS) to address non-motorized mobility challenges, highlighting how political shifts influence spatial infrastructural changes in the city. The chapter also investigates how urban actors translate mobility infrastructure projects into solutions for promoting sustainable mode of mobility. The argument presented in the chapter highlights that advancing cycling as a common practice in Nairobi goes beyond the mere construction of cycling lanes. It delves into ancillary aspects such as the everyday mobility practices of residents, the bicycle industry, and bicycle markets essential for the adoption and operationalization of cycling in the city. The overall analytical approach

contributes to infrastructure studies by critically examining urban infrastructures as solutions for enhancing the overall functions of the city.

The fifth chapter points to the ways in which spatial justice in urban mobility in Nairobi can be assessed, by broadening the focus beyond distribution of resources. It suggests a comprehensive examination of how risks and misfortunes are distributed across the various modes of mobility within a given spatial context. Discussions on spatial justice have mainly centred around equitable distribution of resources such as infrastructure, services and opportunities. However, this chapter analyses not only who has access to what resources but also who bears the most risks and adverse outcomes in their daily mobilities. This approach acknowledges that different modes of transportation come with distinct sets of risks and challenges, but some modes are exposed to more risks than others. In essence, the chapter advocates for a comprehensive understanding of justice that encompasses various dimensions of resource distribution. It emphasizes the importance of addressing and potentially eliminating spatial injustices in urban mobility, recognizing both aspects that need improvement and those that contribute to a more equitable system.

The research concludes with a recommendation section that provides specific suggestions for spatial planning aimed at promoting equitable access to essential resources, services and opportunities for all and prioritizing non-motorized mobility. The chapter also proposes interventions and strategies to rectify the existing injustices in the mobility landscape, considering the viewpoints and needs of commuters in Nairobi.

In each of these chapters, the research questions have been systematically addressed, contributing to a comprehensive exploration of the relationship between mobility and spatial justice.

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Appendix 1: Overview of Research questions

	Research Question	Chapter	Topic	Published in:
a.)	How does the spatial development of Nairobi contribute to the intricate production of spatial injustices within the city's mobility landscape?	1	Accessibility, Mobility and Spatial Justice in Nairobi, Kenya	Journal: Journal of Urban Affairs Publication Date: 14 July 2022
b.)	To what extent do historical patterns and path dependencies contribute to the perpetuation of spatial injustices within Nairobi's mobility landscape, and how have these historical factors shaped the current disparities?	2	A Historical Account of Walking in Nairobi within the Context of Spatial Justice	Journal: Urban Forum Publication Date: 11 November 2022
c.)	What are the distinctive mobility patterns of the diverse social groups in Nairobi, and how do these groups encounter and perceive spatial injustices within the mobility landscape?	3	Invoking spatial justice in urban mobility in Nairobi: A commuter's perspective.	Journal: European Journal of Spatial Planning Publication Date: 22 November 2023
d.)	How has the governance and political structure influenced the progression of spatial (in)justice in the realm of urban mobility in Nairobi?	4	Cycling infrastructure as a 'solution' to safe mobility	Submitted to: Journal: Urban Studies Publication Status: Under peer review.
e.)	What risks and misfortunes are experienced by non-motorized commuters in Nairobi, and how are these experiences indicative of spatial injustices?	5	Assessing equity in urban mobility through shared risks and misfortunes	Submitted to: Journal of African Transport Studies Publication Status: Under peer review
f.)	How might the concept of spatial justice be operationalized to address challenges and improve equity in urban mobility in Nairobi?		Recommendations	N/A

Chapter 1: Accessibility, Mobility and Spatial Justice in Nairobi, Kenya

Dorcas Nthoki Nyamai, Sophie Schramm

TU Dortmund University

Abstract

A focus on motorized mobility has subtracted from the advancement of the modes of mobility used by the majority in Nairobi, especially the most vulnerable, with a discernible outcome of injustices. This article explores mobility in relation to spatial justice through three accessibility dimensions – spatial, modal and individual – that place significance on the comprehension and configuration of spatial justice in relation to mobility. Viewed from this perspective, the organization of space and the prioritization of the mobility needs of the most vulnerable present a notable way in which spatial justice unfolds and is understood. Through a spatial assessment of Nairobi's urban growth and analysis of the existing modes of mobility, we find that the mono-centricity of Nairobi city contributes to challenges in accessibility to places of necessity. The city's spatial layout where places of necessity cluster in the urban core together with the spatial brokerage role of the central business district within the public transport network speaks for greater attention to the reorganisation of places of necessity. We argue that promoting transit-oriented development, investing in state-provided public transport and provision of safe non-motorized infrastructure are integral to advancing justice in relation to mobility and building an inclusive city for all.

Key words: accessibility; mobility; spatial justice; Nairobi

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1.0 Introduction

In the recent decades, mobility has witnessed numerous innovations where technology has become a catalyst of change facilitating ease of access through various modes of mobility. Ride hailing through mobile applications are novelties that have altered the functioning of mobility systems and as the innovations continue to develop, they present mobility as a dynamic field of systemic unfolding. Planning for mobility is therefore a process that requires constant adjustment to understanding the diversity of individual mobility behaviour among city inhabitants. To systematically analyse these dynamics, we examine the interlinkages between accessibility and mobility in relation to the broader questions of spatial justice. We postulate that accessibility is governed by a set of dimensions that entail the individual, spatial and modal dimensions. The interplay of these dimensions frames our approach and understanding of how spatial injustices are reflected in urban mobility.

The **spatial dimension** refers to the organization of functions within space. The clustering and redistribution of necessary functions within the city and the layout of land-uses reflects the accessibility levels to places of necessity relative to residential areas.

The **modal dimension** is associated with the array of means or modes that enable the individual to obtain access. The unavailability, unaffordability, lack of safety and inefficiency of the existing modes of mobility may reflect the injustices that some commuters are exposed to and the difficulties of access.

The **individual dimension** which refers to the commuter, interacts intensively with the modal and spatial dimensions and encompasses an individual's social, cultural and economic characteristics such as income, gender, age, religion, employment status, physical capabilities, residential choice and location, preferences and education level, *inter alia*. These factors influence the ability of the individual to take advantage of opportunities necessary to improve one's well-being and the accessibility to places of necessity.

Each of these dimensions present varying degrees of complexity and it cannot be assumed that addressing them directly correlates to obtaining spatial justice. We do not perceive justice as a conclusive state but rather in agreement with Amartya Sen's (2009) Idea of justice and Mimi Sheller's (2018) Mobility justice concepts, we perceive justice as an ongoing pursuit of the public good and an evolving concept that can be improved and advanced. By mobilising these dimensions, we aim to contribute to the discourse of understanding mobility and justice especially in a southern context. We explore the mobility of individuals in urban space in relation to the spatial layout of land uses, the network of mobility infrastructure, the available modes of mobility and the existing regulations that govern the mobility sector in Nairobi.

Nairobi, Kenya's capital, is a city shaped by rapid urban growth and a historic legacy of socio-spatial fragmentation with large disparities in terms of income and access to resources among different population groups (Klopp, 2012). Spatial justice, which is discussed in more depth in the following section, hinges on Rawls' (1971, p.100) 'difference principle' whose core reasoning is to advance outcomes that ultimately benefit the underprivileged in society. In a spatial context, this broadly relates to fairness in the outcome of the allocation of resources within space while giving attention to individuals' circumstances, rights and entitlements (Soja, 2009; Fainstein, 2009). In the perspective of urban mobility, spatial justice places emphasis on intentional investment and prioritization of the mode of mobility mostly used by the poor and people with disabilities since their mobility options are often limited (Kenyon & Lyons, 2007; Martens, Golub & Robinson, 2012; Lee, Sener & Jones, 2017).

Mobility is more than a process of journeying from origin to destination. It is linked to the livelihood and health of an individual, to the advancement of a city's economy, to the history and political engagement of the city, to the environmental conditions of the city, to the impact of climate change, to the international relations of the city, to participation of city's inhabitants in cultural, social and religious activities, to the access of civic services, and nearly every other necessity that an individual requires to dwell in the city (Sheller, 2018). Put differently, mobility is more than movement and opportunities, services and social interactions are causal factors of mobility (Hansen, 1959).

The placement of structures and infrastructure within space directs the movement of an individual and determines the accessibility to desired destinations. Accessibility is conditional to the design of the physical space and the layout of land uses within that space (Geurs & van Wee, 2004). Land use influences mobility and has an impact on access to services and livelihood opportunities (Hagans, 2011). Mobility and accessibility can be understood as mutually interdependent. The places of necessity, referred in this paper as areas of opportunities and services, and the potential life that an individual can build or achieve are all in one way or another dependent on accessibility and mobility and the way space is organized in cities. Mobility can therefore be defined as the inevitable action that enables accessibility to places of necessity.

Although the allocation of land uses determines whether the places of necessity can be conveniently accessible to individuals living in dispersed areas throughout the city (Geurs & van Wee, 2004), accessibility gaps are inevitable because the growth of cities creates a core and periphery (Martens and Bastiaanssen, 2019) meaning that individuals closer to the core, where places of necessity are clustered benefit from proximity and have higher levels of access in relation to those living in the periphery without access to adequate motorized mobility. Many highly privileged urban residents in Nairobi, however, choose to live in exclusive areas in the periphery, contributing to a spatial extension

of the city and generating access by use of private vehicles. In many cases, journey times for these inhabitants in the periphery are the same or even longer as an individual from the low-income settlement who walks for an hour to the desired destination. The proximity versus exclusivity trade off distorts the city's mobility system and land-use patterns to cater for that exclusion. It is also a perpetuation of the spatial colonial history of Nairobi where segregation by design discouraged mixed-use and reinforced social segregation and shaped the contemporary patterns of land use and mobility that sustain inequalities. We postulate that accessibility can be enhanced by the re-distribution of places of necessity throughout the city and investing in the modes of mobility used by the poor urban commuters as a means of advancing the concept of spatial justice in relation to mobility.

Notably, accessibility connotes both access to the mode of mobility and the access to places of necessity. This research, however, directs attention to accessibility to places of necessity, whereby the mode of mobility is considered a facilitator of access. This is in part due to the already existing high accessibility levels to public transport for a significant majority of Nairobi's inhabitants (Salon & Gulyani, 2019).

Nairobi is a city with a large share of urban commuters who walk to work daily (Fried et al., 2020) and at the same time, a large youthful population of under 35 years who make up over 75% of the total population according to the 2019 Kenya National Census (KNBS, 2018). We perceive this as a unique opportunity that can be harnessed towards uptake of sustainable modes of mobility. In contributing to the planning of urban mobility in Nairobi, we point out specific areas that could strengthen the resilience of the public transport route network in the city and potential ways to direct the youthful population in the city to drift from personal car ownership and be drawn to more sustainable modes of mobility. This research further aims to assist the county government of Nairobi in their efforts to provide a more efficient public transport system by providing ideas for transit-oriented development and non-motorized infrastructure provision.

The paper is organised as follows: we continue the next section with a discussion on the relationship between spatial justice and accessibility while relating this to the three dimensions. We then explain the methods and data that we used to assess the case of Nairobi city. The section that follows explains the existing situation of mobility in Nairobi within the framework of the various dimensions and finally a discussion of the findings and some planning recommendations.

1.2 Accessibility in relation to Spatial Justice

Spatial justice is concerned with the localization of social justice across various geographies (Soja, 2013). It portrays the understanding of how the spatial form shapes social processes (Harvey, 2010).

The core concern of social and spatial justice is in the distribution of resources that are confined within a particular place, the associated processes of resource distribution and the individuals or institutions that ultimately promote and guarantee fairness in distribution of resources (Rawls 1971, Soja, 2009). These resources are broadly defined as goods that an individual requires to successfully pursue their intentions and they entail: “rights and liberties, opportunities and power, income and wealth” (Rawls, 1971, p.62), services and opportunities generated by and in a city, as well as ‘natural and cultural’ resources (Soja, 2013, p.46). Although accessibility and mobility may not be perceived as resources that are subject to distribution or re-distribution, we understand them to be a necessity that individuals require to pursue their daily intentions. Using the framework of the three dimensions – individual, spatial and modal, we relate accessibility to the notion of spatial justice based on the understanding that space does not only contain resources that can be distributed but also consists of individuals who undertake various activities that require movement within that space and whose actions continuously re-arrange the space, generating various levels of accessibility. The dimensions are not treated as separate entities but are rather parts that interact together and constitute a holistic understanding of accessibility within the city as shown in figure 4.

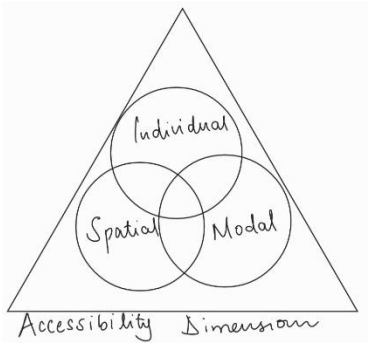

Figure 4: Accessibility Framework. Source: Authors’

Relating the spatial dimension to the city, the organization of urban functions determines the diversity of access among individuals. The heterogenous landscapes of the city produce challenges in achieving homogeneous equality across space (Soja, 2013, p.71), hence, accessibility levels are bound to vary across the city. Spaces are mainly organized according to the individual’s needs such as need for housing, employment, recreation etc and most individuals tend to prefer proximity to these essential places to reduce time and costs related to longer distances. However, the desire for the wealthy individuals to live in exclusive neighbourhoods that can be reached by a motor vehicle contributes to the advancement of car-centric mobility.

Physical distance, as a product of the organisation of space, constitutes a precondition of spatial justice. The tendency to minimize distances in accessing places of necessity, especially for the poor, is a fundamental part of the spatiality of individuals (Soja, 2009). An individual’s level of access is directly correlated to the distribution of land uses within an urban area (Kang, 2015). Land use planning that

is attentive to proximity to places of necessity closer to residential areas contributes to better social and spatial interactions and improved accessibility (Martens & Bastiaanssen, 2019; Moeckel, Wegener & Beckmann, 2005; Handy, Cao & Mokhtarian, 2005).

The re/production of space in a city through spatial planning and, importantly, the social processes and activities undertaken by individuals and groups are factors that can explain spatial injustices (Soja, 2013, p.72). The diversity of individuals in a city means that mobility and accessibility are experienced differently among individuals. Those with low income and disabilities, for example, have more limited options of mobility; children and women may be more vulnerable to unsafe spaces when using certain modes of mobility; those residing in peripheral areas may experience more disadvantages of access to necessities that are centrally located, *inter alia*.

When relating spatial justice to the individual dimension, we draw from Rawls (1971) 'difference principle' which, in general, promotes actions that aim to improve the situation of the least fortunate. The principle argues that improving the situation of the underprivileged in society constitutes to benefits across all other members of society (Rawls, 1971, p.100). Linking this to urban mobility means deliberate actions and investments that are directed to improving the accessibility levels of the most vulnerable (Kenyon, Lyons & Rafferty, 2002; Preston & Rajé, 2007). Put differently, it relates to prioritizing the mode of mobility used especially by the poor and people with disabilities, whose choice of mobility is often limited (Jeekel & Martens, 2017; Dong, 2018).

The modal dimension can be categorised into two. The first is the available mode of mobility, either motorized or non-motorized, that facilitates accessibility to places of necessity. The second is the infrastructure that supports and enables the use of motorized or non-motorized modes e.g road or rail infrastructure. With reference to the latter, inequalities in the spatial provision of infrastructure contribute to mobility challenges that generate social and spatial inequalities (Cass, Shove & Urry, 2005; Currie, 2010; Guzman, Oviedo & Rivera, 2017). Such is the case where large capital investments are directed towards infrastructure that prioritizes the use of motorized modes over other more sustainable non-motorized modes (Banister, 2011; Lucas, 2013). The availability of efficient, safe, affordable and reliable modes of mobility determines an individual's level of access (Maartens & Bastianseen, 2019) and reduces burdens of access especially for those living in peripheral areas (Jeekel & Martens, 2017). Additionally, a wide array of available modes of mobility reflects the freedom of choice for the individuals in deciding the most preferred mode and confronts historically entrenched inequalities of access to space (Klopp, 2012). In a report developed by the Socially Just Public Transport Working Group in collaboration with the Friedrich Ebert Stiftung based in Nairobi, access to safe and affordable public transport and the freedom to choose from different travel options are considered a

form of equity and make up one of the pillars of a socially just public transport system (Kamau & Manga, 2020).

Justice in relation to mobility also relates to a nuanced debate on mobility justice that associates movement with politics. Mimi Sheller argues that power controls mobility in cities resulting in unequal capabilities for movement that are ultimately influenced by systems of political management occurring within and between borders (Sheller, 2018). Looking specifically at the context of Nairobi, politics and planning are conjoined whereby the political context dictates the development progress (Mitullah, 2010 in Charton-Bigot & Rodriguez-Torres, 2010). The enforcement of laws and regulations governing mobility are in most cases dependent on the political situation of the country and are characterized by authoritarian politics that continue to influence mobility in the city (Klopp, 2012).

Bringing these dimensions together, we understand that spatial justice in relation to accessibility connotes a) the arrangement of space intended to reduce disadvantages of distance b) the intentional investment in improving the accessibility of the most vulnerable c) the equity in provision of mobility infrastructure to support more sustainable, safe and affordable modes of mobility and d) the influence of politics on mobility in the city. The distinction of what constitutes spatial justice in terms of allocation of space involves several other layers relating to individual preferences, choice of residential location, policy and governance, income and employment etc, reinforcing the indirect correlation between spatial justice and mobility and drawing attention to constant depth in understanding these complexities.

1.3 Methods and Data

In order to contextualize these dimensions in Nairobi, we carried out a progressive analysis of each dimension. Starting with the spatial dimension, we conducted a spatial assessment of Nairobi city using Geographical Information Systems (GIS). We first explored the periodical growth of the city to observe changes in urban development over time. Using Landsat imagery, we developed maps of the changes in the extent of the built-up area within five-to-ten years intervals. Starting from the year 1984, which was the oldest year available for download, we examined changes over a longer time series up to the year 2020. Landsat scenes of Nairobi were downloaded from the United States Geological Survey website (USGS, n.d.). Using QGIS and its Semi-Automatic Classification Plugin for supervised classification of remote sensing imagery, we manually created ROI's (Regions of Interest) for the various classes in the imagery. We focused on built-up areas, forested areas, and open spaces. The spectral signatures were recorded, and the automatic land cover classification of the whole image was performed using these ROI's. The final output images were 're-classified' to only one region for built-up area and all other regions were set to 'Null'. This process was repeated for each available

Landsat scene. We initially intended to generate the maps of the imagery at 10-year intervals, however, due to the dense cloud cover in the 1994 imagery, we selected 1995 and mapped in 10-year intervals until 2015 then a five-year interval until 2020. The urban extents of the city across the years were then compared and used to calculate the urban growth using the percentage change in land cover. Secondly, we analysed the land uses in the city using data from the Nairobi County Urban Planning Department. The data comprised of shapefiles of the various land uses according to the 2014 Nairobi Country Integrated Urban Development Master Plan (NIUPLAN). We generated maps from the shapefiles of the existing land uses in the city to visualize the organization of urban functions within space, especially the distribution of places of necessity within the city. This spatial assessment aided in the analysis of the spatial dimension.

To investigate the individual dimension, we used County level secondary data obtained from various Kenya government websites. We obtained household survey data from the Kenya National Bureau of Statistics (KNBS), a governmental body that is mandated to collect, analyse, and disseminate statistical data. The KNBS conducts countrywide longitudinal household surveys every 10 years that we used in this research. We used available data for the periods 2005-2006[3] and 2015-2016 household surveys and filtered out individual mobility data of Nairobi County respondents. The data contained information for over 1,200 respondents for the year 2006 and over 1,050 respondents for the year 2016. Analysing data from both years allowed for comparison of the modes of mobility between the two periods. Secondly, we obtained data from the National Transport and Safety Authority (NTSA) on commuter fatalities from the period 2017 to 2019. This data was used to analyse the safety of individuals using various modes of mobility and to understanding how spatial injustices are reflected at the individual level.

The same data provided information that was used to analyse the modal dimension. Additionally, network analysis was conducted to calculate centrality measures within the public transport network using matatu route network data. Matatus are privately owned and privately operated vehicles that provide public transport as a service in the city. They found their niche, post-independence, in meeting a crucial need for mobility in the event of the decline of State-provided public transport (Mutongi, 2017). They have now become a crucial player in the urban mobility landscape of Nairobi (Salon & Gulyani, 2010). Reference of public transport in this paper hence implies mobility by use of matatu which range from minivans to high-capacity buses. The matatu route network was mapped out by the Digital Matatus Team that consisted of a collaboration between the University of Nairobi School of

[3] The final year of completion of the surveys i.e. 2006 and 2016 appear as the years of reference throughout this paper.

Computing and Informatics, Centre for Sustainable Urban Development at Columbia University, and the Civic Data Design Lab at the Massachusetts Institute of Technology. The team developed transit data for Nairobi, collecting data for the various matatu stops using a phone-based tracking application that also relied on the knowledge of the regular users of the various routes (Williams et.al, 2015). The data culminated in the design of a matatu transit map for the city which is publicly accessible (Digital Matatus Project, 2015).

We used the existing data and maps to carry out network analysis using Gephi, a software for calculating network centrality measures, to observe the varying degrees of spatial influence that some spaces exert on others and how this affects the functioning of the entire network. The measure of betweenness centrality was used to capture the degree to which a single node stands in between others and hence its position of power within the network as it influences the access to other nodes. The nodes in our network analysis represented the origin and destination of matatu routes and the linkages represented the various ply routes of the matatus. We also reviewed the 2019 Kenya National Census Data to map the population distribution in the city and the KNBS National Economic Survey of 2020 to note the changes in acquisition of personal vehicles and to substantiate the necessity of investing in sustainable modes of mobility.

These different types of analysis helped to unpack the complexity of spatial justice in relation to urban mobility and to advance the understanding of the relationship between the two concepts. Finally, we reviewed the existing regulations that govern the transport sector. Most of the regulations exist at a national level but some, such as the 2017 Non-Motorized Transport (NMT) policy, the county integrated development plan and the transport development plan were specific for Nairobi.

1.4 Spatiality of access in Nairobi

This section investigates the spatial dimension of accessibility starting with a brief historical overview of the growth of the city to provide a broader perspective of the origins and perpetuation of mobility injustices (Sheller, 2018). It also assesses the periodic growth of the urban form and the existing spatial layout.

Nairobi's historical urban growth is rooted on segregation by design and typified by chaos as the city was established without any intent of expanding into its current global city status (Halliman & Morgan, 1967). It developed in the late 19th Century as a railway camp and a resting point for the construction of the Kenya-Uganda Railway (Ogot & Ogot, 2020). Given that the city was only meant to be a resting point, it grew without a proper plan (Murunga, 2012). The first urban master plan was developed in 1926 and updated and commissioned in 1948, half a century after the city was established (King'oriah, 1983). Although the plan was never implemented, the spatial design that already existed in the city was in a fashion typical for colonial urban planning, to guard the interests of European settlers in

securing private land ownership and to discriminate Asians while largely excluding Africans (Polèse, 2000: 251; Hagans, 2011:17). The development pattern of the Central Business District (CBD) was dictated by the Europeans and Asians who owned land in the city centre while the residential location of Africans was to the East of the CBD (Kingoriah, 1983). From its foundation as a colonial railway quarter on, Nairobi has experienced decades of significant and fragmented urban growth.

Presently, Nairobi is fully urbanized. Figure 5 shows a periodical expansion of the city within the past three and a half decades starting from the year 1984 to the year 2020. The boundaries of Nairobi changed four times since the establishment of the city in 1899 to the time of Kenya's independence in 1963 and have since remained unchanged (Halliman & Morgan, 1967:99). The urban growth of Nairobi from the mapped year of 1984 is witnessed to have grown towards the East and later spread to the North. Conspicuous growth occurred in the period between 2005 and 2015 with development towards the south inhibited by the Nairobi National Park. Presently, the city's urban agglomeration has a significant extension, stretching over more than 20km from the CBD to the West and over 30km to the East.

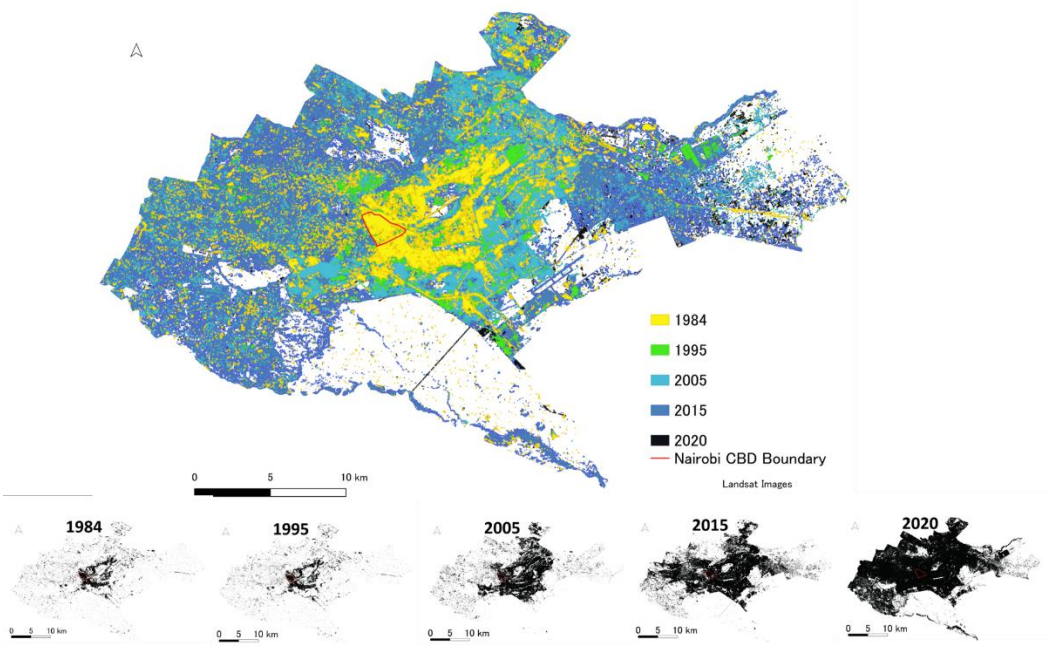

Figure 5: Historical development of Nairobi. Source: Authors' – mapped from Landsat images.
The map shows the development of the built-up area over a period of 36 years from 1984 to 2020

Urban growth has been consistently high with an observed rapid growth rate of 12% and 18% in the periods 2005 and 2020 respectively as shown in Table 1, suggesting that the urban development process has more than doubled roughly every 10 years. The current urban built-up area is an estimated 696[4] sq. km, around five times larger than in 2005 and more than fifteen times larger than in the year

[4] *Landsat analysis provides for the identification of parcels of land within the urban footprint that are as yet undeveloped i.e. open spaces, parks, gardens etc. The Landsat analysis hence tends to produce lower estimates of total urban land. The calculated figure was therefore corrected from 688sq. km to the current statistics of 696 sq. km according to the Kenya National Census 2019 report.*

1984. Nairobi has a present population of over 4 million inhabitants and is expected to reach 6 million inhabitants by the year 2030 (Alam & Powell, 2017), compelling need to develop sustainable ways of mobility as many more people will need to be mobile.

Period	Built-Up Area (km^2)	No of Years	%change	%change p.a
1984	46.7	-	-	-
1995	58.6	11	28%	2%
2005	152.9	10	59%	16%
2015	427.8	10	80%	18%
2020	696	5	63%	12%

Table 1: Land cover change in Nairobi as observed and calculated from Landsat images between the period 1984 and 2020.

The city's history is reflected in the fragmented materiality of built space and infrastructure provision and apparent in land-use patterns, where high-income areas are low density and vice versa. The map of the existing land use plan for Nairobi in figure 6 illustrates selected zoned out areas in accordance with the research interests of this paper. We singled out commercial, institutional and industrial zones as areas that a) concentrate and attract opportunities and services that individuals require for their livelihood and b) generate a demand of necessities that require individuals to journey to these locations from their residential areas (Geurs & van Wee, 2004).

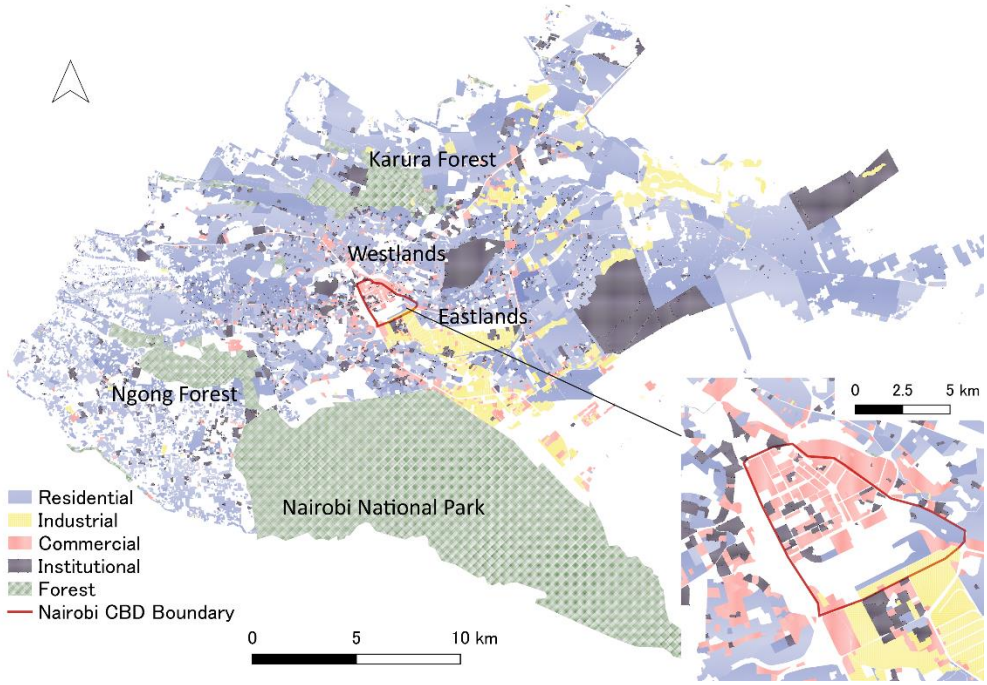

Figure 6: Land Use Map of Nairobi. Source: Authors' - generated from shape files obtained from Nairobi County Planning Office in accordance with the 2014 Nairobi urban master plan. The figure maps out selected Land Uses in Nairobi that illustrate places of necessity.

Many of the historically wealthier urban areas are located towards the higher-lying and greener north-west and south-west of the city, around the regions of Karura and Ngong Forests. The neighbourhoods are characterised by low density generous villas surrounded by large green spaces and tree-lined alleys that still reflect the garden city ideal colonial planners once pursued. The lower-lying, dryer eastern parts of the city around the Eastlands area, that were reserved by colonial planners for “African” housing (Kingoriah, 1983) are today locations of affordable housing, characterized by high density and home to a rapidly growing urban lower- and middle-income class.

Nairobi has developed into a regional hub connecting other cities in the East African region and as a global player, receiving the highest number of foreign direct investments in East Africa according to the State of African Cities Report (UN-Habitat, 2018:49). These investments have altered the spatial landscape of the city, shifting the commercial and institutional land uses to other areas proximate to the CBD.

Within the past decade, two main areas, west and northwest of the CBD, have developed as clusters of places of necessity, with a high concentration of international and government institutions and a mixture of private and public commercial areas. These are the areas of Westlands to the northwest and Upper Hill to the west of the CBD as shown in figure 7. The area of Upper Hill changed use from a low-density residential area to a high-density commercial area with very few residential areas (Njehia, 2015). Westlands is a recently emerging commercial zone with a fair share of residential space; however, changes are anticipated in the coming years after the completion of the ongoing construction of the Nairobi Express Highway whose aim is to accelerate the growth of Westlands area for business according to a press release by the Kenya National Highway Authority (KeNHA, 2022). As postulated in the gravity model by Hansen (1959), areas that concentrate opportunities tend to have high accessibility levels and are more likely to attract other areas of opportunity within proximate reach. This can be witnessed in the current spatial growth of Nairobi. The CBD, which has the highest cluster of commercial and institutional areas, and a density of public transport connections as will be illustrated in the following section, has attracted clusters of places of necessity within its proximity. These two emergent areas of Upper Hill and Westlands are strategically located within 5km radius from the CBD, benefitting from the high accessibility levels of the CBD.

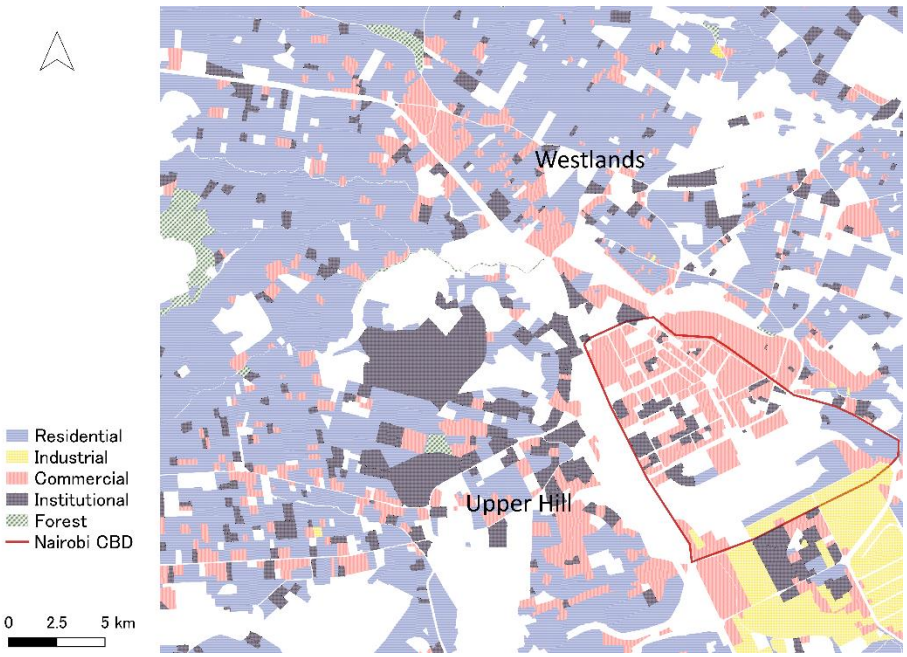

Figure 7: Emergent places of necessity within 5km radius from the CBD. Source: Authors'- generated from shapefiles obtained from the Nairobi County Planning Office. Upper Hill and Westlands areas have, in the recent past, developed as clusters of commercial and institutional activity.

What is however striking about the CBD is the meagre availability of residential areas, resultant from its colonial zoning as a commercial area. This means that it is a space of quiet neglect in the night while it could be transformed to become the most ideal location for residential use. The emergence and growth of Upper Hill and Westlands have led to an emptying of several buildings in the CBD indicated by the number of rental signs on the buildings that formerly housed offices that have relocated to these areas. The situation could have arguably been aggravated by the outbreak of the Corona pandemic as more people became accustomed to working from home. These empty buildings, however, present a chance for converting some of the former office spaces to residential spaces, a move that could attract people to take advantage of the proximity to places of necessity and the density of transport interchanges in the city centre. This action calls for a policy shift that would ultimately support active mobility for movement over short distances and support a high quality of life. In addition, increasing the residential space in the CBD would advance the second agenda of Kenya's Vision 2030 'Big 4 Agenda' of providing affordable housing.

1.5 The individual dimension of access in Nairobi

A comprehensive study conducted by Salon and Gulyani (2010) investigated the mobility of slum residents in Nairobi using data from a household survey that was conducted by the World Bank in 2004. Through inductive research, the authors found a negative correlation between poverty and accessibility to motorized mobility among *slum* residents. Over 65% of the adult respondents registered walking to work as their main mode of mobility and over 96% of children walking to school

(Salon & Gulyani, 2010). Additionally, research on urban mobility in Nairobi by Fried et al. (2020) found walking to be a popular mode of mobility across all income groups but especially among the poor and low-income commuters who travel for far distances of 10-15 km. This situation is reflected in many parts of Nairobi where a large percentage of the inhabitants walk to their places of work or other important destinations. The 2014 Nairobi Integrated Urban Master Plan (NIUPLAN) indicates that walking is the dominant mode of mobility for over 51% of Nairobi's inhabitants who travel to school and to all other activities except for work trips where public transport (34%) recorded a 6% higher usage than walking (28%) (County Nairobi 2014). Other studies on mobility in Nairobi also conclude that walking is the mode of transport for more than 80% of all trips especially among the urban poor mainly attributed to high costs of public transport (Avner & Lall, 2016; Alam & Powell, 2017).

Our analysis of the KNBS household survey data of 2006 and 2016 revealed that walking and public transport were the most dominant modes of mobility among the respondents in both study periods. Walking and public transport recorded a higher usage in 2016 as shown in figure 8. In another comprehensive study conducted by Salon and Gulyani (2019) using 2013 household data from the World Bank database, one third of the surveyed households in Nairobi registered walking as the only means of mobility to reach their work destinations.

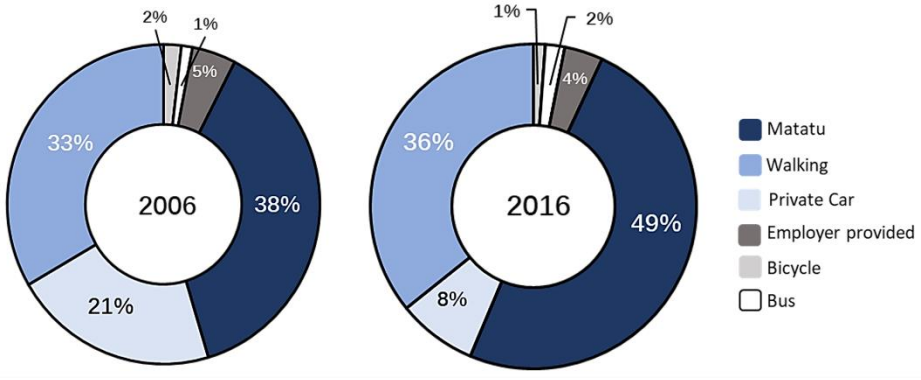

Figure 8: Modal split in Nairobi for the years 2006 and 2016. Source: Authors'– generated from KNBS data. The graphs represent responses from individual commuters based on two periodical household surveys conducted by the Kenya National Bureau of Statistics.

Although walking is the norm for many urban residents in Nairobi, it is unfortunately by the same token, subject to peril (Salon & Gulyani, 2019). An analysis of NTSA data between the years 2017 and 2019 revealed that nearly 60% of all commuter fatalities annually constitute pedestrians. The figures would certainly be higher with non-recorded pedestrian fatalities. In a recent study conducted by the Climate and Development Knowledge Network (CDKN), all the 12 pedestrian corridors that registered high foot traffic in Nairobi had inadequate pedestrian crossings and inadequate protected footpaths (Odhiambo, 2021). Many roads are characterized by narrow and in many sections, divested sideways where pedestrians are forced to risk sharing the road with motorists. Relating this situation to spatial

justice, the high number of pedestrian deaths, relative to other modes of mobility reflects the neglect to invest in providing safe mobility for the underprivileged who make up most of the population especially because walking is directly correlated with unaffordability of motorized transport costs among the poor (Salon & Gulyani, 2010).

It is apparent that prioritization of safe non-motorized mobility infrastructure has the potential to alleviate these injustices. This, however, requires political will and intentional shift from addressing the interest of the elite and powerful to addressing pertinent issues of spatial injustice that manifest in the mobility system of Nairobi (Klopp, 2012).

The recent changes in the governance of Nairobi County have proven that safe non-motorized infrastructure can efficiently be provided through concerted efforts among various governmental authorities. Following an agreement between the Nairobi County government and the Central government, four core functions of the city were transferred to the National Government, among which was the county transport services. This engendered the formulation of a new task force, Nairobi Metropolitan Services (NMS, 2021), whose functions quickly advanced the provision of NMT infrastructure in Nairobi's CBD. In less than a year, more than 5km of safe pedestrian and cycling infrastructure was provided in the CBD as shown in figure 9 with a plan to extend to the eastern part of the city where foot traffic is highest (Odhiambo, 2021).

Figure 9: Non-motorized mobility infrastructure in Nairobi's CBD. Source: Authors'

Notably, multiple factors such as individual commuter preferences or residential location within the city, *inter alia*, influence the choice of either motorized or non-motorized mobility modes. The emphasis however is on advancing the mode of mobility that will benefit many urban residents, especially the poor and at the same time promote the use of more sustainable modes.

Another focus of the individual dimension is the existing demographics in the city. Nairobi is comprised of a striking number of young people who make up over 75% of the city's residents according to the 2019 National Census report. Many of these young people, however, are said to be employed in the informal sector according to the KNBS Economic Survey (KNBS, 2020). This implies a high number of the population that either a.) do not own a personal vehicle due to their economic or social status e.g., students who may not have the capacity to afford a vehicle or who may prefer cheaper modes of transport; or b.) individuals, who, due to circumstances presented by everyday mobility such as intense traffic congestions, find no incentive to own a vehicle or c.) simply forfeit vehicle ownership by choice. This represents a group whose mobility patterns could be shaped and directed towards the uptake of the already ubiquitous sustainable modes i.e walking and nudged towards cycling when safe infrastructure is provided. It also presents a decisive moment to shift the current focus of investment in car-centred mobility (Klopp, 2012) to people-centred mobility by prioritizing safe non-motorized infrastructure provision. Delayed action, however, is likely to lead to a missed opportunity since income and education levels are directly linked to use of motorized transport according to research on commuting in Nairobi by Salon and Gulyani (2019). This means that as this group of young people become more educated and move up the income ladder, there is a high likelihood to shift to motorized transport, in the extreme case – car use if the public transport is unreliable and inefficient. The rising middle class acquire a personal vehicle as soon as they can afford one while walking among the urban poor increases (Klopp, 2012). Harnessing the potential of the youthful population to take up sustainable modes of mobility can be done through safe and aesthetically valuable walking spaces and provision of safe cycle routes in addition to providing an efficient public transport system that enables circular mobility through the city.

1.6 The modal dimension of access in Nairobi

The mode of mobility in this paper is understood to be a facilitator of access to spatially disjointed places of necessity. As examined from the analysis of the two household surveys of 2006 and 2016, conducted by the KNBS in figure 08 and from previous cited research on mobility in Nairobi, walking and the use of matatu constitute the largest modal share among Nairobi's urban commuters. Although infrastructure provision and mobility design in Nairobi focus on improving the accessibility of those with private vehicles, the acquisition of private cars has been declining. The findings of the KNBS household survey in year 2016 recorded a decline of 13% in private car usage compared to year 2006 and additionally, a decline in private car acquisition was recorded in the KNBS Economic Survey report (KNBS, 2020). In figure 10 below, a steady decline in private car registration was observed between 2017 and 2020 while acquisition of 14-seater matatu vans and high-capacity buses was observed to have a steady increase.

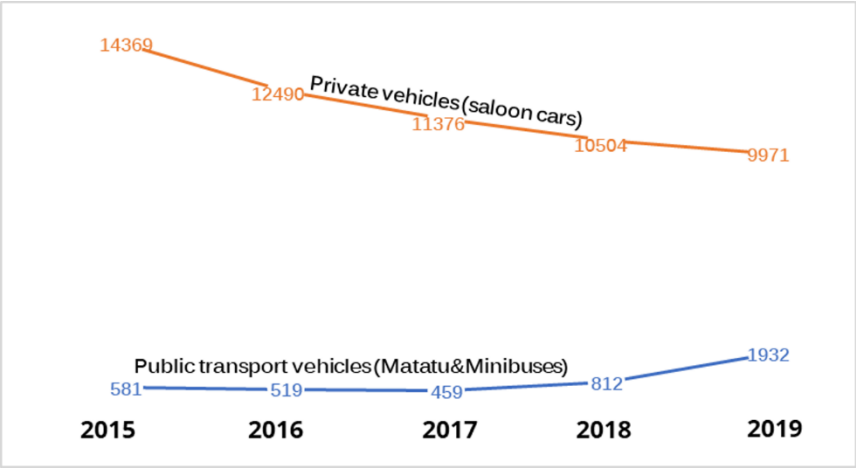

Figure 10: Vehicle registration in Kenya. Source: Authors' – generated from Kenya National Bureau of Statistics Economic Survey Report 2020 Data.

The decline in private vehicle acquisition is attributed to a few reasons, among which is the increase in taxes and levies imposed on imported vehicles (KNBS, 2020), hence a higher demand for public transport as the population increases. The same report recorded a 10.3% increase in the issuing of public service vehicle licenses between 2018 and 2019, however, it is not clear whether the licences were exclusive to matatu drivers or drivers of shared vehicle services such as Uber and Bolt. These findings only testify to the indisputable need to shift from the existing path dependency of car centric planning and invest in people-centred mobility, particularly active mobility, together with an efficient and reliable public transport system. Put differently, the approach to planning cities only for cars is outdated and calls for a shift towards active mobility which would directly address the needs of many Nairobi's commuters including the most vulnerable.

In the second step of analysing the modal dimension, we investigated the flows and patterns of public transport throughout the city. The mapping of the matatu route network was conducted by the University of Nairobi School of Computing and Informatics, Centre for Sustainable Urban Development, Columbia University, and the Civic Data Design Lab, Massachusetts Institute of Technology. The data is freely available for use and research. We overlayed the matatu route network on the existing road network in Nairobi to show the coverage of public transport in the city as shown in figure 11.

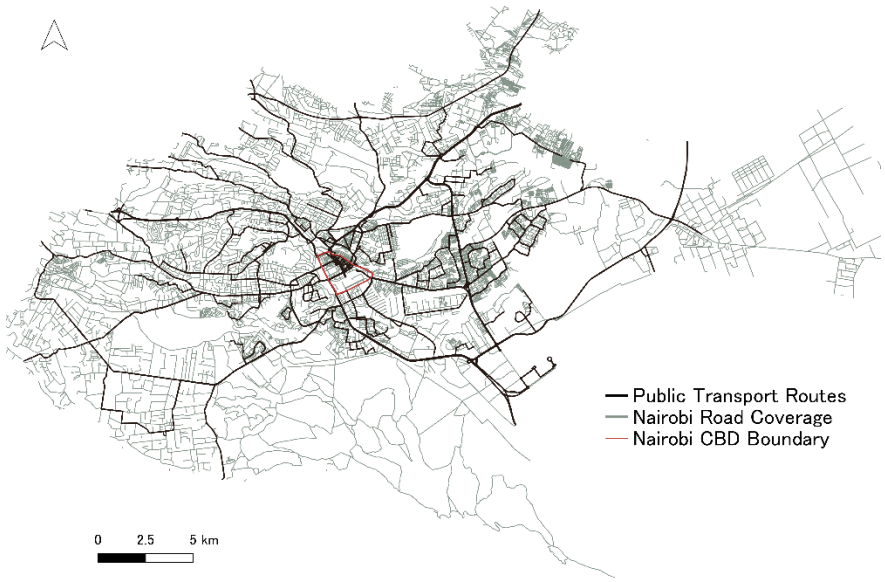

Figure 11: Public transport route network in Nairobi. Source: Authors'- generated from digital matatu data (Williams et.al 2015) and data from Nairobi County Planning Department

The CBD is an origin and destination for nearly all the public transport routes. The Kenya Roads Board classifies the Kenyan roads from A to F roads in hierarchy of connectivity between international, regional and local boarders: Classes A – corridors that connect international boundaries, Class B – corridors that link various counties and Class C – primary feeder roads that link to Class A and B roads and so on up to Class F which is the smaller unit in residential neighbourhoods. The matatu route network indicates a radial pattern that is funnelled to a restricted set of major highways, mainly Classes A, B and C. These routes converge to the CBD where majority of the route interchanges take place, inhibiting circular mobility and making journeys unnecessarily longer for those whose final destinations are not in the CBD.

In addition, being a privately owned service, matatus are costly for many urban commuters especially the poor. We analysed the transport cost data from the KNBS longitudinal surveys of 2006 and 2016. Over 62% of the commuters who used matatu paid more than 100 Kenya Shillings (≈1$) for a round trip. Of these commuters, over 37% were casual and seasonal workers whose daily wage, according to the 2017 Kenya Regulation of Wages Amendment Order, averages between 400-600 Kenya shillings (≈$4-$6) a day. This indicates the high cost of mobility among many matatu users who spend on average 20% of their daily income on transport. Research by Hagans (2011) also found that matatus were unaffordable to many urban poor who relied on this mode of mobility for their livelihoods. These findings are also in line with research by Salon and Aligula (2012) on urban travel in Nairobi where affordability ranked highest for choice of mode especially among the urban poor in a sample of 2105 surveyed households.

We carried out a network analysis of the routes to get a clearer indication of the trends in the public transport route network. Using betweenness centrality – a measure used to reflect the strategic position that a place holds within the city, relative to other places within the network (Newman, 2005) – we observed the role of the CBD and other areas in the network. The output of the network as shown in figure 12 is not based on spatial coordinates as with GIS mapping but rather represents the mathematical distribution of the route networks. Each matatu is assigned a number depending on the ply route and the end destination, for example, matatu number 15 would have the route [CBD – Langata] or number 44 [CBD - Kahawa West]. The nodes represent the origin and destination points of the matatu, and the linkages represent the ply routes. Some linkages are thicker than others indicating that multiple matatu numbers ply that route. The analysis revealed the CBD as the centre with the highest degree of betweenness centrality meaning that it holds a strategic position relative to all other destinations in the matatu route network. This is not surprising as its dominance emerges from the mutual reinforcement of the clustering of places of necessity and the high density of route interchanges and flows of public transport.

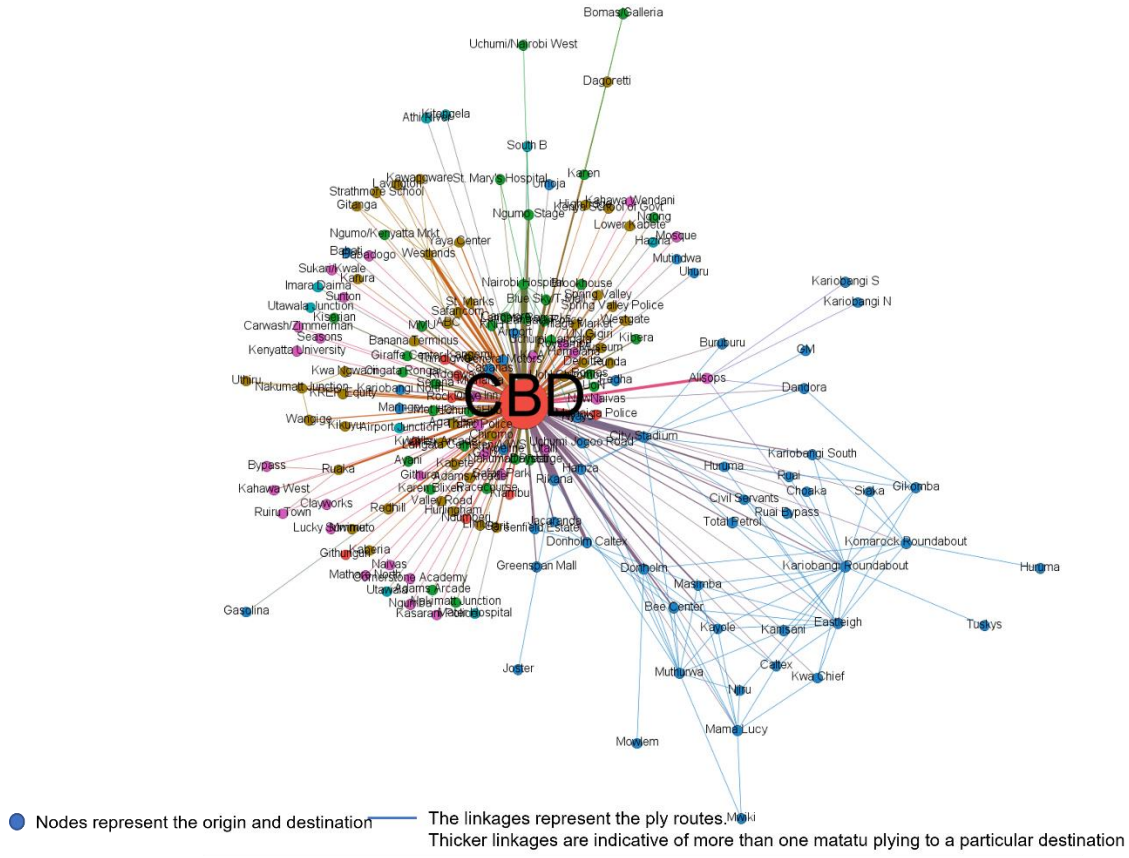

Figure 12: Betweenness centrality of matatu routes in Nairobi. Source: Authors'– generated from existing data on matatu route networks from digital matatu data (Williams et al., 2015). There seems to be a relatively independent network in the East differing from the situation in the west, which is totally oriented towards CBD.

The strategic positioning of the CBD within the network makes it a spatial broker, connecting all other areas within the city and other neighbouring counties. Nearly all public transport destinations have a direct link to the CBD. While this presents the significance and importance of the CBD, it also represents the fragility and the weak resilience of the entire public transport network. An elimination of the CBD from the network could result in a collapse of the complete network, negatively impacting the whole city since it bears the highest degree of clusters of places of necessity. This draws attention to the need for re-distribution of places of necessity to other areas in the city but also the focus on transit-oriented development by planning for public transport hubs outside of the city centre.

To investigate potential areas for transit-oriented development, we carried out the network analysis a second time, eliminating the CBD from the network and re-running the network calculations. This process helped to observe the changes in the network that might result in other emergent areas of betweenness centrality. A few areas emerged as strategic places of connectivity. These are areas whose functionality is independent of the CBD, and they facilitate connections to other areas in the city. Majority of these strategic destinations are in the East of the city, an exception being the area around Nairobi Hospital which lies west of the city centre as shown in figure 13 below.

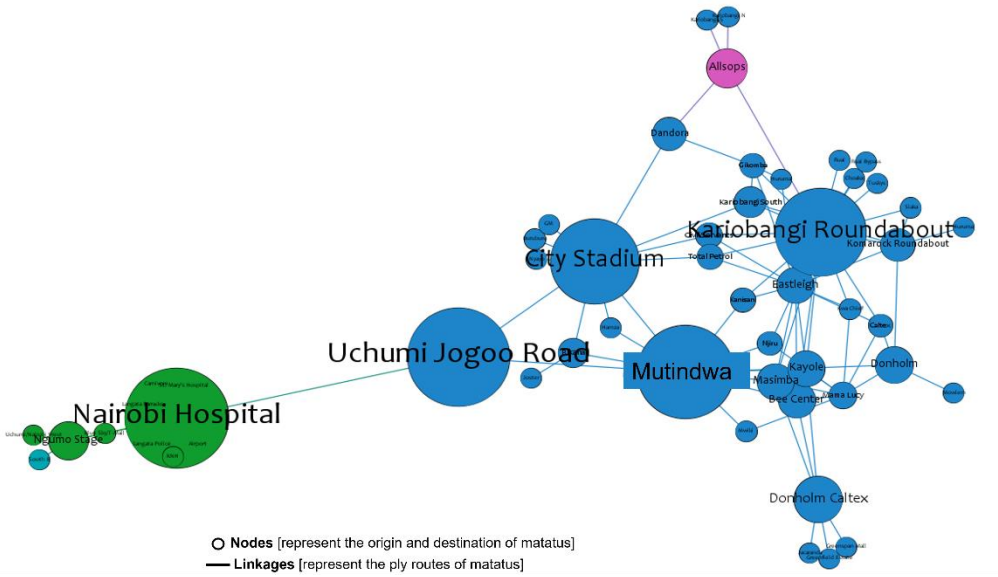

Figure 13: Emergent areas of betweenness centrality without direct linkages with the CBD. Source: Authors' – generated from existing data on matatu route networks from digital matatu data.

These emergent areas of betweenness, present a possibility for creating a self-sustaining space in the most densely populated areas of the city. Specifically, areas of Kariobangi Roundabout and Mutindwa are in the eastern part of the city that are located in Embakasi and Njiru sub counties respectively. These sub counties recorded the highest population of Nairobi's residents in the 2019 Kenya National Census, with a total of over one million residents, constituting over 37% of Nairobi's urban population as shown in figure 14. The areas of Kariobangi Roundabout and Mutindwa are connected to multiple

other destinations in the network including Allsops – an area northeast of Nairobi. They present a budding chance for transit-oriented development through maximizing on places of necessity and the existing population density to encourage movement within short distances. Investing in a well-functional and efficient public transport terminus in these areas might potentially improve their attractiveness and generate some gravitational pull for other opportunities and services to locate in these areas.

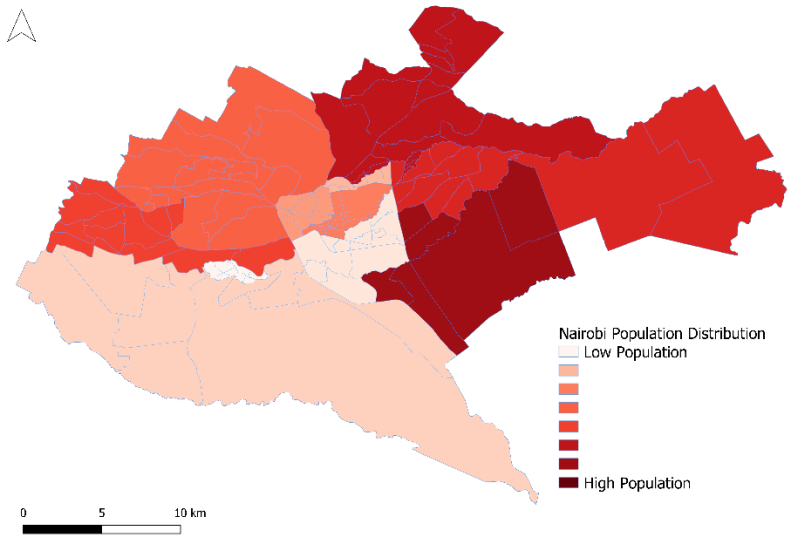

Figure 14: Population Distribution in Nairobi. Source: Authors' – generated from 2019 National Census Data.

An interesting location was the Nairobi Hospital which appears to be strategically located as a connection point in the western part of the city. Nairobi Hospital can be reached by public transport from the west and southwest of the city. As an example, it is possible to take a direct line (Line 34) from St. Mary's Hospital in Langata whose end destination is Kenyatta Hospital located directly opposite Nairobi Hospital. Since the completion of the Ring Road Kileleshwa, Nairobi Hospital can also be reached by public transport commuters from the western part of the city albeit with a changeover at Yaya Centre.

1.7 Discussion and Conclusion

Investigating mobility and accessibility in Nairobi through the lens of the spatial, individual and modal dimensions reinforces the understanding that the interplay among these dimensions advances the concept of spatial justice in relation to mobility. Neither of these dimensions should be addressed independently. It is not enough to only provide safe non-motorized transport infrastructure and reliable public transport networks without considering the spatial organization of the city. Conversely, if the spatial layout of the city was made favourable to encourage shorter distances and ease of access

to places of necessity, other elements of the individual dimension also need to be factored such as gender, age, and physical capabilities. Concisely, the three dimensions are mutually dependent.

1.7.1 Spatial justice in the spatial dimension

The spatial dimension indicates the residential growth of Nairobi that has led to a vast expansion of the city's built-up space. While the city has sprawled extensively to about 30 km to the East and 20km to the West, places of necessity are still clustered in the CBD with other emergent areas of opportunity, specifically Westlands and Upper Hill, located in proximity to the CBD. Considering the projected population growth of Nairobi, the slow spread of places of necessity closer to residential areas means that many urban commuters will continue to rely on the CBD to get access to opportunities. This comes at a disadvantage to many since according to Fried et.al (2020), the average resident of Nairobi has only 12% access to all opportunities due to the mono-centricity of Nairobi where many opportunities and transport connections are clustered. Accessibility declines already when moving 3km away from the CBD particularly when using matatus (Fried et al., 2020). Re-distribution of places of necessity from a single location – the CBD – to multiple locations within the city is therefore paramount to enhance accessibility for many inhabitants, especially in high density residential areas, hence advancing spatial justice. As revealed by Campbell et al. (2019), high density residential areas have access to fewer hospitals within an hour of walking compared to low density residential areas. The proximity to the CBD is beneficial to those who dwell closer, but inequalities of access are higher for those residing further from the CBD.

1.7.2 Injustices in the Individual dimension

Evaluating from an individual dimension, investments on mobility infrastructure favours those who are already well-off. It is evident that the highest level of injustice is experienced by pedestrians who risk their lives daily to make a living. The chances of death among pedestrians are more than 60% higher than that of an individual who moves by any other means, presenting an unfair chance for the urban poor, who constitute most of the pedestrians (Hagans, 2011; Salon & Aligula, 2012) and whose choice of mobility is limited.

Injustices are also apparent when one is forced to adapt to walking long distances due to the high public transport costs or even yet, one fails to look for job opportunities elsewhere due to mobility constraints. Walking is the only means of mobility that exclusively relies on the infrastructure for safety – since the use of helmets or safety belts is ludicrous – however, investment in motorized modes of mobility has gained more attention in comparison to non-motorized means. The use of a car is often associated with positive aspects such as convenience, comfort and freedom, often advertised as the most ideal mode of mobility. Besides, it is an aspiration to modernity that has impacted on lifestyle

and culture as it is deemed to elevate one to a higher social status (Dupuy et al., 2008). Planning for car use to facilitate direct access to destinations is often at a higher level of consideration, arguably because the decision makers who are responsible for providing the necessary mobility infrastructure are not attuned to the realities of all other modes of mobility except the private motorized modes. In many cases, when a city begins to shift towards active mobility, pedestrian paths and cycling lanes are often expanded to follow the routes that were initially designed for the car. These routes are mostly indirect routes for those walking and cycling and usually make these sustainable modes of mobility unattractive due to longer distances and health reasons when inhaling fumes from motorized vehicles, creating difficulties in convincing car users or even youthful populations to take up active mobility.

1.7.3 Spatial justice in the modal dimension

From a modal dimension, it is evident that the spatial brokerage role of the CBD weakens the resilience of the public transport network. Furthermore, the radial structure of the network hinders circular mobility, and results in longer commute journeys for individuals who would wish to circumvent the CBD, potentially restricting the number of activities that a public transport user is able to undertake. A study by Campbell et al. (2019) reinforced this finding by revealing that the radial pattern of public transport routes decreases the accessibility to health facilities when moving away from the CBD compared to the use of private vehicles primarily because of the density of interchanges in the CBD relative to other areas.

Spatial injustices of accessibility have been experienced by many commuters who rely on public transport due to a) the constrained circular movements within the city, b) long and arguably forced commute to the CBD for individuals intending to circumvent the CBD, c) restrictions in the number of activities to undertake due to long commute times and d) high costs of transport especially among the poor.

Advancing spatial justice from the perspective of the modal dimension would mean first and foremost investing in state-provided public transport that is affordable and efficient. The plans and ongoing implementation of the Bus Rapid Transit (BRT) system and the revival and improvement of the rail system is an indication of progress for implementing sustainable mobility that needs to be advanced especially for ease of access in the first and last mile journeys. The privately owned matatu seeks to maximize on profits resulting in high expenditure on transport among many poor households. Although the County government of Nairobi has made several attempts to get rid of the matatu industry and to restrict their operation in the CBD, the efforts have proven futile partly due to vested interests where some government officials and politicians are also owners of matatus (Klopp, 2012) but also due to their historical role in meeting the crucial need of mobility particularly in areas that

were underserved by the bus service in the years following Kenya's independence (Mutongi, 2017). This draws attention to the need for incorporating the matatu in the public transport reforms especially those that revolve around the introduction of the BRT as opposed to their complete eradication. Their contribution to direct and indirect employment, relevant knowledge of the routes, areas of high demand and the passenger needs, reinforces their central role in the re-organization of the public transport sector (Klopp, 2021).

Although there has been a decline in car acquisition in the past five years, there is an increase in car promotion infrastructure. In 2019, the central government of Kenya endorsed the construction of a 27.1 km express way for quicker and direct movement of motorized vehicles from the southwest of the city where the international airport is located to the west of the city, counter to the existing demand for more safe and sustainable means of mobility. The project which was a top-down implementation, lacked public participation, reflecting the developmental injustices as postulated by Fainstein (2009) where public opinion is ignored through authoritarian top-down approaches. This can also be attributed to colonial and post-independence practices where the needs of the well-off are prioritized over those of the poor (Hagans, 2011). In addition, the role played by the international investors and aid from international governments facilitates the bias towards promotion of infrastructure for motorized vehicles (Klopp, 2012) evident in the construction of the Nairobi Expressway, which is a public private partnership between the Government of Kenya and the China Road and Bridge Cooperation (CRBC, 2020). This tends to perpetuate the neglect of walking as a dominant mode of mobility and takes away from the interests of most of Nairobi's inhabitants including the poor, children and people with disabilities.

1.7.4 The role of policy

Nairobi's urban and transport policy makers and planners are not unaware of the issues presented in this paper. There are several plans and policies at the national and local level that recognize the need to improve the spatial, modal and individual dimension. The Kenya National Spatial Plan (2015-2045) bears ideas and visions for improved accessibility within urban residential areas through an improved urban land use system. The plan proposes an integrated national and urban transport system that seeks to maximize efficiency and sustainability of the public transport system and NMT. This is also a vision that is shared in the 2017 NMT policy for Nairobi County. The vision of the policy is to incorporate NMT to the existing transport network especially for short- and medium-term trips. The challenges faced by pedestrians and cyclists such as inadequate and unsafe infrastructure and disconnected cycling networks are recognized in the policy and suggestions of incorporating NMT into the existing transport network are included in the policy (KARA, n.d.)

Another policy is the Kenya National Urban Policy (2012) that recognizes the need for integrated transport networks. The policy places emphasis on the need for development and improvement of pedestrian walkways and highlights the benefits for investment in cycling modes alongside mass public transport. Other plans such as the 2015 National Integrated Urban Master Plan (NIUPLAN) encourages improved accessibility through circular mobility as a strategy for Nairobi County to achieve the Metropolitan's Vision 2030 goal of optimising mobility and accessibility through effective transportation. In addition, the plan also identifies satellite cities where functions could be devolved to encourage poly centric city growth.

These policies and plans reflect a clear understanding of the need to improve NMT and public transport towards a more annular distributed system. However, the policies exist independently and lack harmony among them. This is primarily because the transport sector in Nairobi County is governed by seven different authorities, separately enforcing the policies. Concerted efforts, however, can result in successful and expedited enforcement of policy as exemplified by the actions of the NMS in providing NMT infrastructure in parts of the CBD.

Our analytic framework on accessibility and spatial justice suggests that the three dimensions of spatial, modal and individual, when addressed together both in planning and policy making can improve accessibility to places of necessity and contribute to the advancement of spatial justice in relation to mobility. If applied in practise, there is need to pay attention to the non-uniformity of the city. Areas should be addressed differently i.e., residential areas and commercial areas and even high-density residential areas and low-density ones all have differing characteristics of commuter flows and spatial structure. Although challenges of non-motorized transport are evident in many parts of the city, mapping the quality of non-motorized infrastructure on specific roads where foot traffic is highest would be a necessary addition to this research. There is indeed a necessity for further studies on the complex relationship between mobility and justice that take into account diverse individual choices and preferences which is a limitation of this research.

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Chapter 2: A historical account of walking in Nairobi within the context of spatial justice

Dorcas Nthoki Nyamai

TU Dortmund University

Abstract

In the ostensibly unceasing prioritization of motorized infrastructure, walking has remained a ubiquitous mode of mobility for a large proportion of Nairobi's urban commuters. Planning for motorized mobility has historically been at a higher level of consideration although a much larger percentage of the population travels on foot. The conspicuous pedestrian has been and continues to be masked under the spotlight of the motor vehicle with a discernible outcome of spatial injustices. Using secondary data, historical literature and expert interviews, this paper examines how walking as a mode of mobility has developed over time and the challenges experienced by pedestrians in Nairobi. Linking to the notion of justice, the paper attempts to assess the association between walking and spatial justice using three dimensions – spatial, modal and individual dimensions – that are used as a framework to assess how injustices unfold and are experienced by Nairobi's pedestrians. The historical path dependency that has restricted and attempted to replace walkability by prioritizing motor vehicle use as well as the technical engineering design that lacks integration of social aspects of mobility have presented challenges in provision of safe non-motorized infrastructure in the contemporary urban travel in Nairobi, enduringly dismissing walking as a valid mode of mobility. Advancing spatial justice in Nairobi's urban mobility will require more than a technical process of extending the side of the road by a metre or two but rather deliberate effort in understanding the pedestrians' mobility needs that can best be understood by attuning to the everyday realities of traveling on foot.

Key words: pedestrian, walking, justice, infrastructure, history

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2.0 Introduction

Advocacy for use of active mobility using terms such as the 'fifteen-minute city' has drawn attention to the use of sustainable means of mobility through transit-oriented development (Pozoukidou & Chatziyiannaki, 2021; Ibraeva et.al., 2020). This principally involves increasing the number of opportunities or services that can be reached in a short period – preferably through walking or cycling – and planning cities around ease of reach to public transport. The ASI (Avoid-Shift-Improve) framework (Dalkmann &Brannigan, 2007), a strategy for promoting sustainable mobility, emphasises the reduced desire to travel in order to achieve zero carbon emissions and where travelling is necessary, shifting to more environmentally friendly modes of mobility and improving the vehicle technology for energy efficient motorized modes. The *Avoid* strategy advocates for strategic planning that endeavours to reduce or, as much as possible, hold off the need to travel using motorized transport by shortening the distances to places of necessity to encourage active travel i.e. travelling on foot or cycling. Shifting towards more energy efficient modes of public transport and improving efficiency through vehicle technology for individual motorized transport are specific strategies within the ASI Framework that support sustainable urban mobility.

In many African cities, studies on non-motorized mobility have called attention to a.) the ubiquity of walking as a main mode of mobility for many urban dwellers in cities such as Cape Town, Nairobi and Dar es Salaam, (Khayesi et. al., 2010; Mitullah et.al., 2017; Salon & Gulyani, 2010; 2019; Salon & Aligula, 2012.), b.) the challenges that pedestrians experience daily while travelling along urban roads (Odhiambo, 2021; Nyamai & Schramm, 2022) and c.) the legislative framework of non-motorized transport (NMT) (Odhiambo, 2019) as well as the positive impacts on climate change for promoting the use of non-motorized mobility (Cooke et. al., 2019). Nearly 78% of people in Africa travel on foot every day according to an assessment by UNEP and UN-Habitat in a report on walking and cycling in Africa. Non -motorized mobility however constitutes the highest number of victims of road crashes mainly due to inadequate and unsafe infrastructure. Most of the roads fail to meet the acceptable spatial requirements to cater to the large volumes of foot traffic and where the service for pedestrians is provided, it is often of poor quality, on the one hand, making walking unpleasant for those who are already accustomed to walking and on the other, discouraging the uptake of walking as a mode of sustainable urban mobility (United Nations Environment Programme and United Nations Human Settlements Programme, 2022).

Walking is an ordinary and only mode of commute for nearly half of Nairobi's urban commuters. According to the 2014 Nairobi Integrated Urban Development Master Plan (County, 2014), over forty percent of all daily trips that include going to work, going to school, shopping and travelling back home, are made on foot and over long distances of more than three kilometres. Across many poor

settlements in Nairobi, walking is the main mode of mobility for over 65% of adults and over 96% of school going children (Salon & Gulyani, 2019).

Despite the overt immensity of pedestrians throughout the city, infrastructure is bereft along many of the urban roads in Nairobi. Odhiambo (2021) analysed the infrastructure provision on twelve of the corridors with high foot traffic and found that nearly all the corridors are characterized by a limited number of pedestrian crossings, narrow sidewalks that are inadequate for the high volumes of pedestrians and along some busy corridors, divested sidewalks that force the pedestrians to share the road with the speedy motorists, posing a high risk to pedestrian safety.

Planning for motorized modes of mobility is often prioritized over non-motorized modes even though walking is the most used mode of mobility (Khayesi et.al., 2010). According to the 2017 Nairobi Non-Motorized Transport Policy, less than 2% of the annual budget of road infrastructure is dedicated to non-motorized infrastructure. This imbalanced investment in motorized modes vis a vis non-motorized modes takes away the prioritization of walking infrastructure with resultant spatial injustices experienced by the pedestrians, evident in the number of road crashes where pedestrians are largely casualties. More than 60% of annual road crash victims in Nairobi between 2015 and 2019 constituted pedestrians as recorded by the National Transport and Safety Authority (NTSA) of Kenya, a statutory body that oversees road safety, motor vehicle registration and licencing, and the enhancement of traffic law. These high incidences of pedestrian fatalities are mainly due to inequalities of infrastructure provision where many streets lack safe and spatially adequate infrastructure to support the high volume of pedestrian flows. Unlike other means of mobility such as motorized vehicles that have safety belts or airbags to reduce the chances of fatal accidents, or helmets that provide a degree of safety for cyclists, walking is the only mode of mobility that relies on infrastructure for safety. The lack of provision of safe infrastructure in the design of urban roads, therefore, subjects the pedestrian to much higher risks and reflects the degree of spatial injustices exposed to the pedestrian relative to other road users.

This paper investigates walking from a historical perspective in order to understand the path dependencies that pose difficulties in addressing the present mobility needs of pedestrians in Nairobi. Using a framework of three dimensions that comprise the spatial, individual, and modal dimensions, (see Nyamai & Schramm, 2022) the research investigates how spatial justice is understood and ascertained within the mode of walking. The spatial dimension focusses on the prioritization and provision of the necessary infrastructure to support travelling by foot. The modal dimension is concerned with walking as the main mode of mobility for accessibility to areas of opportunities and services. Since walking as an active mode of mobility does not engage the support of other tools for movement (e.g. motorized vehicles that rely on the car or cycling that relies on the bicycle), it is

therefore closely linked to the individual dimension which is concerned with the pedestrian as the individual whose journey is actively made on foot. The individual dimension also considers the individual's socio-economic characteristics such as income, gender, age, physical capabilities *inter alia* particularly because walking in Nairobi is experienced differently across various income and social groups. For instance, it is a mode of mobility used mainly by the poor due to public transport affordability constraints while those in higher levels of income mainly consider walking as a leisure activity; walking is also experienced differently by women and men based on perceived safety along certain streets, and people with disabilities and the elderly have trouble when walking in places where infrastructure is bereft.

Tenably, the interaction of these dimensions advances the comprehension of how spatial injustices manifest in active mobility. Due to their independent complexities, it cannot be assumed that addressing each of the dimension directly relates to obtaining spatial justice. This research postulates that understanding the interrelation of these dimensions underscores the emancipatory potential of advancing a more inclusive urban mobility system through the lens of spatial justice, especially in a southern city context.

By investigating the historical overview of walking as a common mode of daily travel in Nairobi, this paper aims to firstly underscore the enduring ubiquity of walking despite the constant prioritization and advancement of motorized modes over non-motorized ones and secondly, to call attention to the need for prioritizing safe infrastructure for walking as a step towards a just mobility system in Nairobi. The paper traces the development of mobility in the city from the colonial history and its influence on contemporary urban mobility in Nairobi while building on two key points. Firstly, from both the individual and modal dimensions, that the protracted neglect of walking as a mode that is common to a significant majority has manifested spatial injustices experienced mainly by pedestrians. Secondly, from a spatial dimension, the historical and contemporary development of Nairobi as a motor centric city has infringed and restricted walking as a popular mode of mobility and contributed to the paucity of investment in adequate and safe non-motorized infrastructure.

This paper seeks to identify some of the ways in which investment in and allocation of non-motorised infrastructure in Nairobi can be related to epistemic view of justice. The paper then continues with a theoretical review of the link between mobility and justice by looking into the different notions of epistemic justice in an urban mobility context. The section that follows explains the methodology and data used in this research followed by an analysis of walking in Nairobi in three periods that broadly assess historical and contemporary development of urban mobility. The last section enunciates the events of the different periods of mobility development in Nairobi using the framework of the spatial, modal and individual dimensions and underscores the spatial injustices experienced by the

pedestrians. The paper concludes with the understanding that walking has not only been the norm for many urban commuters in Nairobi both historically and in contemporary times but that other forms of mobility, especially motorized mobility modes have rather infringed, restricted, altered and attempted to replace patterns of ever-existing flows of walking in Nairobi.

2.1 Mobility and Justice

Justice as fairness often places the less fortunate at the core of the discourse on the distribution of primary goods and resources to ascertain the benefit of the greater majority. This comprehension of social justice postulated by John Rawls in the 'difference principle' (Rawls, 1971: 75) advocates for securing the wellbeing of the less fortunate amidst the changing inequalities in society as a fair way of ensuring justice for all. When invoked in the mobility discourse, justice relates to prioritizing the mobility needs of the less fortunate in society, more specifically, the poor and people with disabilities as they often have the most limited choice of mobility options due to affordability constraints and physical restraints (Pereira et.al., 2017; Lee, Sener & Jones, 2017; Dong, 2018). Social justice is concerned with the fair distribution of goods that individuals require to advance their daily lives and the processes of fair distribution by institutions that are held accountable for fair outcomes (Rawls, 1971; Soja, 2009; Moroni, 2020). Closely linked to social justice is the notion of spatial justice that is related to the way social justice unfolds in space and across various domains. The geographical difference across cities produces a variation of the distribution of inherent resources and the processes of their distribution and hence, the unfolding of spatial justice is heterogeneous (Soja, 2013). Space, however, not only contains resources that can be distributed but also consists of individuals whose actions and mobilities constantly modify the urban form (Nyamai & Schramm, 2022) and who make up the institutions and authorities that are mandated to ensure fair processes in the distribution of goods (Soja, 2009). The crosscutting understanding of both social and spatial justice is the fairness in distribution of resources, the shared benefits and burdens of accessing and utilizing the resources, the processes of resource distribution and the decorum of the institutions responsible for equitable outcomes (Soja, 2013; Harvey, 2010).

In a study of Walzer's sphere of justice, Karel Martens (2012) highlights transport as a social good that is subject to distribution, recognizing the inescapable inequalities of access that emerge from the organization of space which inevitably creates a centre and periphery. The varied registers of meaning of what constitutes a social good produces different impact on the distribution of transport as a good. This distributive element of transport can be related to the spatial dimension in this paper, that emphasizes on equitable distribution of mobility infrastructure to support all modes of mobility but especially non-motorized modes as they are first of all sustainable and secondly, mainly used by the less fortunate in the context of Nairobi. Transportation planning and policy that seeks to reduce the

inequality between the transport disadvantaged and those that have multiple opportunities of accessibility represents a fair mobility system. The transport disadvantaged are categorized as those that often live in the periphery with reduced accessibility to opportunities and services in comparison to those living in proximity with more diverse opportunities and advantages of accessibility (Martens 2012). In some cities such as Nairobi, the choice to live in suburban areas in the periphery for exclusivity distorts the spatial urban form of the city and effectuates access by use of motor vehicles. Given that rental costs are also more affordable for the low income in peripheral areas, those who cannot afford to purchase a private vehicle or can only intermittently bear the cost of public transport, experience higher disadvantages of access to opportunities and services clustered in the core.

A nuanced perspective on the association of mobility and justice is the understanding of accessibility as a human capability (Pereira et. al., 2017; Vecchio & Martens, 2021). Emerging from Amartya Sen's (1999) 'Capability Approach', the discourse primarily advocates for recognition of diverse human capabilities and the freedom to be mobile in order to undertake activities that are essential for survival. This understanding has been defended as an approach that considers the diversity of humanity in terms of i.) personal/physical features e.g the less abled whose capability for mobility is limited, ii.) choices, such as residential choice or choice of mobility option, and iii) aspirations that affect the opportunities that individuals can access as well as their ability to be mobile in order to fulfil diverse wants and needs (Vecchio & Martens, 2021). An alternative but closely linked stance of the 'Capabilities Approach' in relation to transport by Randal et.al. (2020) introduces transport policy as a factor for social transformation that enables an individual to convert resources and opportunities into capabilities that benefit the individual's life. Policies can be perceived as an initial step towards just mobility systems as they provide operational guidelines for infrastructure provision and against which retributive action can be pursued in the event of injustice. The formulation of policies, however, is not an end in itself and requires enforcement. Poorly formulated policies can potentially evoke latent injustices, for instance, when policies acknowledge the need for an integrated transport system but prioritize and enforce infrastructure that encourages the use of motorized modes without consideration for non-motorized means. This directly relates to the modal dimension of this research whereby the ubiquity of walking tends to be masked under the spotlight of the motorized vehicle. This reflects a degree of injustice through the risks and misfortunes that result from the high incidences of road crashes and health risks that pedestrians are exposed to relative to other commuters. Additionally, the systems of political management and the powerplay in controlling mobility in cities results in unequal capabilities for movement among city inhabitants (Sheller, 2018).

Notions of epistemic justice in relation to urban mobility are complex and multifaceted as they are not only defined by the organization of space but also the social, cultural and economic characteristics of individuals that determine their mobility and access to places of necessity. Injustices in urban mobility,

can however be recognized in different spatial forms whereby the design and layout of streets is consequential to the accessibility of different groups of people – those with disabilities or the aged population (Sheller, 2018) – and to the inclusion of different groups as streets are often spaces where cultures meet, where information is shared, ideas exchanged, friendships formed (Kinyanjui, 2014) and also where income inequalities are made manifest (Kamau & Manga, 2020).

Bringing together these perspectives of justice in relation to urban mobility, conveys the interpretation that the fair distribution of infrastructure and equity in investment that supports safe mobility for all in the city along with the prioritization of the mobilities of those with less capabilities and limited options of movement reflects how spatial justice in relation to mobility unfolds and is understood. By shifting the narrative to not only look at the distribution of infrastructure as a good but also at the risks and misfortunes shared among urban commuters in Nairobi, the paper contributes to a nuanced perspective of investigating justice in relation to urban mobility. Since mobility is not a good that can be distributed or redistributed (Nyamai & Schramm, 2022), the associated misfortunes that result from reduced accessibility to opportunities and the risks of fatalities in everyday travel relate to how mobility can be associated with justice. Put differently, when one mode of mobility becomes far riskier for a significant majority than any other mode, then tenably, injustices become prevalent. Noteworthy, the association between spatial justice and mobility is intertwined with several elements that involve the influence of politics and external actors on the governance and management of infrastructure, the choices and preferences of individuals as well as the heterogeneity of space that rouses the complexities of justice in relation to mobility but at the same time, implores constant cognizance of these complexities for advancement of fairness in the development of urban mobility systems.

Research on socially just public transport in the context of Kenya by the Socially Just Public Transport Working Group (SJPT-WG) developed five pillars for a socially just transport which include availability, safe and affordable access, inclusion, human rights and equity, and sustainability. Although the pillars directly address social justice in motorized public transport, the pillar on safety forms the central argument of this research as it emphasizes the need for pedestrian infrastructure that enhances safe mobility. In addition to this is the necessity for a supportive political system and a government that actively involves the users of the various mobility modes in its effort to provide a just mobility system (Kamau & Manga, 2020).

2.2 Data and Methodology

The intertwined association of the spatial, modal and individual dimensions that are used as a framework for analysing the link between urban mobility and spatial justice in this research produces overlapping outcomes. Since the research considers a historical perspective, the period of analysis is categorized in three parts for coherence and the ease of analysis using the framework of the

dimensions. The first period, called the *early period* refers to the colonial period between 1899 to Kenya's independence in 1963 then the period after independence to the year 2019 forms the second part of the research period referred to as the *recent past*. The third part, *contemporary development* relates to the current infrastructural changes for non-motorized mobility that have taken place in Nairobi due to an unexpected temporary change in governance that has led to changes in spatial infrastructure non-motorized mobility. It also raises awareness on the design of urban roads and the existing standards that pose challenges in the socio-technical approach to road infrastructure projects.

2.2.1 Early period

To analyse the spatial dimension, the research uses various data to investigate the infrastructure provision for walking from a historical perspective that dates to the colonial history of Nairobi. This applies diverse historical literature that discuss the spatial development of Nairobi (Mumford, 1961; Morgan, 1967; Murunga, 2012; Banyikwa, 1990, Kingoriah, 1987; Ogot, 1963; Ogot & Ogot, 2020) including the review of the pre-existing Nairobi urban development plans of 1926 and 1948 to understand the foundations of urban growth and the projections of infrastructure provision. Since infrastructure for walking in Nairobi is often designed to accompany road infrastructure, the review focusses on historical development of road infrastructure for motorized mobility to infer the development of infrastructure for non-motorized mobility.

The modal and the individual dimensions are closely interlinked as walking is a form of active mobility that completely engages the effort of the individual without the use of any vehicular machines. Investigating the history of walking as a main mode of mobility therefore also includes the study of the individual's characteristics that relate to gender and income (Kinyanjui, 2014; Mutongi, 2017). Walking has been a common mode of mobility for a larger number of people both historically and in contemporary urban mobility but the design of mobility infrastructure that prioritizes motorized mobility has continued to persist despite the ubiquity of pedestrians in Nairobi. The review of both scientific literature and historical books about Nairobi that outline walking as a dominant mode of mobility (Mutongi, 2017; Klopp, 2012; Miller, 1971; Jedwab et.al., 2013) have been used to understand the path dependency of prioritizing motorized infrastructure and the spatial injustices that have been perpetuated by the constant neglect of investment in safe infrastructure for walking.

2.2.2 Recent past

To connect the past with contemporary mobility, the research investigates both walking and public transit as affordability of public transit is causal to walking especially among the poor (Salon & Gulyani, 2019). Analyses of existing household data from the Kenya National Bureau of Statistics (KNBS) is used to investigate the modal share in Nairobi and the cost of travel among Nairobi's public transit

commuters. The KNBS is a national governmental body that is mandated to collect, analyse, and distribute statistical data. KNBS performs periodic household surveys every 10 years and this research analysed data from the periodic survey of 2016. This section also addresses the challenges that pedestrians experience through an analysis of accidents data recorded between 2015 and 2018 by the NTSA.

2.2.3 Contemporary developments

The recent changes in Nairobi County governance have impacted the provision of infrastructure for walking. In the first quarter of 2020, four core functions of the County government were transferred to the central government among which transport was one. The formation of the Nairobi Metropolitan Services (NMS), which governed the County for a period of two years, led to the prioritization of non-motorized infrastructure especially in the central business district. Through an interview with the director of roads and public works at the NMS, this section highlights the impact of change in governance, albeit temporary, for the progress and prospects of safe infrastructure for walking in Nairobi. Furthermore, through a review of the existing road design guidelines and an interview with a civil engineer working in a long-established engineering firm in Nairobi, this section highlights the structural and pedagogical constraints that viably contribute to the constraints of prioritizing non-motorized infrastructure.

2.3 Walkability in Nairobi in the early period (1899 – 1963)

Nairobi was ostensibly founded along a mobility route during the construction of the East Africa Railway from Mombasa city in the coast of Kenya, to Kampala, the capital of Uganda (Ogot & Ogot, 2020). Several scattered camps were in the area that is today Nairobi's city centre, but the larger part was a swampy area and a wildlife territory (Miller, 1971). This provided large uninhabited space for development such that when the railway arrived in Nairobi in 1899, development of Nairobi into a town began rapidly soon after. The formation of an administrative authority and the relocation of the headquarters of the colonial government from Machakos County in the East to Nairobi County catalysed the development of Nairobi (Morgan, 1967). The rapid growth attracted an increasing number of Europeans and a large number of Asians who worked on the railway construction as well as Africans from different parts of the region who sought after trade and employment (Murunga, 2012).

Alongside the rapid growth of population was also the rapid growth of infrastructure to support movement throughout the city. Road construction in Nairobi began as soon as the government administration was set up in 1899 and within a decade, most of the road network that still exists in the city centre today was established (Morgan, 1967), shaping the functions of Nairobi as a future motor-

centric capital. The car defined the focus of infrastructure provision as it was envisioned as a symbol of prestige and was the main mode of mobility for the ruling colonial government. Car acquisition among the Europeans increased sharply such that by 1928, Nairobi city had accumulated up to 5,000 vehicles, obtaining a global record of the city with the highest per capita vehicle ownership at the time (Klopp, 2012).

The allocation of functions within space was controlled by the British colonial administration who took on the responsibility of land subdivision in the city centre (Murunga, 2012:465). Allotment of land parcels was based on partiality, first to the European then to the Asian (Kingoriah, 1983:250, Kinyanjui, 2014). This endeavour largely defined the mobility of different groups in the city as racial hierarchies dictated residential spaces and the freedom of movement among the African population. Majority of the land (90%) in the city centre was owned by the Europeans and a relatively less percentage (10%) belonged to the Asians while the Africans resided in the margins of the city where they lived in settlements – a political move that ensured surveillance and dominance (Vogel, 2008). Spatially, the city centre located administrative offices, government services, commercial areas, and partly residential areas especially in the south of the city centre. These residential areas were mainly habited by the Indian businessmen who lived in storeyed dwellings that were partitioned to accommodate their business activities as well as provided residence (Murunga, 2012). Most of the Africans resided in proximity to the industrial area where they provided cheap labour and earned incomes that could mainly afford them to commute to their workplaces on foot (Kingoriah, 1983:253).

The mobility of Africans in the city was restricted by the issuing of pass laws in 1902, at the early stages of the development of the city (Robertson, 1997:14) and also in the spatial development plan of 1948 whose objective under section 8 of Chapter 21 was to “promote stabilization of the urban African population and reduce horizontal mobility” (White et.al., 1948:57). The pass laws dictated who had access and where the access could be granted. Only Africans who worked for the Europeans could obtain access to the city centre (Mutongi, 2017:22). These were largely African men as the colonial labour policies favoured men over women (Kinyanjui, 2014). Despite the restrictions on mobility, Nairobi attracted many Africans from different parts of the country who mainly travelled on foot for long distances. On a documentation of trade in the Nairobi area during the colonial period, Claire Robertson gives an account of the multitudes of traders who travelled every day into Nairobi from neighbouring countries for trade. These traders, who were mainly women, walked as far as 20km on foot from regions bordering Nairobi to buy and exchange goods (Robertson, 1997:107) and trade was the only way that women dared to obtain access to spaces that excluded women and created barriers of movement (Kinyanjui, 2014). A similar recountal by Kenda Mutongi indicates that women mainly

walked for distances as far as 24km on foot to their regular destinations while men occasionally rode bicycles (Mutongi, 2017:23).

Accompanying this image of long-distance pedestrians was the image of a motor-centric city. Nairobi was viewed as an elitist town - a town for Europeans even though the African population comprised the majority (Robertson, 1997:13). As a result, the design and investment in mobility infrastructure was guided by the ease of access for elitist groups as development was dictated by the British colonial government whose main mode of mobility was the motorized vehicle. In two of the earliest urban development plans of Nairobi for the years 1926 and 1948 shown in Figures 15 and 16 below, spatial expansion of the road infrastructure throughout the city was a definitive priority. The planners, F. Walton James and Eric Dutton, proposed an expansion of the road network from the original 25km^2 to 77km^2 (Vogel, 2008).

1926

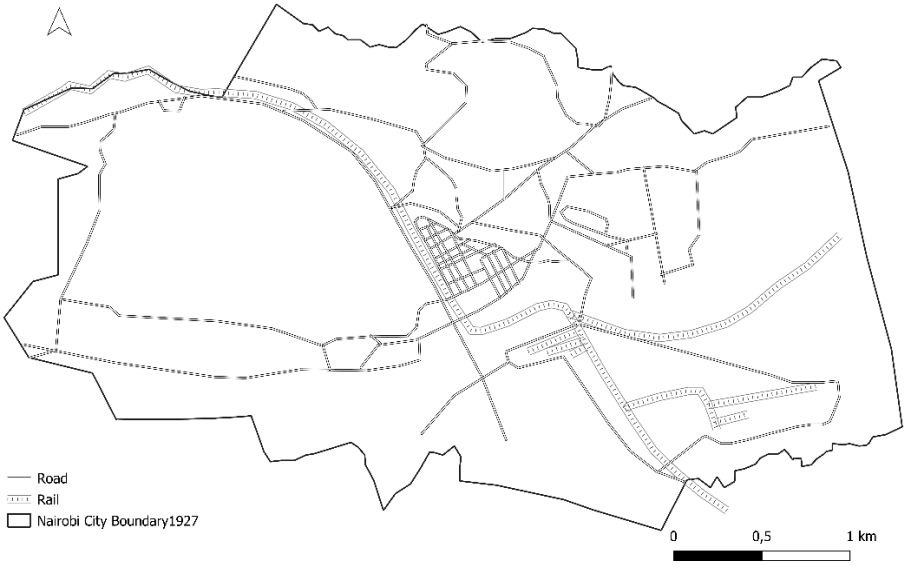

Figure 15: Major transport routes in the 1926 development plan of Nairobi. The proposed transport routes were digitized by the author. Source: ETH Studio Basel – History of Urban Planning in Nairobi, (Vogel 2008)

1948

Figure 16: Major transport routes in the 1948 development plan of Nairobi. The proposed transport routes were digitized by the author. Source: ETH Studio Basel – History of Urban Planning in Nairobi, (Vogel 2008)

Section 6 in Chapter 21 of the 1948 Master Plan indicates the objectives of enhancing faster flow of motorized traffic through "a clearly defined parkway system for fast traffic both for local and national needs, a clearly defined system of local main roads, feeding the parkway system at restricted intervals". The plan also considered the establishment of cycle lanes but restricted them to "open spaces of neighbourhood units and not along main roads" (White et.al., 1948:57). Although the plans did not materialize due to financial constraints (Vogel, 2008), they indicate the vision of improving access by use of motorized vehicles throughout the city meaning that only those who could afford moving by motorized mobility could get access to places of necessity and move easily within the city while cycling was restricted to neighbourhood areas. As the population grew, public transport became a necessity for movement of larger masses across the city. The public transport system, introduced in 1934, initially only served the Europeans and was funnelled through a set of designated routes, operating within specific time schedules (Klopp, 2012; Opiyo, 2002). As the bus fleet increased, some of the buses became admissible for the Africans, however, the modest income of many could only afford travelling by bus for a few days – on and after pay day. For the rest of the month, travelling to work or for shopping or visiting friends and relatives was mainly on foot (Mutongi, 2012:22). Public transport therefore excluded the poorest who could not afford as well as those who lived in the periphery away from the bus service routes.

2.4 Walkability in Nairobi in the recent past (1963 – 2019)

Walking continued to be a main mode of mobility among many Africans due to affordability constraints and poor accessibility as the buses did not serve the areas where many Africans resided (Mutongi, 2017). This contributed to the foundational tenet that walking was a mode of mobility only for the poor, despite its importance as a sustainable means of mobility. A decade prior to Kenya's independence, a state of emergency was declared due to fears of uprisings as the Africans fought for independence. Within this period, the movement of Africans throughout the country was kept under surveillance and highly controlled by the colonial government especially in Nairobi and its environs (Durrani, 2018:132; Mutongi, 2017). When Kenya obtained independence in 1963, the period marked a significant moment in Nairobi's mobility history. Firstly, it not only meant freedom of governance but also freedom of mobility, particularly for the Africans, when the state of emergency was lifted and the restrictions on movement were abolished (Mutongi, 2017:17). Secondly, independence induced a large influx of migrants looking for employment opportunities in Nairobi especially from the rural areas such that Nairobi grew at a rapid rate of 10% p.a. (Mutongi, 2017:43). Additionally, it meant the emancipation of women in overcoming material deprivation by generating employment for themselves through the 'informal economy' that rapidly grew in the city (Kinyanjui, 2014). The migration resulted in a third significant outcome which was the expansion of the city boundaries to accommodate the large inflow of migrants. The city grew eight times larger in size in 1963 from the original demarcated boundary in 1948 (Banyikwa, 1990:187). The boundary has remained unchanged since then (Morgan, 1967) however, it induced residential mobility in areas that were further away from the city centre – where most services and opportunities were concentrated. These events shaped the mobility of Nairobi and continue to impinge the progress of sustainable urban mobility.

After independence, the Kenya Bus System (KBS) was the only legal form of transport in the city and although the bus fleet had a carrying capacity of over 100,000 passengers daily (Mutongi, 2017:31), they did not adequately meet the needs of the larger population. The new migrants who flocked Nairobi from rural areas in search of jobs were unable to afford the buses and many resided in neighbourhoods that were outside the designated ply routes of the buses. Journeys made on foot were common as was the most affordable way to search for livelihood opportunities in Nairobi, however, it was not long until some of the Africans who owned private vehicles started providing public transport services when the exigencies of affordable and accessible mobility demanded it. These individualized public transport services were accessible in areas where many Africans resided and led to the evolution of the private 'Matatu' industry (Mutongi, 2017:24) that presently dominates the public transport sector in Nairobi (Kamau & Manga, 2020).

The Matatus are presently registered as public transport providers by the NTSA but are operated by private individuals organized in Savings and Credit Cooperations (SACCOs) according to their route of operation. In an analysis of 1050 respondents of a 2016 household survey conducted by the KNBS, public transit was popular among many respondents as shown in figure 17. This was also registered in a study of the 2014 Nairobi Integrated Urban Development Master Plan (NIUPLAN), where Matatus were the main mode of mobility for trips to work.

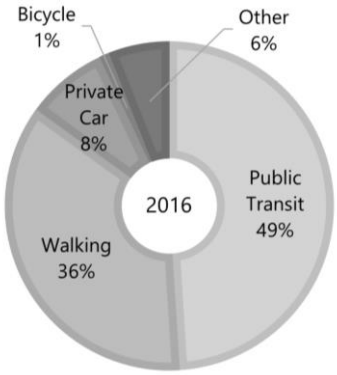

Figure 17: Modal Share in Nairobi in 2016. Source: Author's analysis of KNBS household survey data. The survey comprised of 1050 respondents from Nairobi

Although the use of public transit is high, many journeys are made on foot especially for key livelihood activities that include shopping, going to school trips to work and trips back home. Walking is a mode of mobility across every wealth bracket as indicated in a study by Salon and Aligula (2012) on urban travel in Nairobi, but with a significant increase among the very poor urban residents. In another analysis, Salon and Gulyani (2019) found walking to be the dominant mode of mobility for more than 65% of adults and 96% of school-going children living in poor settlements in Nairobi. This is related to the high costs of public transit which is operated by private individuals who are driven by profit gains, hence the poor who cannot afford the high and fluctuating fares are excluded from using public transit and opt to walk (Avner & Lall, 2016). The 2016 KNBS household survey data as analysed in this research revealed that many commuters pay approximately between $1 and $2 US Dollars a day for a journey to work and back home as shown in Table 2.

Table 1 Costs of transport using public transit (Matatu). Source: Author's analysis of KNBS 2016 household survey data. The survey comprised of 1050 respondents from Nairobi

Cost of transport for a round trip	Percentage of households
Less than 100 Kenya shillings (less than ≈$1)	38%
Between 100 and 200 Kenya shillings (between ≈$1 and ≈$2)	47%
Between 201 and 300 Kenya shillings (between $2 and $3)	3%
More than 300 Kenya shillings (more than ≈$3)	12%

Table 2: Costs of transport using public transit (Matatu). Source: Author's analysis of KNBS 2016 household survey data. The survey comprised of 1050 respondents from Nairobi.

More than 47% of public transit users paid over 100 Kenya Shillings (≈1$) for a round trip. Although this is causal to other factors such as distance and time of travel, the data failed to capture this additional information, however, out of the 47% who paid over $1 for a roundtrip, 37% were casual and seasonal workers whose daily wage according to the 2011 Kenya Regulation of Wages Amendment Order (Law, 2011), averages between 400-600 Kenya shillings (≈$4-$6) a day. This indicates high transport expenditure costs among low-income commuters who spend on average about 20% of their income on transport. In a study on household expenditure on transport in Sub-Saharan Africa (Olvera et. al., 2008), households categorized as 'very poor' and 'poor' based on household expenditure accounted for higher expenditure on transport, around 15% - 20%, than the estimated expenditure on consumption indicating that the poor spent a significant share of their cost on transport even though they did not afford to travel on a daily basis.

The lack of affordability of public transport among the poorest enroots their invisibility in the planning of inclusive urban mobility. In Nairobi, this is embedded in the historical development of the city where pedestrians were not part of the imaginaries of the urban city. Termed as the 'urban invisibles' in the assessment of Nairobi as a just city, Churchill Otieno (2020) refers to those who are excluded from the city's socio-economic architecture design as 'mobility invisibles' whose safety and accessibility is compromised.

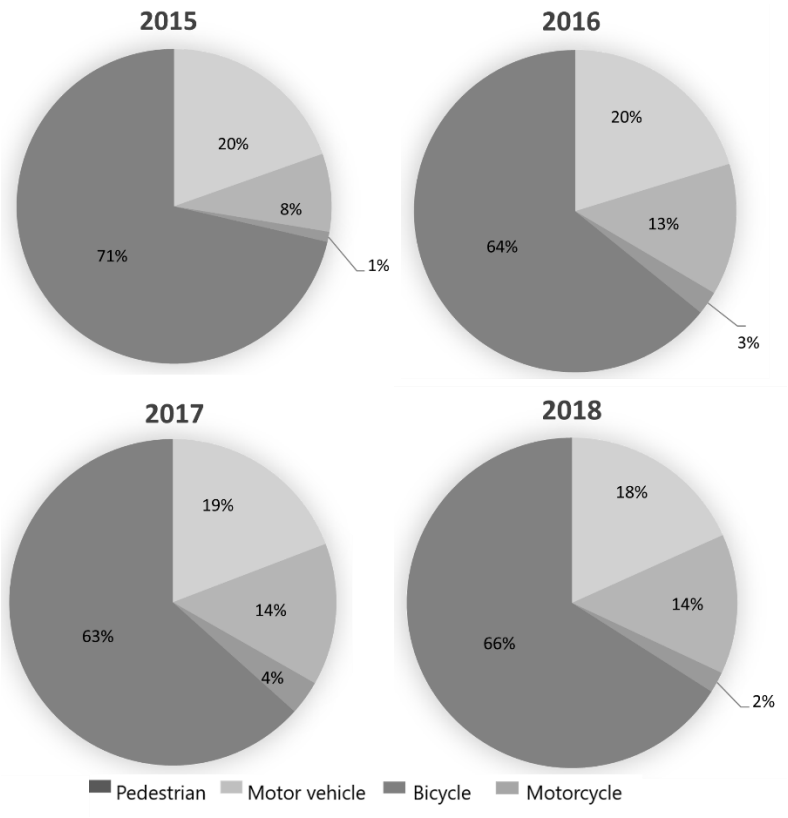

Figure 18: Recorded annual road crashes in Nairobi. Source: Author's analysis of data derived from the National Transport and Safety Authority of Kenya (NTSA).

Lack of infrastructure to support safe walking unfortunately renders it as the riskiest mode of mobility given the high number of pedestrian crashes recorded in the NTSA database annually. Over 60% (more than 400) pedestrian crashes were recorded between 2015 and 2018 as shown in figure 18 posing a threat to many urban commuters as walking remains the only option of mobility for the poorest even though public transit stops are easily accessible across many residential neighbourhoods in Nairobi (Salon & Gulyani, 2010).

2.5 Contemporary developments on walking (2020 – 2022)

The ambiguity of the design guidelines for urban roads in Kenya developed by the Ministry of Local Government under the Kenya Urban Transport Infrastructure Project (KUTIP, 2001), present challenges in the provision of safe pedestrian infrastructure. While the guidelines provide a minimum width of footpaths along selected roads, the recommended 1.25m is inadequate to cater for the high foot traffic along many urban arterial roads. The 2017 Non-Motorized Transport policy addresses the lack of safe infrastructure for pedestrians that exposes them to the risk of accidents from speedy motorists. Furthermore, the explicit divestment of footpaths along international and national trunk roads contributes to the risks of pedestrian crashes as these roads register very high foot traffic because they connect key commercial and industrial areas where many urban poor people travel daily on foot to look for or provide casual labour. These are some of the ways in which the spatial development of mobility infrastructure contributes to spatial injustices and deters the uptake of walking as a sustainable means of mobility among those who would do not necessarily belong to the low-income bracket but would prefer to walk, for instance, for health reasons.

In practise, the provision for 'safe' walking infrastructure across many highways are the footbridges. The use of quotation marks for the word 'safe' denotes the illusion of safety that these footbridges provide. They are rather constructed with the intention to ensure faster and free flow of traffic without any interruptions of pedestrian crossings than to provide actual safety for the pedestrians.

Most of the footbridges in Nairobi are unsafe spaces at night and at times also during the day. They are often appropriated by vendors, restricting the space allocated for walking. Some of the footbridges are also spaces of advertisement with large billboards that create blind spots for unsafe practices. Furthermore, the design of footbridges often fails to provide direct access across the motor way and increases the travel time for pedestrians. For this reason, many pedestrians risk directly crossing the motorway for faster access, increasing the high risk of accidents that are mostly fatal.

This directly links to the disconnect of the social and technical elements of infrastructure in the design and development of urban roads in Nairobi. The pedagogy of civil engineering at the tertiary level of education lacks provision for the social component of infrastructure and viably forms the basis of the negligence of the pedestrian as a significant road user and the risks of fatalities that they are exposed to. In an interview with an engineer in one of the leading and oldest engineering firms in Nairobi, the lack of integrating social element to infrastructure design is not only a pedagogical problem in engineering studies but also the perpetuation of British design standards that historically failed to envision the pedestrian as a user of the road.

> *"Well, the fact that non-motorized infrastructure doesn't features as part of the design is a combination of things. As an engineer, I have not been trained to think of infrastructure in a multi-disciplinary manner, meaning the social, environmental, climate or stakeholder engagement such as planners. It is because engineering is a codified science that strictly follows what the standards and regulations dictate. We tend to follow what the code says so we can easily push through projects […]. In engineering school, inclusion of non-motorized infrastructure doesn't feature prominently. It has never been at the forefront of engineers' mind to provide for walking and cycling lanes. I think this is in part because a lot of the engineering that is currently taught is dated and was taught at a time when there was a huge deficit of infrastructure and brownfield areas of development […] We still have a lot of old traditional engineers who are teaching and have taught through many decades. It's a profession that it's a bit rigid in accepting new ways of doing things. For road design, we primarily use British standards and that is what we have been taught" [Interview with a civil engineer from a top engineering firm in Nairobi that has existed since the 1930s].*

The spatial inequalities of non-motorized infrastructure provision are therefore rooted in colonial pasts where British standards are applied in contemporary road designs despite the expansion of the city and the ubiquity of pedestrians in the city.

This despondent narrative of the neglect of pedestrian safety however recently witnessed a temporary shift after an evanescent change of county governance between February 2020 and March 2022. Within this period, four core functions of the county government, among which was transportation, were transferred to the central government. This led to the formation of the Nairobi Metropolitan Services (NMS) who attested a significant progress in provision of NMT infrastructure. In the confluence of the outbreak of the Corona pandemic and the formation of NMS, more than seven kilometres of newly developed footpaths and extended sidewalks as shown in figure 19 were developed along several streets in the Central Business District (CBD). The recognition of the need for safe NMT infrastructure was central to the NMS according to an interview with an NMS official responsible for transport.

"Since the development of the Nairobi integrated urban development plan, a directive was given to all road agencies to include NMT in infrastructure development especially in urban areas. As NMS, we have prioritized NMT because we have over two million people who walk to their places of work daily […]. The challenge we have is that the infrastructure has not been designed to cater for pedestrians and cyclists. They are the major victims of road crashes in Nairobi. In 2018, a study was carried in Nairobi to assess the safety of Nairobi commuters particularly with regards to crashes. What was found was that 71% of all fatalities are pedestrians and cyclist. This means that they are very vulnerable, and the contributing factor is lack of infrastructure. This has now been given priority as part of the sustainable mobility plan for Nairobi" [Nairobi Metropolitan Services (NMS) representative].

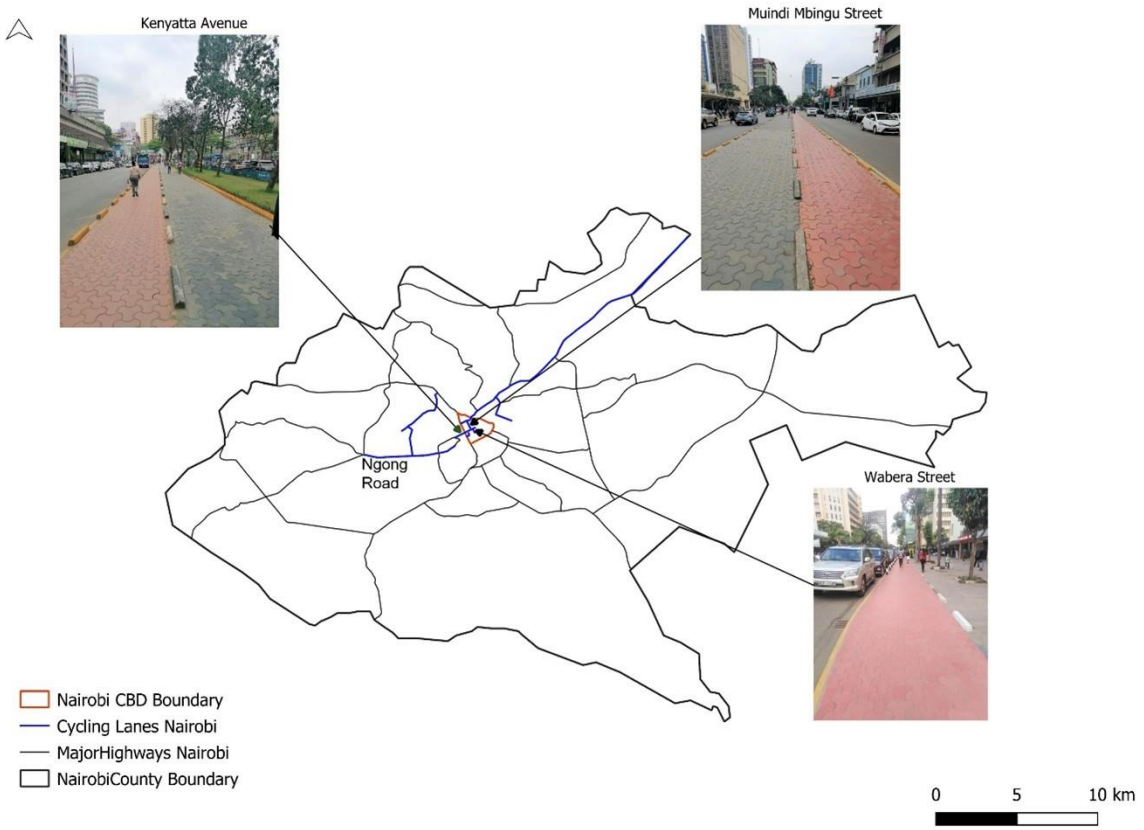

Figure 19: Non-motorized infrastructure provided by the Nairobi metropolitan Services (NMS) along selected roads in Nairobi's Central Business District (CBD). Source: Author's.

Although the formation of the NMS was temporary, the spatial changes in the CBD indicate the progressive changes over a short period of time that can be achieved when investment is directed to serve those who need it most. The lived experiences of pedestrians however extend beyond the CBD which is often a transitory space to get access to other areas in the city. Risks are much higher along other urban roads where the infrastructure is either inadequate or divested (Odhiambo 2021).

The Ministry of Transport, Infrastructure, Housing, Urban Development and Public Works (MOTIHUD-PW) together with the institute for Transport and Development Policy (ITDP), UN Habitat, Global Road Safety Fund (GRSF), The World Bank, and International Climate Initiative (IKI) developed a street

design manual that was published in February 2022. This is the most recent advancement of safe infrastructure for pedestrians in Nairobi. The manual offers guidelines for development of various street typologies in accordance with the classification of urban roads in Kenya. Recognizing the high volume of foot traffic, the manual explicitly indicates a minimum of 2m width for footpaths and comprehensively addresses the needs of pedestrians including gender sensitivity given that perceptions of safety differ among men and women. The manual further offers guidelines for motorist speed limits of between 15 and 30km/h on smaller streets to maximize safety for pedestrians. If adhered to, this manual will not only address the historically embedded spatial injustices that perpetuate in contemporary urban road standards and designs but will significantly improve the safety of pedestrians and contribute to the advancement of a just mobility system.

2.6 Discussion and Conclusion

2.6.1 Spatial dimension

Bringing the three periods together within the framework of the spatial dimension, infrastructure for motorized mobility has been at the fore front of Nairobi's development from the inception of the city. Spatial injustices in provision of pedestrian infrastructure have been manifested from the onset of the development of Nairobi city both by design and by political choice. The established colonial racial hierarchy resulted in prioritization of motorized mobility against the considerable number of pedestrians in the city. Soja (2013) and Fainstein (2014) in their theorization of justice acknowledge that fairness – or its absence – is made manifest in the outcome of allocation of resources. The outcome of land distribution that spatially excluded the Africans and dictated the allocation of road infrastructure created an imbalance of mobility needs and manifested spatial injustices.

This is a situation that persists in contemporary modes of mobility in Nairobi where pedestrians experience a disproportionate share of risks as the 'invisibles' in the mobility plans of the city. The historical path dependency of prioritizing motorized mobility over non-motorized modes has contributed to the neglect of safe pedestrian infrastructure as well as the perception of pedestrian as a nuisance to the flow of car traffic. Private car use in Nairobi makes up a small percentage (13%) of the modal split relative to walking (49%) but receives much more investment at the cost of safe non-motorized infrastructure. The budget allocated to non-motorized transport, according to the 2017 Nairobi NMT policy is only 2% of the transport budget contrary to the incessant prioritization of motorized mobility manifested in contemporary investments particularly in the development of the Nairobi Expressway. Recent development of the updated street design manual as well as the recent transformations of spatial infrastructure in the city centre by the NMS demonstrates progressive efforts towards a just mobility system, however, the investment in the costly Nairobi Expressway

demonstrates retrogressive efforts. The government of Kenya invested billions of Kenya Shillings on a road project to mainly facilitate the movement of private vehicles from Nairobi's major international airport to the west of the city in an aim to enhance business operations in the city. The commissioning of the road allowed for the use of public transport but only temporarily after a lot of contestations related to road accidents. The toll fee charged for the use of the road makes it exclusive to only those who can afford and for public transport, the cost is transferred to the passengers. Given the unclarity of whether public transport will be allowed to use the highway, and the already low percentage (13%) of private car ownership in Nairobi, the investment of such costly infrastructure to serve a limited number of Nairobi's travellers, mainly the elite illustrates the contemporary neglect of the mobility needs of the most vulnerable who make up the majority of urban commuters. This not only represents the perpetual prioritization of motorized mobility needs but also manifests an overt injustice to many pedestrians who risk their lives daily in the absence of adequate pedestrian infrastructure.

2.6.2 Modal and individual dimensions

Linking the modal and individual dimension to the spatial dimension, walking in Nairobi can be said to be the place where sustainability and poverty meet and where spatial injustices are made manifest. Historically, the growth of Nairobi an urban city bore the imaginaries of motorized mobility that did not include the pedestrians in the future of urban mobility of the city, resulting in spatial inequalities of accessibility that manifest themselves in contemporary Nairobi. The exclusion of the poorest from accessing public transport during the colonial period when the buses were unaffordable to many is also perpetuated in present day public transit that results in the poor walking as the only affordable mode of mobility. This neglect of pedestrians has exposed them to a disproportionate share of mobility risks and misfortunes as the chances of pedestrian deaths are significantly higher than any other road user. Since pedestrians contribute a large proportion of the urban poor, the inequalities are even higher given that their choice of mobility options are limited relative to other urban dwellers. Reflecting on John Rawls' "Difference Principle'' (Rawls, 1971:75) injustices are evident when securing the advantage of the well-off comes at a disadvantage for the less fortunate. With respect to walking in Nairobi, securing the interests of those with private vehicles, by investing in the extension of the road network and expansion of the existing roads without paying attention to other road users has come at the costly price of loss of lives among the pedestrians who mainly comprise the poor.

The channelling of pedestrians through risky footbridges signifies that the pedestrian is viewed as a nuisance to the free flow of motor vehicle traffic. On the one hand the footbridges expose the pedestrian to inconveniences of indirect access and on the other, to the restricted space appropriated by vendors and the spaces of potential anti-social behaviour.

The recent efforts by the NMS to provide safe infrastructure for pedestrians in the city centre provides hope for the prospects of safety. However, the temporality of the NMS and the latent mindset that indexes car ownership with prestige presents and walking with poverty challenges the prioritization of pedestrian infrastructure in Nairobi. Walking in this research has been presented as a mode of mobility that has persisted over time despite the spatial, institutional and political efforts of promoting motorized infrastructure as way of hindering, altering, restricting and even replacing ever existing patterns and flows of walking in the city.

The injustices that pedestrians in Nairobi experience are historical legacies that infiltrate the paucity of recognizing the urgent need for pedestrian safety. Prioritizing safe pedestrian infrastructure will not only require a technical process of widening the footpaths adjacent to road infrastructure but rather a deliberate effort to provide direct access to destinations according to the mobility patterns of pedestrians. In many cases, pedestrian infrastructure is laid side by side with motorized mobility leading to exposure to health risk from carbon emissions. The pedestrian is also forced to adapt to the design of infrastructure that was prioritized to provide direct access to the motor vehicle, resulting to indirect access and in some cases longer journey time for the pedestrian. Breaking the path dependency, of investment in motorized transport while neglecting the mobility needs of pedestrians will require deliberate effort from the authorities at both the local and national level. Unless the authorities attune to the realities experienced by pedestrians daily and structural changes made in the pedagogy and standards of road design, the attempts to ensure safety will continue to be lethargic at the expense of pedestrians' lives.

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Chapter 3: Invoking spatial justice in urban mobility in Nairobi: A commuter's perspective

Dorcas Nthoki Nyamai

TU Dortmund University

Abstract

Justice in relation to mobility is invoked and performed in various ways. This is based on the premise that space not only contains resources that can be distributed but also consists of individuals who are highly mobile within that space, and whose perceptions play a pivotal role in shaping the concept of justice in relation to mobility. Mobility is an enabler for access to resources and opportunities that are spatially dispersed, however, in Nairobi, the injustices prevalent in the mobility landscape enable access for some users while restricting it for others. This presents a notable way in which justice in relation to urban mobility unfolds. Through sixty-five in-depth interviews with commuters in Nairobi this research reveals that individuals' everyday experiences not only present a multifaceted connection between justice and mobility but also shape which specific facet of justice takes precedence in one's consciousness. Notably, affordability of public transit, police misconduct, safety of non-motorized users, neglect of traffic regulations and ensuing impunity are some of the prominent ways in which injustices in mobility are made manifest. Furthermore, the unclear laws and regulations that govern road use sustain a system riddled with uncertainties and injustices. Promoting transparency, creating platforms for citizen engagement, integrating technology in traffic management system, fostering a culture of accountability, and enhancing public awareness of regulations and mobility rights through comprehensive civic education represent some of the interventions and strategies that can be invoked to redress the injustices prevalent in Nairobi's mobility landscape.

Key words: justice; perceptions; mobility; Nairobi

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3.0 Introduction

"No mobility for us without us".

This phrase draws inspiration from the broader slogan, "Nothing About Us Without Us", which has been an acclamation for disability advocacy and inclusion. "No mobility for us without us" is introduced in this research to specifically highlight the need for inclusivity and active participation of city inhabitants in shaping urban mobility systems that meet their needs.

The exclusion of users from planning and execution of mobility projects has far reaching implications on the livelihoods of the users as well as the accountability of relevant stakeholders, as illustrated in Edward Soja's book "Seeking Spatial Justice" (2013). The book highlights a legal case involving the Los Angeles Metropolitan Transit Authority and the Bus riders Union of Los Angeles. Over several decades, the bus riders, who primarily consisted of poor and racial minorities, experienced discrimination and limited access to essential services and opportunities due to inadequate bus services. Part of the reason for this situation were the conflicting views on equity between the transit service providers and the bus riders. According to the transit authority, equity translated to equal distribution of public transit buses across all districts. This understanding of equity, however, failed to address the needs of the bus riders as it overlooked the heterogeneity of space and the reality that services and opportunities cluster in some areas more than others. Hence, vital destinations that were crucial for the livelihoods of the poor bus riders remained inaccessible by bus. This specific instance illustrates the adverse effects on the wellbeing of commuters, as relevant stakeholders, when their requirements are overlooked in the provision of services intended to cater directly to their needs. It also emphasizes that decisions regarding mobility should involve the people who directly benefit from or are affected by those decisions.

With the *Just City* concept, Susan Fainstein (2010) argues that citizen engagement and democracy are central to the development of equitable outcomes in the city. She advocates for participatory approaches that include and consider the voices and needs of the disadvantaged and affected groups in decision-making process for fairer outcomes. Placed in the context of urban mobility, the involvement of users/commuters as key actors in shaping processes and decisions for equitable mobility systems ideally advances the concept of justice in the city. Advancing spatial justice in urban mobility, therefore, is not solely dependent on the distribution of spatial or material resources, but also the efforts towards including the perspectives of those who are directly affected in the decision-making processes.

The concept of just mobility is often shaped by scholarly viewpoints, providing suggestions and interventions to develop and execute a just mobility landscape (Cook and Butz, 2018; Golub and Martens, 2014; Martens et.al., 2012, Martens, 2016; Nyamai and Schramm, 2022; Nyamai, 2022; Pereira et.al., 2017; Sheller, 2018). When seeking stakeholder participation in mobility projects, the notion of justice is typically predefined. Stakeholder involvement, if it occurs, tends to involve users in contributing to the design of projects with a predetermined definition of justice or their participation becomes a formal/legal requirement prior to the project implementation (cf. Omenya, 2020). Rarely are the perspectives of users obtained at the onset, regarding their perception of justice or their vision of an ideal just mobility system.

This study therefore aims to discuss justice in mobility, not only from scholarly viewpoints but from the viewpoints of the users themselves, as important stakeholders in the advancement of justice in urban mobility. Understanding how individuals perceive justice on their own terms is essential for advancing a just mobility system for various reasons. First, these perspectives potentially unveil diverse interpretations of justice, which can serve to strengthen the linkage between justice and urban mobility. Second, the varied perspectives on justice held by urban commuters can offer a deeper comprehension of the mobility needs and experiences among different user groups. This knowledge can be instrumental in developing comprehensive and inclusive strategies to address injustices within urban mobility systems. Third, this approach has the potential to contribute to a broader understanding of epistemic justice, in both scholarly and societal discourses, particularly within the context of a southern city.

This research highlights key findings regarding the multifaceted dimensions of justice that are reflected through the lived experiences of individuals in Nairobi, Kenya. It also points out the different ways in which commuters associate justice with urban mobility in the city.

The subsequent sections present a theoretical review of justice and its application in mobility and an overview of the methodological approach used to explore the different perspectives on justice in Nairobi. The article concludes by discussing potential interventions that could foster justice within Nairobi's urban mobility landscape while integrating the views of the commuters.

3.1 Justice in an urban context

Justice as a concept, idea, theory, experience or as depicted in other iterations continues to be explored both in scholarly circles as well as in political discourses of urban development, governance, and various socio-cultural constellations. This has led to the emergence of various ontologies of justice. Different societies, cultures, histories, political contexts, academic disciplines and

philosophical perspectives have developed their own understandings of justice that often overlap and intersect with each other.

One frequently made distinction in the theorization of social justice in scholarly circles is between distributive and procedural justice (Marcuse, 2009; Pereira et.al., 2017; Reisch, 2002; Soja, 2009). Distributive justice addresses fairness in the allocation of resources, rights or valued goods, encompassing both benefits and disadvantages, and taking into account the different impacts these allocations have on individuals. It advocates for resource distribution in a manner that ensures the least advantaged members of society experience progressive improvements in their livelihoods (Harvey, 2002; Rawls, 1971; Soja, 2009). Procedural justice addresses the way structures in society shape possibilities, responsibilities and duties for various actors and those who benefit from these structures. It argues that the transparency of processes by which decisions are made, and rules are enforced within a system is important, regardless of the outcome (Marcuse, 2009). These ontologies are interrelated as the fairness of the procedures and decision-making processes are used to determine equity in how resources should be distributed. Several other ontologies have emerged, among them reparative justice (Williams and Steel, 2023), socio-ecological justice (Yaka, 2019), spatial justice (Soja, 2013), food justice (Cadieux and Slocum, 2015), intersectional justice (Rice et.al., 2019). The shared objective of these diverse categories is promoting the equitable distribution of resources and opportunities, focussing on addressing the needs of the most vulnerable groups.

Spatial justice is an ontology that is of particular interest for this research as it localizes social justice and gives it geographical relevance. Soja (2009) explains that spatial justice does not replace other forms of justice but is a concept that emphasizes the spatial perspective of justice, which is crucial as uneven geographical development leads to differences in social processes that inevitably produce inequalities. Within such differences, competing and co-existing visions and ideals emerge, with different actors holding power and negotiating for processes that might lead to equitable or inequitable outcomes (Marx et al., 2022). Continuous spatial appropriation and resistance of affected groups in the production of unjust urban spaces represents the manifestation of spatial justice in cities (Dikeç, 2009; Soja, 2013). Spatial justice is therefore an outcome of actions, interactions and mobilities within space and the space itself, a manifestation and permanence of the dynamics that produce and reproduce injustices (Dikeç, 2009). In this article, the concept of spatial justice is important to inform the dynamics in the mobility landscape that produce and sustain spatial injustices as expressed by the lived experiences of city dwellers.

Justice in relation to urban mobility advocates for the prioritization of the mobility needs of the most vulnerable, especially those with limited mobility options such as the poor and those with disabilities (Dong, 2018; Nyamai and Schramm, 2022; Pereira et.al, 2017; Sheller, 2018). This approach entails providing sufficient resources, including material, spatial, infrastructural and financial resources, to ensure equitable access to transportation (Martens, 2016). The concept of the just city, as proposed by Fainstein (2010), holds significant value and can be partially applied to African cities especially with regard to stakeholder participation in decision-making processes. However, it is important to understand how the citizens themselves perceive justice, how they directly link this understanding with their daily mobilities and their ideals for a just mobility system.

3.2 Urban mobility in Nairobi and the application of justice

Nearly half of Nairobi's commuter population relies on active mobility, primarily walking, as their main mode of travel (Odhiambo, 2021) for trips to school, work, shopping and journeys back home (County Nairobi, 2014). This prevalence of walking is largely influenced by unaffordability of public transit and paratransit options (Nyamai, 2022). Paratransit, commonly known as matatu[5], is the second most used mode of mobility in the city accounting for about one-third of daily trips (Kamau and Manga, 2020). The transit routes largely originate and terminate in the city centre and are limited to specific highways, which restrict circular mobility throughout the city (Nyamai and Schramm, 2022). Private car use accounts for about 13% of the commuter trips while cycling accounts for 1% (Odhiambo, 2021).

Similar to many other southern cities in Africa, Nairobi faces an imbalance that heavily favours the promotion of motorized mobility over non-motorized modes despite the ubiquity of active travel (Khayesi et.al., 2010). This can be traced back to the historical growth of the city, which prioritized motorized mobility and restricted the use of non-motorized modes (Nyamai, 2022). The historical path dependency continues to influence contemporary urban mobility in the city. Presently, equity is not adequately integrated into the city's overall infrastructure planning and policy development (Mitullah & Opiyo, 2016). A small fraction of the annual transport budget is allocated to improving non-motorized modes of transport compared to motorized modes. This has significant implications for the majority who use non-motorized mode as they are exposed to higher risks of road crashes due to inadequate infrastructure (Nyamai and Schramm, 2022).

In a study on the application of social justice in public transport, Kamau and Manga (2020) highlight injustices that emanate from the historical development of public transport in the city. They argue

[5] Paratransit in Nairobi is provided by private entities operating minivans and buses that are commonly known as matatu. The words *matatu* and *paratransit* and at times *public transport* (with reference to the respondents' views) are used interchangeably in this research.

that availability, accessibility, safety and affordability are among some of the critical pillars for a socially just public transport in a Kenyan context. Their findings reveal that the current public transport provision falls short of meeting these pillars, hindering the realization of a socially just public transport system. Some of these issues, particularly affordability, emerge as significant contributors to injustices in urban mobility in Nairobi as discussed in the following sections.

3.3 Research Methodology

This study has applied a qualitative approach to explore perceptions of justice among Nairobi's urban commuters and how they relate justice with urban mobility. A total of 70 interviews were conducted between October and December 2021. Only 65 interviews were ultimately utilized in the analysis and reporting. The decision to exclude the remaining five interviews was primarily due to issues related to recording quality and the inadequacy of information gathered during these interviews. Of the 65 interviewees, the majority were private car users and public transit users as shown in Table 3. The views expressed in this research are therefore largely the views of motorized users, however, the views of non-motorized users are also included in the study.

Participants were selected using convenience and snowball sampling methods. An initial selection of the respondents was based on the city's inhabitants who were willing to participate in the interviews. Afterwards, each participant was asked to recommend one or two other participants. Most of the respondents were aged below 35 years. This is not surprising as more than 75% of Nairobi's inhabitants are younger than 35, as documented in the 2019 National population Census. There was also a higher male than female participation.

Transport mode	Number	Percentage
Private car users	31	47%
Public transit users	20	30%
Pedestrians	5	7%
Cyclists	3	5%
Train riders	3	5%
Taxi riders	2	3%
Motorcyclists	2	3%

Table 3: Respondents' primary mode of transport (n = 65).

To be eligible to participate in the study, respondents had to be residents of Nairobi who commuted within the city, at least three to four days a week. Taking into consideration the regular use of multiple modes of transport, the respondents were asked to indicate their primary mode of mobility for at least 80% of their journeys. Notably, the interviews were conducted amidst the uncertainties of the COVID-

19 pandemic, leading to some respondents experiencing changes in their mobility behaviour during the interview process. The interviews took into account the mode of mobility used at the time of the interview.

The interview was divided into three different sections as shown in Table 4. The first section asked general questions about age, occupation and social status to obtain a profile of the respondents. The second section addressed daily mobility patterns of the respondents while the third section focussed on justice and its association with urban mobility. The questions were asked in a way that allowed for the respondents to voice their own perspective on justice.

Section	Question no.	Question
Section 1: General questions	1	How old are you?
	2	What is your current occupation?
	3	Do you have a family of your own?
Section 2: Mobility	4	Do you commute on a regular basis?
	5	What would you say is your main reason for commuting?
	6	What means of mobility do you mainly use when commuting for your full journey or 80% of the journey?
	7	Please give an account of a typical working day from when you leave home to when you return.
Section 3: Justice	8	In your own words, how would you define justice?
	9	Is there any particular experience that has led to this definition?
	10	How do you associate your definition of justice with mobility in Nairobi?
	11	What, if any, injustices have you experienced in your day-to-day movement within the city?
	12	Are there some commuters, who in your view, experience more injustices in their daily mobility than others?
	13	Who do you think should be responsible for ensuring a just mobility system in Nairobi?
	14	Do you think you have the capacity to contribute to a just mobility system? How so?
	15	Do you think there is hope for Nairobi to achieve a just mobility system?
	16	In your ideal world, what would just mobility look like?

Table 4: Interview questions

This article focusses specifically on discussing the questions about justice and its relation to urban mobility (Section 3). The other sections are used to complement the respondents' perspectives,

considering factors such as age and mode of mobility used. Questions 11 to 14 were designed to explore how each participant perceived justice and how they associated this understanding with their daily travels. The survey also delved into the respondents' perceptions of the essential elements required to attain an equitable mobility system. These insights were gathered through questions 15 and 16.

The research carried out qualitative document analysis using MAXQDA software. Each question was coded and analysed separately. The analysis started by looking for common patterns or differences in how the respondents' defined justice, and proceeded to examining how justice is connected to urban mobility. The responses were then juxtaposed with the broader concepts of justice as discussed earlier in this article. This allowed for the assessment of the variation between individuals' personal justice perspectives and the broader epistemic justice. The research also evaluated the perspectives of justice concerning urban mobility and the suggested interventions by the commuters in addressing the inherent injustices in the mobility landscape.

The findings of this research do not reflect the views of all Nairobi's commuters. However, they provide a starting point to identifying and addressing injustices in Nairobi's urban mobility system. The perspectives collected in the study represent important points from which efforts towards achieving a more equitable mobility system can begin.

3.4 Research findings and discussion

3.4.1 Perceptions of justice among commuters

To be able to understand how the commuters relate justice with urban mobility, it was important to first understand their perceptions of justice generally. Two questions were of importance: How do respondents perceive justice in their own terms? How do their perceptions differ from the broader epistemic justice?

The respondents' perception of justice was primarily shaped by personal experiences of encountering what they perceived as unfair treatment or observing instances where justice was not upheld.

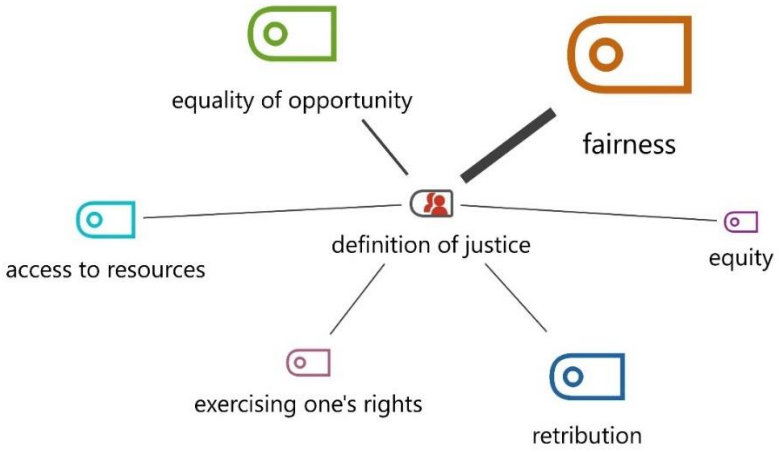

Figure 20: Justice as perceived by Nairobi's commuters. Note: The thickness of the line and the size of the icon represents the frequency of the responses.

As shown in Figure 20, justice is perceived as a holistic concept that encompasses various dimensions. It is expressed as a complex amalgamation and interplay of fairness, retribution, equality of opportunity, access to resources, equity and the opportunity to exercise individual and collective rights. The majority of the respondents, approximately two-thirds, defined justice as fairness. This conception of justice revolves around the notion of individuals receiving what they rightfully deserve. Abdul[6], a 45-year-old male respondent articulated this perspective by stating,

> To me, justice is fairness. You fairly get what is yours and I fairly get what is mine.

Belinda, a 33-year-old female respondent echoed a similar sentiment remarking,

> Justice should be fair for everyone. Everybody feels that they have gotten their fair share of whatever it is that is in question.

Kiptoo, a 21-year-old male respondent also characterized justice as fairness explaining,

> Justice is an act of fairness given to people who deserve it without favouritism or biasness.

This perspective was also expressed by Sarah, a 31-year-old female respondent,

> Justice to me is getting what you deserve. And when you deserve it without any prejudice.

Collectively, these viewpoints underscore the paramount importance of fairness and impartiality as core components of justice.

[6] Pseudonyms have been used throughout the article when citing the interviewees' responses.

Some respondents expressed the view that justice related to equitable access to shared resources. Daudi, a 56-year-old male respondent articulated this perspective saying,

> The society is structured in a manner that people are not likely to be equal in any way. But access to common services, say, access to public transport, access to health care, access to government services, should be fair.

This definition of justice was closely tied to the belief in the equality of opportunity and the capacity to exercise one's rights without encountering discrimination or bias. Fali, a 34-year-old male respondent emphasized,

> Justice has to be accessible. That means if a disadvantaged person in society wants to seek justice and a rich person wants to seek justice, it is afforded to both of them at the same level, so, it doesn't favour one or the other.

These perspectives were strongly influenced by personal experiences where respondents felt they had been treated unfairly. As Evira, a 51-year-old female respondent put it,

> Justice is not infringing on my rights. Everyone should have access to health services, for example, the COVID vaccination services provided by the Ministry of Health should be accessible to everyone without any favouritism.

These responses emphasize the notion that justice is intricately connected to equitable access to essential resources, opportunities and services.

In a just society, individuals should ideally receive equitable and impartial treatment, regardless of their background, capabilities, wealth or social standing. This aligns with the scholarly perspective of justice as fairness initially introduced by John Rawls (1971) and further elaborated by Sen (2009). The viewpoint of justice as fairness was also shared by certain respondents in this study who stressed the importance of impartiality in the dispensation of justice. As expressed by Gloria, a 34-year-old female respondent,

> Justice is something that is judged and fairly done for everyone despite your age, your race or social status.

For other respondents, justice was associated with holding individuals accountable for their actions.

> Justice means one get what one deserves. And wrong is punished and right is rewarded. Yes, I think that's what justice means, to me.

These varying but interconnected viewpoints underline the significance of fairness and accountability as integral components of justice, resonating with both scholarly perspectives and the personal beliefs of the participants.

The multifaceted notion of justice as observed across various demographical differences such as age and gender is reflected through the lived experiences of individuals. The understanding of justice in its various forms, including fairness, retribution, equality of opportunity, access to resources or exercising one's own rights, suggests that the fundamental principles of justice as applied in practical terms, closely align with the universal scholarly perspective on justice.

The influence of everyday encounters, however, shape the specific aspects of justice that take precedence in an individual's perception. This implies that justice is not solely an abstract or theoretical concept but a practical lived experience that is profoundly influenced by social, cultural and economic contexts in which individuals find themselves. In this sense, the everyday encounters of individuals play a pivotal role in determining their personal emphasis on various dimensions of justice, whether it pertains to fairness, retribution, equality of opportunity or other aspects. This understanding aligns with Amartya Sen's Idea of Justice (2009). In his view, what we can observe and understand is often limited by our perspective or position. Our observations and inferences are influenced by where we are standing in relation to the things we are observing. This can impact our beliefs, understanding, and decision-making. Our position or viewpoint, therefore, plays a significant role in shaping our knowledge and practical reasoning, and this concept is relevant to epistemology.

This study further explored the association of justice with urban mobility guided by the respondents' definition of justice. Two key questions were paramount in gaining a comprehensive understanding of the relationship between justice and mobility: How do commuters relate their understanding of justice to mobility in Nairobi? What is their vision of an ideal and just mobility system?

3.4.2 How do commuters associate their definition of justice with mobility in Nairobi?

Initially, establishing a direct link between justice and urban mobility posed a challenge for most of the respondents. However, many were able to establish this connection with justice when they contemplated on the injustices they encountered or observed during their daily commutes. The association of justice with urban mobility was articulated through several interconnected factors (Figure 21). This section explores the four primary ways in which respondents drew a connection between justice and mobility.

3.4.2.1 Unaffordability

A significant injustice, as perceived by most of the respondents revolves around the unaffordability of paratransit services. Paratransit, as discussed previously, constitutes a substantial portion, approximately one third of the total trips in Nairobi. It operates under the purview of private individuals who offer public transportation services. While the government partially regulates the paratransit sector through registration of vehicles and route designation, the pricing of transportation fares is predominantly influenced by market dynamics and the decisions made by paratransit operators. The substantial and unpredictable fluctuations in the fare costs are viewed as exploitative and are closely associated with perceptions of injustice among commuters.

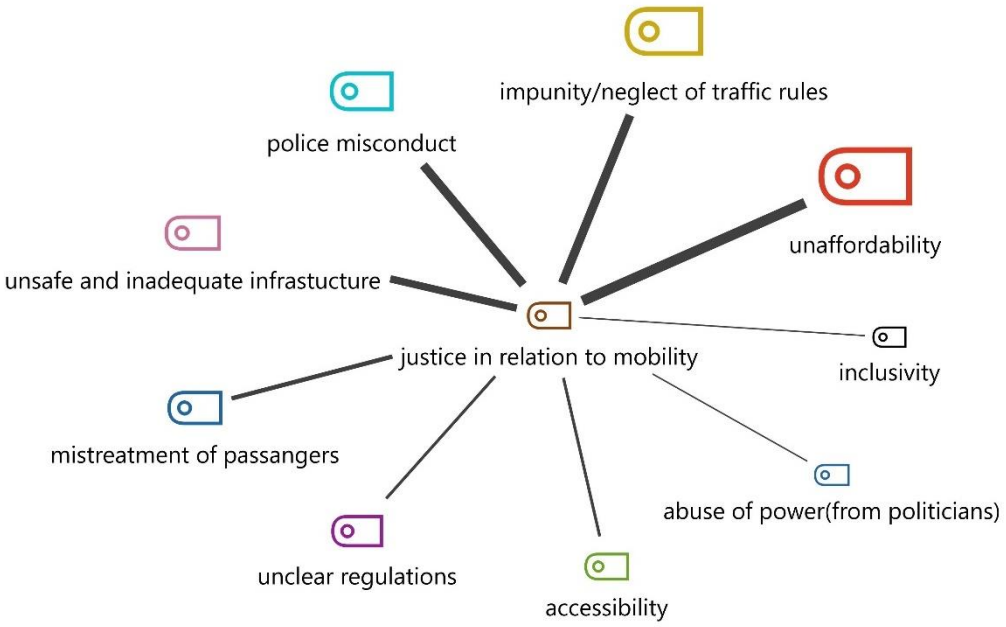

Figure 21: Association of justice with urban mobility in Nairobi. Note: The thickness of the line and the size of the icon represents the frequency of the responses.

In Salamatu's experience, a slight change of weather can cause a dramatic change of fares.

> The other day, I entered a matatu that was charging 50 shillings to Langata. It suddenly started drizzling and as soon as the first few droplets hit the ground, the fare went up by 100 shillings.

This experience was also shared by Regan,

> the bus fare changes when you're not expecting. You've been used to paying a fixed amount from point A to B but because of some other reasons which are unexpected, the matatu conductor just decided the bus fare has gone up. And sometimes they take advantage when the situation is not favourable, especially when it rains or when there is a lot of traffic. So that's quite unfair.

This is a prevalent issue that creates obstacles for affordable and reliable transportation options for those with limited financial means. In many instances, commuters wait for more than one hour for the fares to return to an affordable rate, limiting the areas that are accessible within a specific time frame.

The cost of public transportation primarily accounts for the substantial pedestrian population in Nairobi, as many individuals cannot bear the high and fluctuating costs associated with paratransit. Anita, a pedestrian, described her daily struggle of walking due to unaffordability of public transit saying,

> I mainly walk for more than an hour (one-way) daily. This is not something I have chosen for myself. My circumstances have forced me. I would not say that I enjoy it, but I have gotten used to it! Sometimes I would like to get somewhere faster, but I am not able to pay for it. You know that 20 shillings (~$20 cents) can take you for a number of stops but sometimes even the 20 shillings for fare is hard to come by. I walk during the week, then save some money to be able to afford a matatu to church on Sundays because my church is far.

For Wekesa, government intervention in the regulation of fares would make it affordable for him to use paratransit,

> If the government could control the fares, I would at least be able to use public transport twice a week to the places that are a bit far for me. Now, I walk every day for part of my journey then when I can afford it, I take a matatu when I am somehow close to home because I cannot afford the high cost for the entire trip.

These accounts highlight the significant financial burden that high and fluctuating paratransit fares place on individuals. Public transport is a fundamental component of urban life as it provides essential access to employment education, healthcare and other livelihood opportunities. When public transport become unaffordable, it restricts people's ability to access these vital resources and participate fully in urban life. This restriction is perceived as unjust, both by those with limited financial means and even those who can afford it.

3.4.2.2 Police misconduct

A significant proportion of the respondents, particularly those who use motorized vehicles such as private cars and paratransit, highlighted police misconduct as a major contributor to injustice within

the mobility landscape. In this context, police misconduct encompasses inappropriate behaviour by law enforcement personnel including soliciting bribes and profiling based on various factors. Profiling, in particular, revolves around the type of vehicle being used as pointed out by Hawi,

> Police tend to be biased based on the model or type of car. If it's very big, then you probably won't have any issues. Maybe they'll assume it might be someone who has high political influence. But if it's just a normal car, then you'll just face issues similar to public transport operators.

Chengo shared a similar observation stating,

> Most of the matatu operators are arrested for a simple mistake but if someone with an SUV (Sport Utility Vehicle) does the same mistake, they would not be penalized in the same manner.

These comments emphasize how partiality in law enforcement contributes to perceptions of injustice. The issue of police misconduct in Kenya is pervasive and has been the subject of recent research by Onyango (2022). The study highlights the prevalence of bribery, often characterized by coded language which creates a complex interaction between traffic policemen and motorists, resulting in mutually beneficial gains. Some respondents recounted witnessing such transactions between traffic police officers and paratransit operators, as mentioned by Chacha, a paratranist user who explained,

> I have even seen it. You see that matatu conductor come out with something and they exchange it [with the police officer].

The possibility of paying bribes sets off a chain of consequences where injustices affect both paratransit operators and users alike. According to Jane, another paratransit user,

> The public transport operators have to pay police every day. As a consequence, it increases the amount of fare that I pay to get to town, because they are businessmen, and they have to account for that lost money in one way or another.

A similar finding emerged from the study on socially just transportation in Kenya by Kamau and Manga (2020) which revealed that the expenses incurred due to bribery among the paratransit operators are ultimately shifted to the end users.

The culture of bribery has given rise to a mutually reinforcing cycle in which the police anticipate motorists to offer bribes for traffic violations, while motorists perceive it as a convenient means to avoid lengthy court proceedings. As Musa, a private car user, candidly admitted,

> the problem is that we have a lot of hurdles. The traffic officer wants something, so you decide to break the rule and bribe them. If I have an extra 500 Shillings (~$5) when they ask me, I will pay them otherwise, I will end up wasting my whole day.

Elias, another private car user, shared a similar sentiment, stating,

> me in fact I hate to be caught in the morning. Because that means they take you then go keep you somewhere. And then you go to court in the afternoon. So, my time will be wasted.

Bribing has become a perversive issue viewed as a means to avoid inconvenience. However, this behaviour is also exacerbated by the lack of clarity in traffic regulations as noted by Femi,

> I bribe my way out of a traffic ticket because I don't know what the policeman will do if he takes me to court. If I know I've overlapped in traffic, and I will be taken to court for overlapping, and I will pay the fine for overlapping, then that's a system whereby I know my offense. But we are in a system whereby I don't know what the policeman is going to charge me with, and I don't know what I will pay for.

Her rationale for payment of bribes for traffic violations underscores the lack of transparency in traffic penalties, revealing an underlying issue in the traffic regulations.

The Kenya Traffic Act lists traffic offenses, however, these regulations, as revealed in this research, are often vague and lack clarity when it comes to specifying the consequences for certain offenses. For example, Part 9, Section 86 on the offences of reckless driving states:

> Any person who on any road or in any public place drives any vehicle, other than a motor vehicle, recklessly or at a speed or in a manner which is dangerous to the public, having regard to all the circumstances of the case, including the nature, condition and use of the road and the amount of traffic which is actually at the time or which might reasonably be expected to be on the road, shall be guilty of an offence and liable to a fine not exceeding one hundred thousand shillings or to imprisonment for a term not exceeding two years or to both (Kenya Traffic Act CAP 403)

The statement initially outlines an offense related to reckless driving for any vehicle other than a motor vehicle on the road. However, in the context of Nairobi, where motor vehicles predominantly occupy the road space, it raises the question of which specific non-motor vehicles are typically encountered on the roads, aside from cyclists who generally travel at considerably lower speeds.

Additionally, the lack of clarity stems from the vague and subjective language used in defining the offense. Terms such as “recklessly”, “dangerous to the public” and “including the nature, condition, and use of the road”, are open to interpretation and may vary based on individual perspectives. Consequently, it becomes challenging for both motorists and traffic police to establish the precise boundaries for such an offense, potentially leading to inconsistent enforcement and exploitation of loopholes where acts of bribery persist and flourish.

The prevalent culture of bribery has facilitated efforts to circumvent bureaucratic hurdles and prevent time wastage. This has given rise to impunity and neglect of traffic regulations, which many respondents associated with injustices in the mobility landscape.

3.4.2.3 Impunity/neglect of traffic regulations

According to the respondents, paratransit operators are identified as the primary perpetrators when it comes to neglecting traffic regulations and managing to evade consequences. While this research did not get to interview paratransit operators, most of the views were expressed by paratransit users and private car users who have witnessed the acts of bribery. This prevalent culture has resulted in acts of impunity and the disregard of traffic rules and regulations with motorists expecting that they can essentially buy their way out of fines or legal consequences. Amina, a public transport user, highlighted this dynamic by stating,

> Sometimes the matatu drivers are on the wrong, but also I think they can take advantage of that because they know the end game is that the police would accept a bribe.

David, a private car user, echoed this sentiment stating,

> First of all the matatus don’t follow rules. Most of the time, they get away because they're able to buy their way out of traffic offences. There are so many unroadworthy vehicles, but they still operate, they break the law, and they get away with it.

Esther, another private car user, shared a similar observation:

> Matatus do not obey traffic. They drive recklessly and carry beyond their capacity. They drop off and pick up passengers in undesignated areas and I always have to take caution whenever a matatu is in front of me.

These accounts collectively illustrate the perception that paratransit operators often flout traffic regulations and operate with a sense of impunity due to their ability to offer bribes.

This erosion of the rule of law primarily due to acts of bribery within the transportation system has far-reaching consequences for all the road users. The fluctuating fares that paratransit commuters experience, as mentioned in the previous section, create a financial burden for the commuting public.

3.4.2.4 Unsafe and inadequate infrastructure

Unsafe and inadequate infrastructure emerged as another significant finding concerning the link between mobility and justice. Respondents identified pedestrians and cyclists as the most vulnerable road users. Their vulnerability primarily stems from disparities in spatial infrastructure distribution. The existing infrastructure not only falls short in accommodating the high number of pedestrians but is also frequently appropriated for various other uses. These include access routes for motorcyclists and at times as pick-up and drop-off locations for paratransit operators. Consequently, pedestrians and cyclists often find themselves sharing the road with fast-moving motorists and are hence exposed to heightened risks while navigating the roads.

Several instances reveal paratransit and motorcyclists, locally referred to as *bodaboda,* encroaching onto pedestrian sidewalks and cycling lanes, compromising the safety of these vulnerable users. As outlined by two pedestrians, Tete and Ngechu,

> In Nairobi, I think it's better to walk sometimes because of traffic. But then again, there are a lot of issues of pedestrian and vehicular conflict because there are no walkways. Most of the places don't have walkways and where they have put walkways, they are not ours. They are supposed to be ours but there is a lot of conflict with bodabodas, so it makes it so hard to walk.

> I decided to start walking because I was trying to lose a few pounds. There are a lot of bodabodas on my route to work and the probability of you being knocked by a motorbike is very high even though you walk on pedestrian paths.

Non-compliance with traffic regulations frequently occurs even when pedestrians are in situations where they should have the right of way. One pedestrian, Zari, vividly expressed this issue:

> Many times, you can be crossing the road, and you fear for your life yet you're on a zebra crossing. You don't know whether the driver will stop or not.

During the course of this research, observations were carried out on specific roads that register high foot traffic within a 3 km radius from the city centre. This investigation unveiled a concerning issue where certain pedestrian crossings were inadequately marked, not clearly visible and at times

completely missing especially at road intersections. In many cases, drivers illustrated a lack of deterrence and failed to yield to pedestrians.

The tendency for drivers to rush through traffic, often neglecting pedestrians, can be attributed to several factors. Firstly, the absence of a holistic approach to road safety education that fails to emphasize consideration for pedestrian safety. Secondly, the frustrations arising from traffic delays frequently compel drivers to resort to aggressive driving behaviour as they seek ways to navigate through congested roads quickly. As articulated by Mbako, a private car user,

> When I'm trying to beat traffic, I'm not looking at the pedestrian who's trying to cross the road. I'll just be fast past a zebra crossing.

These factors compound the challenges in creating a safer and more equitable urban mobility landscape and in turn pose a safety risk among pedestrians leading to increased pedestrian crashes according to the National Transport and Safety Authority of Kenya (NTSA) accidents data.

3.4.3 What is the vision of an ideal and just mobility system?

The second part of this study on the linkage between mobility and justice asked respondents to envision an ideal and just mobility landscape. A recurring theme revolved around safety, civic education and prioritization of pedestrians' and cyclists' mobility needs.

3.4.3.1 Smart traffic technology

The integration of smart traffic technology, including automated traffic management systems is perceived as a way of improving traffic control and reducing the reliance on extensive human intervention. Sheila, a public transport user, stated,

> We do not need police on the road trying to control traffic. We need information technology, technologies to make everything orderly you know.

This sentiment was echoed by Sadiq and Esther, two private car users who advocate for the installation of security cameras and automated system for penalties in traffic violations. They emphasized the importance of leveraging technology to create a more efficient and less human-dependent traffic management system.

In such an automated paradigm, the role of traffic police may arguably diminish particularly in routine traffic management tasks such as ensuring smooth flow at intersections and monitoring compliance with speed limits or traffic light signals. A central argument made by most of the respondents is that

the reduction of traffic police involvement could help mitigate the police misconduct associated with bribery. Since smart technology systems are typically designed to operate based on predefined rules and clear algorithms, the subjective element in traffic enforcement would be significantly reduced. This argument is grounded on the notion that human interactions between traffic police and drivers often create opportunities for corrupt practices. Additionally, the inherent ambiguity in traffic regulations, coupled with discretionary authority vested in individual officers, leads to situations where drivers feel compelled or incentivized to offer bribes as a means to evade fines or penalties. This shift from subjective human judgment to objective technology-driven enforcement holds the potential to minimize opportunities for bribery by providing an electronic record of traffic violations, thereby enhancing transparency and accountability in the enforcement process.

Nevertheless, the complete eradication of the role of traffic police is not without challenges and may give rise to concerns related to the employment of those currently involved in traffic enforcement. Moreover, the effective implementation of smart technology requires robust infrastructure and well-defined regulations. As such, while the integration of smart technology may offer promise in reducing police misconduct related to bribery, it requires thorough planning, regulatory frameworks, and an awareness of potential unintended consequences.

3.4.3.2 Affordable and efficient public transport

The emphasis on affordable and efficient public transport emerged as another key element of an ideal just mobility system. As expressed by Suleiman, a private vehicle user,

> A just mobility system would be most importantly, regulation of fares for matatus. That is justice.

Wanjiru, another public transport user shared a similar view stating,

> A just mobility system should be cost effective, you know, whatever time of the day you pay the same amount of money.

The high and fluctuating costs of paratransit pose a significant burden. The respondents' view on affordability, including those who use private vehicles, underscores the belief that public transport should not present a financial obstacle for any segment of the population. A just mobility system should ideally promote equity and inclusion, ensuring that everyone can afford and access reliable transportation options.

Efficiency in public transport is equally paramount. The interconnection between affordability and efficiency cannot be overlooked, as an efficient and cost-effective public transportation system can motivate more individuals to choose public transport over private vehicles. Many respondents, particularly those who use private vehicles emphasized that a scheduled and aesthetically pleasing bus system would ideally encourage them to use public transport more often especially given the rising cost of fuel that is presenting an economic burden. This shift can result in reduced congestion, lower carbon emissions, and an overall advancement of a just mobility landscape. This is however contingent on various factors, government commitment, deliberate investment in infrastructure to facilitate the seamless operation of public transport and the implementation of policies.

Overall, the findings from this research shed light on the numerous challenges prevalent in Nairobi's mobility landscape. The challenges have wide-ranging consequences that affect the daily lives of all city dwellers.

These issues encompass police misconduct that gives rise to impunity and neglect of traffic regulations, unaffordable public transportation, and unsafe and inadequate infrastructure for pedestrians and cyclists. In the current state of the mobility landscape, individuals across all socioeconomic backgrounds and choices of mobility mode are impacted. Private car users contend with traffic congestion, which leads to aggressive behaviour and lack of consideration for non-motorized users. Pedestrians and cyclists are exposed to risks of road crashes in sharing the road with motorists, due to inadequate infrastructure. Socioeconomic disparities emerge as some groups struggle to access affordable and reliable public transportation, while rampant police misconduct exacerbates the challenges within the entire mobility system.

3.5 Conclusion

This research has provided a nuanced exploration of the intricate relationship between justice and urban mobility in Nairobi, offering a unique perspective from the commuter's point of view. The concept of justice, with its multifaceted dimensions as reflected in the real-life experiences of individuals, provides profound insights from the perspective of mobility. Remarkably, the harmonious convergence between scholarly and public interpretations of justice, as observed in the context of Nairobi, suggests that the core principles of justice may not significantly differ between individuals in the global south and those in the global north, or even from the universal or scholarly perspective on justice. What distinguishes these perceptions is the influence of everyday interactions and experiences that shape which specific element of justice becomes prominent in one's consciousness. Justice, therefore, manifests as a practical, lived reality that is profoundly shaped by the social, cultural, and economic context in which individuals find themselves. This viewpoint underscores the importance of

considering context and the real-life experiences of individuals when discussing and implementing justice-related policies and initiatives especially in the domain of urban mobility.

The distinctive mobility challenges encountered in Nairobi, such as unaffordability of paratransit, instances of police misconduct, impunity regarding traffic regulations, unsafe and inadequate infrastructure, and others, vary significantly from the challenges encountered by commuters in the case of the Los Angeles Metropolitan Transit mentioned in the introduction of this article. This emphasizes that the concept of justice in urban mobility is inherently dynamic and context specific.

Regarding the linkage between justice and urban mobility, four key factors have emerged from the narratives of the city's residents. First, unaffordable public transport stands as a substantial barrier to justice in urban mobility. The high and fluctuating paratransit costs place a financial burden on the average commuter. This intensifies the economic disparities and hinders access to essential services and opportunities for many individuals, particularly those with limited financial means. Addressing this issue necessitates government intervention in either regulating fares while striking a balance between market-driven forces and the public interest or providing state-operated or state-managed public transport that is hitherto lacking.

The second key factor revolves around the pervasive issue of police misconduct and the culture of bribery, which hinders progress towards just mobility. Ambiguous regulations and legal uncertainties have created an environment where individuals resort to paying bribes as a convenient means to bypass bureaucratic obstacles and avoid time wastage. Respondents believe that implementing data-driven automated systems alongside clear traffic regulations that define offences and penalties could serve as interventions to effectively monitor and regulate traffic with efficiency and impartiality. This approach would ensure uniform treatment for all individuals, regardless of factors like social status, ethnicity, or personal connections, thereby reducing the opportunities of law enforcement officers to exploit their positions for financial gain or personal advantage.

The third significant factor is the prevalence of impunity in traffic regulations which is closely related to the issue of police misconduct. This connection is evident in the way violations often go unpunished, primarily because individuals can settle penalties with bribes. This culture of impunity empowers motorists to openly flout traffic rules, confident that they are unlikely to face consequences. As a result, road safety is compromised and the sense of injustice is exacerbated, particularly among vulnerable commuters. This behaviour generally promotes unsafe practices, contributing to a chaotic and hazardous mobility landscape.

Lastly, the absence of well-designed pedestrian pathways, dedicated cycling lanes, and other non-motorized facilities exacerbates the risks and inconveniences faced by those who rely on these modes of transport. In such an environment, injustices emerge, as these vulnerable road users face a compromised quality of life and are at an increased risk when sharing the road with motorized vehicles.

In the absence of robust enforcement and compliance with traffic regulations, the principles of fairness, safety, and accountability are compromised. The consequences are borne by individuals who adhere to the rules, as well as by the broader community, which faces heightened risks and inconveniences on the road. Addressing these challenges requires deliberate actions, including strengthening the enforcement of traffic regulations, fostering a culture of accountability, providing civic education through training of motorists on road safety as well as making the public aware of the regulations and their mobility rights.

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Chapter 4: Cycling infrastructure as a ‘solution’ to safe mobility within changing forms of governance

Dorcas Nthoki Nyamai, Sophie Schramm

TU Dortmund University

Abstract

Cycling in Nairobi is a rather rare practice, albeit one that is promoted not only by recent governance changes and infrastructure development, but also by activists. A notable outcome of a recent governance change in Nairobi has been the installation of cycling infrastructure within the central business district. The Nairobi Metropolitan Services (NMS), a temporary governing body that operated in Nairobi County within the auspices of the central government, implemented cycling infrastructure in the city’s core to essentially solve non-motorized mobility challenges in the city. This presented a particular way in which the political situation configures spatial infrastructural change. Starting from this situation, we aim to investigate how urban actors materialize mobility infrastructure projects as solutions to advancing and promoting the use of sustainable modes of mobility. We assess the way spatial infrastructure changes, specifically in Nairobi’s urban core, have been negotiated through cycling activism and at the same time disputed as inadequate in addressing cyclists’ needs. We argue that several ancillary aspects are integral to advancing cycling as a common practice in Nairobi beyond the construction of cycling lanes – namely the everyday mobility practices of residents, the industry, and the markets necessary for the uptake and operationalization of cycling in Nairobi. In so doing, we make an analytical approach to contribute to infrastructure studies that take a critical examination of urban infrastructures as a solution to improving the functions of the city.

Key words: cycling; governance; mobility; infrastructure

4.0 Introduction

One key tenet of urban studies to date is Harvey's (1985: 16) observation that the built environment is „difficult to alter“ and „often absorbent of large, lumpy investment”. This statement is certainly true specifically when comparing the built environment to other targets of capital investment. However, when considering cities of the global South and East that are currently experiencing an unprecedented building boom, be it the construction of housing estates or infrastructures, the built environment appears to be relatively easy to alter at least in comparison to other, less rapidly changing, places around the world. This is also the case for Nairobi, Kenya. Nairobi currently experiences the construction of satellite cities, shopping malls and apartment buildings as well as massive road infrastructures. The latter is to accommodate the city's increasing demand for individual automobility.

Less apparent within this frantic rush to build, but not less surprising is the recent construction of lanes dedicated exclusively to walking and cycling in the city's bustling CBD. Cycling is an uncommon practice in Nairobi. Despite some policies emphasizing the importance of cycling for sustainable urban mobility, it remains a side issue in urban policy making and investment decisions. These remain largely centred around the automobile system (NMT Policy, 2017). However, there is a growing scene of cycling activists who are trying to create the conditions for Nairobi to become a more bicycle-friendly city. We take activism to be the enthusiastic engagement of various citizen groups to advocate for inclusive urban mobility, specifically referring to the cycling activists in Nairobi that make up the Nairobi Critical Mass cycling group. Their actions shape and afford possibilities for infrastructure change through active participation in planning and lobbying for the uptake of sustainable mobility. These activists have received support in the form of newly built bicycle lanes within the city centre, from the central government body that temporarily governed Nairobi's transportation system, the Nairobi Metropolitan Services (NMS). The unprecedented change of governance took place between 2020 and 2022 when four core functions of the city were transferred from the Nairobi County government to the central government. This led to the formation of NMS, who took over responsibilities related to transport infrastructure, among other functions, in Nairobi County.

The dynamics in governance resulted in rapid development of cycling infrastructure in an arguably hardly cycling friendly city. This motivates us to ask of the political rationales and strategies of urban actors in pushing for infrastructure development as a solution to contemporary challenges of mobility, particularly, cycling in Nairobi. We focus on the strategies that NMS undertook in re-designing transport infrastructure and the role of bicycle activism in the broader transition towards sustainable urban mobility. We mobilize an urban infrastructure studies perspective that considers transformative socio-technical approach to infrastructural changes. This is driven by the understanding that other salient, and often overlooked factors facilitate the pathway to sustainable urban mobility beyond

infrastructural changes – namely, the cycling practices and perceptions of urban residents in Nairobi the bicycle industries and markets that make the bicycles accessible to the urban dwellers.

The research investigates the existing mobility situation in Nairobi, how different actors aim to change it and how far this may reflect a broader transition towards cycling becoming a common practice in Nairobi. The paper continues with an overview of the techno-politics of infrastructure change and the governance of infrastructure in Nairobi. It follows with a discussion on the formation of the NMS, its impact on re-designing Nairobi's mobility infrastructure and how far infrastructure is envisioned as a solution to challenges experienced by cyclists. The section that follows considers the role of bicycle activists as promoters of change and how they navigate the political and cultural spaces that tend to produce tensions in the advancement of cycling as a common practise. The paper concludes by proposing some interventions in the bicycle markets and industries as well as socio-cultural perceptions that are in every way salient to advancing the use of cycling in the city beyond only infrastructure.

4.1 The (techno-) politics of urban infrastructural change in Southern cities

Urban infrastructure studies have long focused on the resistance of large technological systems to change. Scholars have argued that the embeddedness of infrastructures within other infrastructures, social arrangements or technologies creates momentum of sociotechnical systems, which with increasing size become increasingly embedded and therefore „inert" (Hughes, 1987; Hommels, 2005; Leigh Star, 1999). The sociotechnical 'transitions' literature offers an explanatory framework as to how infrastructure regimes may transition from one state to another. Normally the transition is from a less desirable to a more desirable one in different levels, from the overarching landscape to the niche, a kind of safe space for inventions or innovations that may come to challenge the broader regime. These studies are helpful in that they aim to make sense of how large, embedded and path-dependent systems may undergo larger transitions. However, they are often normative, aiming to figure out what is necessary in order to achieve a transition that seems to be desirable in terms of sustainability (van Rijnsoever and Leenderste, 2020; Cohen, 2012; Geels, 2010).

Furthermore, as different scholars investigating infrastructures in Southern cities have observed, infrastructural change often does not come along in the form of larger transitions from one state to another, but rather through various small and incremental activities of people appropriating infrastructure systems in their everyday lives beyond their original design and function as intended by planners and engineers (Kirsch ,2006; Silver, 2014; Schramm and Wright-Contreras, 2017). These scholars acknowledge the dynamism of infrastructures which are subject to perpetual change by different actors beyond any pre-conceived plan. At the same time, it remains important to note that

the possibilities for changing infrastructure are not infinite but continue to depend on the existing networks and artifacts, related practices and governance arrangements (Anand, 2015; Fredericks, 2014; Schramm and Ibrahim, 2019). The various ways in which actors engage in changing infrastructures – be it through everyday manipulations or appropriations of existing infrastructures, through formal political-administrative channels and large investment, or through activism – ultimately decide about urban exclusion or inclusion. Regarding urban infrastructures in the global South, scholars have analysed how everyday manipulations of infrastructures, which, for example grant people access to networked services they have hitherto been excluded from, may function as spaces for a struggle that though not explicitly confrontational is nevertheless political (Schramm and Ibrahim, 2019). In this reading, infrastructures become techno-political, arenas for the negotiation of citizenship outside the conventional political sphere (Von Schnitzler, 2013; Fredericks, 2014). In this vein, Silver (2014) conceptualizes the ways in which people provide themselves access to basic necessities when the state fails to provide, as an act that not only relieves momentary pressures, but that extends into the future as manifesting claims for citizenships and just urban conditions. These studies have ushered insights into a range of actors and interventions that shape the urban development processes at times together with or in conflict with the state (Cirolia and Harber, 2021).

Scholars who have engaged with the debate on the governance of infrastructure in African cities point to the dynamics of the state and its continuous attempts to reform the city (Pike et al., 2019: 794; Cirolia and Harber, 2021). In relation to transport, infrastructure changes are often considered as solutions to developmental progress and economic prosperity (Lesutis, 2021). These changes may take place either through re-design of existing infrastructures or the construction of new infrastructures for greater connectivity and accessibility. Across many cities in sub-Saharan Africa promotion of motorized means of mobility through expansion of existing highways and construction of new ones is contrary to the modes of mobility that are popular across many urban dwellers, namely, walking and cycling (Sietchiping et al., 2012).

We point out that cycling (just like individual automobility) is specific from a socio-technical systems perspective, in that as a system it comprises of the infrastructure necessary for bicycles (and cars) to move in space. The cycling system, like the automobile system, furthermore, encompasses the industries and services facilitating the production and distribution of the means of transportation, that is the bicycle itself. As Dupuy (2008: 126) has pointed out in his account of the automobile system, it is a system of ”mixed private-public economies“. This means that the expansion of this system not only depends on public spatial and infrastructure planning, but also on its embeddedness in private industries that make decisions on the design, construction and marketing of the means of transportation, that is in Dupuy’s case the car. These decisions themselves are contingent on the place-

specific territories the car is to encounter and ”adapt“ (cf. Dupuy 2008). While Dupuy discusses the car as a system that we have come to depend on due to its ability to adapt any territory and that has therefore deeply impacted our lifestyles and cultures, we aim to discuss cycling as a system that has hitherto not shaped our cultures, societies and indeed spaces in any way comparable to the way the private automobile has. However, following the idea of a ”system of mixed private-public economies“, our goal is to understand cycling as a system that is politicized by government actors as well as activist groups and subject to public planning and decision-making. In a city like Nairobi, this hinges on the private industry of production and trading of the bicycle itself.

Taken as a symbol of progress and a solution to improved connectivity and accessibility transport infrastructures in the Kenyan context reflect uneven power relations. They address the transportation needs of some while excluding others, creating socio-political tensions when citizens demand inclusion in the politics of infrastructure provision (Lesitus, 2021). For our account of cycling, it is important to note that many of the actors trying to change the conditions for cycling in Nairobi are explicitly political in the sense that they engage with policymakers and the city government to negotiate and drive systematic changes thus using the ‘conventional political sphere’ rather than manipulations of infrastructure to voice their concerns and demands (cf. Von Schnitzler, 2013). Some activists furthermore link their activities around cycling to other political demands in the general systematic change of urban growth. Also, the current changes of the road infrastructures of Nairobi with the construction of bicycle lanes are politically motivated, although, as we argue below, the actors governing Nairobi’s road infrastructure follow a specific political agenda that is different from that of cycling activists.

The spatial changes in cycling infrastructure occurred within an exceptional and impermanent form of governance. The role of the NMS in materializing non-motorized transport (NMT) infrastructure projects was geared towards solving the problems experienced by cyclist and pedestrians alike, especially relating to road fatalities. In our research we assess the formation, functions and outcomes of NMS, focussing on cycling infrastructure to point out that advancing sustainable mobility in Nairobi goes beyond providing infrastructure as a solution to uptake of cycling. It rather encompasses broader aspects that include the economic markets of bicycle production and supply and dialogues with various actors, particularly, the everyday users of the infrastructure. We emphasize that focussing on these aspects affords transformative socio-technical infrastructural changes.

Our empirical study is based on qualitative interviews with NMS and Nairobi County representatives as well as cycling activists based in Nairobi. We point to the power dynamics of infrastructure governance in Nairobi and the way in which activists negotiate for infrastructural changes. We conclude by indicating that the solution to making Nairobi a bicycle-friendly city depends on the

interplay between governance, social, cultural and political structures. At the same time, we point to the need for investing in bicycle industries and markets as essential for advancing cycling as sustainable mobility.

4.3 A crucial moment? Governance and mobility infrastructure changes in Nairobi

Non-motorised mobility (NMT) has been largely disregarded in Nairobi to date, with fatal consequences. As we show in the following sections, the NMS has set out to solve this situation not least through the construction of cycling lanes.

4.3.1 The state of mobility infrastructures in Nairobi

NMT infrastructure in Nairobi is generally not embedded in the overall structure and planning of road development. Sidewalks are rarely considered a public task and duties of construction and maintenance are often taken up by residents (Mitullah and Opiyo, 2017). Prior to the recently commissioned 2020 Road design Manual, the provision of footpaths along major arterial roads was not included in the road designs. This is despite that a lot of pedestrian activity takes place along these major routes according to two studies conducted in 2017 and 2021 (Mitullah and Opiyo, 2017. Odhiambo, 2021). The development of NMT infrastructure is annexed to the existing road designs in form of footbridges for pedestrians and a roadside path for cyclists. These spaces are often appropriated for other uses, such as street vending on footbridges and offside parking on cycling lanes, making NMT use unattractive and risky. The NMS, in collaboration with the Climate Development Knowledge Network (CDKN) conducted a study on 12 busy pedestrian corridors in Nairobi. The study revealed that pedestrians preferred to cross the road at street level despite the danger from speedy traffic due to the indirectness offered by the footbridges (Odhiambo, 2021). The cyclists interviewed in our study pointed to the risk of sharing the road with speedy motorists due to the appropriation of the cycling spaces by vehicle off-street parking.

These challenges are resultant from the infrastructure design that least considers NMT users. Road infrastructure development in Kenya is primarily designed by a body of engineers who rely on a set of standards that seek to ensure efficient movement of motorized transport. These engineers have traditionally not focussed on the concerns of the majority population of Nairobi using NMT. “As an engineer, I have been trained to think of infrastructure in a technical manner which rarely includes the provision of infrastructure for non-motorized mobility. In the construction of roads, the financier of the road project often stages their own interventions and regulations that we cannot challenge, and we are forced to adapt to their structure and design” (Interview with a Civil engineer in Nairobi, 2021). Where existent, NMT infrastructure is developed without any specific design and is often annexed to

the main road. As a result, the cycling network is interrupted along many sections of the road, particularly at intersections In addition, parking infrastructure for bicycles is non-existent and rarely considered alongside the development of bicycle lanes. This lack of acknowledging the mobility options of Nairobi's majority population is fatal. "More than two million trips are made in Nairobi using only non-motorized transport. Pedestrians and cyclists are, however, the major victims of road accidents because the infrastructure has not been designed to cater for them" (Interview with the NMS representative for Transport, 2021). Pedestrian fatalities account for more than 60% of total commuter fatalities annually (Nyamai and Schramm, 2021). Cyclists account for a relatively small but growing number of commuter population. More than 55,000 trips, comprising 1.1% of the modal split are made only by cycling. However, the per capita deaths of cyclists, as a result of road accidents, are equally as high as those of pedestrians (Odhiambo, 2021).

4.3.2. Formation of NMS and resultant actions

"*Nairobi Governor hands over crucial functions of health, transport, public works and planning to the national government*" (Nyamori and Kwamboka, 2020). In March 2020, Nairobi experienced unanticipated changes in governance when the county governor transferred key functions of the county to the central government. The 'landmark agreement' between Nairobi County government and the national government led to the formation of the Nairobi metropolitan Services (NMS), a military-cum government body that was appointed by the National President and functioned under the leadership of a military general. Through a constitutional deed transfer, NMS was given the mandate to execute the transferred County functions (Orina, 2020). The NMS carried out the mandated duties for a period of two and half years and handed over the functions to the succeeding Nairobi County Governor in September 2022 (Kinyanjui, 2022).

We focus on the two-year County governance period of the NMS to evaluate the infrastructure changes that occurred within this period, particularly within transport in Nairobi. We begin by first pointing out the current structure and configuration of transport infrastructure governance in Nairobi and the position and operation of NMS within this existing structure.

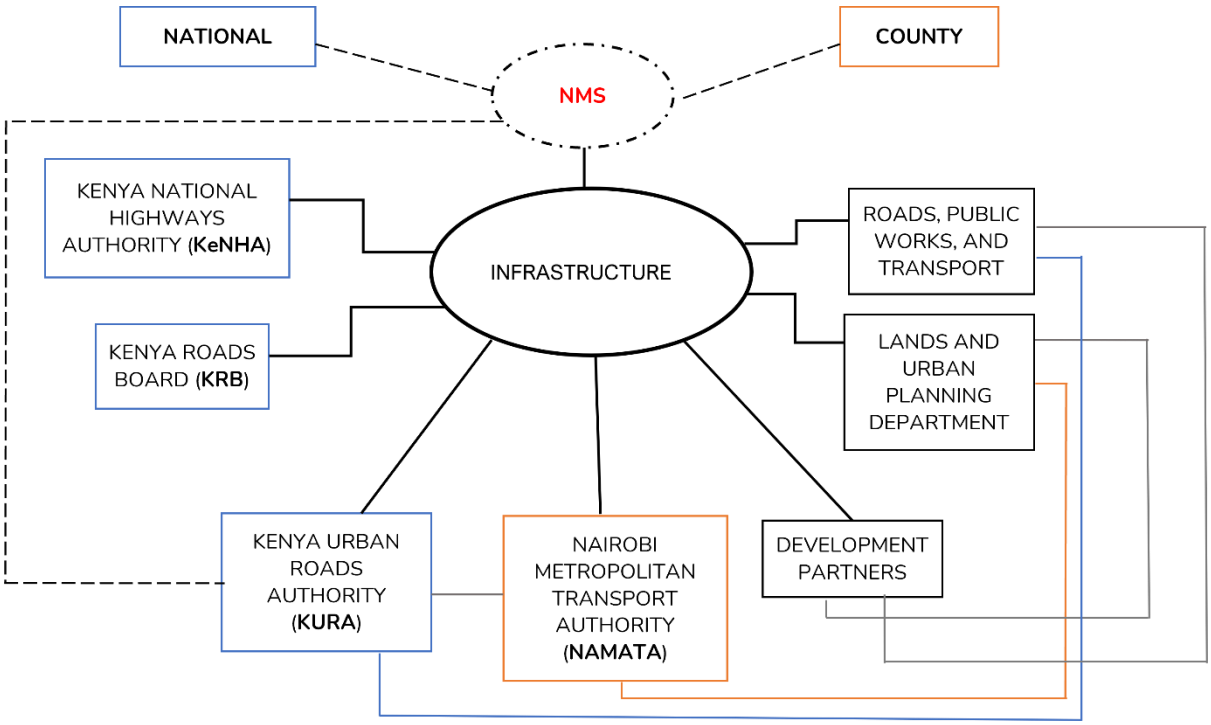

Figure 22: Institutions governing road infrastructure in Nairobi - Author's re-creation of the image from Source: Edna Odhiambo, (2020)

The governance of road infrastructure as shown in Figure 22 concerns a cluster of institutions that are enacted to plan and oversee the implementation and management of road infrastructure. At the national level, these include the Ministry of Transport, Infrastructure, Housing and Urban Development, the Ministry of Land, Public Works, Housing and Urban Development, the Kenya National Highways Authority (KeNHA), the Kenya Roads Board (KRB) and the Kenya Urban Roads Authority (KURA). The Nairobi Metropolitan Area Transport Authority (NAMATA), established in 2017, oversees the establishment of a safe and efficient public transport system at the county level.

The road classification in Kenya defines the institutions that govern specific roads. Nairobi County has a total of about 3000km of road network. Approximately 2,500km are governed by the County Government. The Kenya Urban Roads Authority (KURA) governs slightly over 400km, and the rest is under the Kenya National Highways Authority (KeNHA) who govern major highways that cut across the city linking to international borders. The transport functions that were transferred to NMS included the governance of roads that fall under both the County and National governance. "We as NMS worked closely with KURA since they also govern the roads within the areas where NMS had been given the mandate to execute the County functions" (Interview with the NMS representative for Transport, 2021).

Prior to the formation of NMS, the planning and development of cycling infrastructures have been pioneered by external development partners either through complete donor funding or through public-private partnerships (Mitullah et.al., 2017; Cirolia and Harber, 2021). For example, the

expansion of NMT infrastructure along Ngong Road – a regional road that connects Nairobi to its neighbouring Kajiado County – was partly financed through a donation by the government of Japan and partly through a public private partnership between the Kenyan government and a Chinese company. The United Nations Environmental Programme (UNEP) has also been involved in the pioneering of cycling infrastructure along certain roads in Nairobi, through its 'Share the Road Programme'.

The operational period of NMS was characterized by rapid infrastructural changes. Cycling and walking lanes were rapidly installed along several roads starting from the Nairobi Central Business District (CBD) with plans to extend to residential areas. An NMS representative considered the prioritization of NMT infrastructure as a way to improve road safety for cyclists, and hence a contribution to solving broader issues surrounding NMT in Nairobi. "The main challenge is that the infrastructure has not been designed to favour cycling. There are minimal cycling tracks in the city, making cyclists major victims of road crashes in Nairobi" (Interview with the NMS representative for Transport, 2021).

Within the period of two years, the NMS constructed several kilometres of NMT infrastructure within the CBD as shown in Figure 23. This rapid development of infrastructure, that was for a long time secondary to or completely neglected in the transportation infrastructure designs, reflects the fact that the NMS, as a central government body, have access to funding that the county government lacks. The question of the devolution[7], and the distribution of funds to county governments is key for answering the question as to whether current infrastructural changes may hint toward a broader transformation in the further development of cycling infrastructure.

[7] In 2010, the Constitution of Kenya decentralized systems of government with the objective of redistributing responsibilities, resources and power to the local level. In effect, 47 Counties were formed (Ngigi and Busolo, 2019).

Figure 23: NMT infrastructure developed in the CBD within the period of NMS governance. Source: Authors'

Tenably, the confluence of increasing pressure of activists and the creation of the NMS have together enabled these recent changes in bicycle infrastructure in Nairobi. However, whether this denotes the start of a general shift toward a more cycling friendly city or rather a single act borne out of the heat of the moment shaped by governance changes remains to be seen. The challenge lies in the intermittent infrastructure development in a system that relies on continuity for its effective functionality i.e., continuous bicycle lanes that offer access from origin to destination without interruption. Currently, the NMS infrastructure in the city centre is rarely used by cyclists as the lanes are only located in the city centre without continuity to residential areas. The use of cycling will increase only if the development aims for a continuous network that would allow for access to various neighbourhoods instead of fragmented development in single and separate locations.

4.4. Promoters of change: cycling activists and the state of bicycle markets

Cycling in a motor-centric city such as Nairobi is an activity that is determined by political mobilization and the existence and interaction between various actors. The cycling activists in Nairobi, largely constitute the Nairobi Critical Mass cycling group, as well as smaller groups that operate in various neighbourhoods. Together, they advocate for infrastructural changes in the existing urban roads and behaviour change among motorists. Through their monthly campaigns they put pressure on government actors to implement changes in cycling infrastructures and actively advocate for behaviour change from motorists. “Cycling in Nairobi can be fatal, and it is because the motorists do not respect cyclists. We encourage those who want to cycle with the critical mass group to take part during regular traffic in order to make the motorists aware that cyclists need to be respected as fellow road users” (Interview with first Cycling Activist 1, 2021).

“Through the many advocacy projects that we have carried out, more people, both in governmental authority and the civic domain are realizing the importance of supporting cycling as a mode of mobility. We do not only advocate for big infrastructural changes of brick and mortar as a symbol of development but also changes in the sociological and anthropological factors” (Interview with second Cycling Activist 2, 2021).

The development of the NMT infrastructure in Nairobi’s city centre was driven by the need for inclusive mobility infrastructure that activists have demanded increasingly fervently in the recent past. “The spatial transformations that have occurred in the city centre are in areas where campaigns of placemaking week had been held by urban activists. The first placemaking week was carried out along Muindi Mbingu street where currently, NMT infrastructure has been developed. These activities have brought together stakeholders on the conversation around public spaces and the perception on walking and cycling with the idea of developing non-motorized mobility infrastructure in the whole of Nairobi County” (Interview with a representative of Nairobi County Planning Office, 2021).

The campaign and activism for cycling aspires to promote safe infrastructure, a coherent network and bicycle parking facilities, but also advocates for the access to affordable bicycles. The cost of bicycles in Nairobi reduces their accessibility and affordability to only a few. Out of the 66 cycling activists who participated in our research, nearly all shipped their bicycles from abroad, with costs ranging on average between 30,000 and 40,000 Kenya Shillings (≈ $300 to $400 USD). This represents a high cost of bicycles for many of Nairobi´s urban poor given that thirty-six percent of the population of Nairobi live with less than $1.90 a day (Awiti et al., 2018). The existing bicycle retail shops source their bicycles from abroad. The cost of purchase of the bicycles, together with the taxes levied on the import of bicycles discourages cycling among those who are unable to afford such high costs.

This situation challenges the advancement of Nairobi as a cycling-friendly city. A handful of bicycle retailer in Nairobi make the bicycles available for those who are unable to access online markets abroad. The Baisikeli Centre is one example and hitherto the only privately operated bicycle facility located in Nairobi's CBD that provides all round facilities for cyclists i.e. bicycle repair services, secure parking of bicycles, storage and showering facilities for cyclists at a relatively affordable fee. The Baisikeli Centre was developed by a cycling activist to make both new and second-hand bicycles more accessible and to address some of the infrastructural limitations that cyclists encounter in their everyday cycling practises. They, however, are part of a group of actors in the bicycle industries and trades, that are hitherto rather small and exclusive in Nairobi.

4.5 Beyond cycling infrastructure as a solution for a cycling-friendly city

A comprehensive NMT policy that is specific to the county of Nairobi directly addresses the challenges that cyclists experience and presents a framework for action in realising a cycling friendly city. The policy embodies a core set of design principles that seek to provide safety for cyclists through a cohesive and comfortable network of cycling lanes with direct access to desired destinations (NMT Policy, 2017: 4-8). The policy highlights the inequalities of budgetary allocation for infrastructure provision pointing out that less than 2% of the annual transport budget is allocated to NMT infrastructure (NMT Policy 2017:7). This presents a particular situation in which financial constraints hinder the advancement of NMT infrastructure development. At the same time, it reflects the subordination of NMT with respect to motorized mobility. An increase of the budget share allocated to NMT infrastructure would clearly indicate a broader shift toward these hitherto neglected means of mobility. Yet, such an increase has not been the subject of political debate so far despite that lobbying for NMT infrastructure has been subject of wider media coverage highlighting the social, economic and safety challenges of cycling in Nairobi (Wanjohi, 2020). Various institutions have also attempted to initiate dialogues between government officials in support of inter-agency collaboration towards improved NMT development (Odhiambo, 2022). The use of mass media and inter-agency dialogues is helpful, but it has to be continuous to be effective in having the political actors understand the benefit and necessity for NMT development.

Advancing a cycling friendly city is interlinked with social, economic and cultural structures that are rarely captured in policy making. Some people consider cycling as a mode of mobility for the poor. Considering Nairobi, this view of cycling is contradictory, visible particularly in the Critical Mass group. Besides being composed of largely middle-class cyclists, the special gear – helmets, athletic clothes, sports shoes – and trendy bicycles that line the streets during the monthly campaigns, dismiss cycling as a mode of mobility for the poor. This 'middle-class activism' can help to reverse these cultural

notions that index cycling with poverty, however, with activism promoting cycling as an everyday mode of mobility that does not require special gear as well as advocating for more affordable bicycles.

Among other people, cycling in considered unethical for women. The critical mass group, led by a female middle-class activist and with a high registration of female cyclists, advocates for the uptake of cycling among women. “Cycling is considered a taboo among women in some communities but I and my fellow female activists within the critical mass intentionally challenge these beliefs. At the same time, educational programs in schools on the benefits of cycling presents another way of creating positive perceptions about cycling at a young age” (Interview with cycling activist 3, 2021).

While providing cycling infrastructure is crucial for advancing the city towards a more cycling friendly city the consideration of bicycle industries and markets are equally important. We point out that the high cost of bicycles poses the probability of cycling becoming an elitist mode of mobility but can also be seen as an intervention point for accessing affordable bicycles. The imposition of zero taxes on imported bicycles would be a novel way of reducing the purchase costs of bicycles, however, of fundamental importance, is the provision of a local industry for manufacturing good bicycles. The local availability would create more employment opportunities and a market for locally produced bicycles. In various global cities, local authorities have collaborated with business ventures to provide affordable bicycle sharing that has enabled easy access to bicycles without ownership (Odhiambo, 2021). This model could be encouraged in Nairobi for easier access of bicycles; however, safety and security measures need to be put in place. Establishing finance options such as credit facilities that can encourage the uptake of cycling among commuters would be an additional way of making the cost of bicycle purchase affordable. In the same way that credit facilities for purchasing personal vehicles have been provided to employees in several employment firms in Nairobi, credit for purchase of electric bicycles for example can create an incentive for cycling. Such measures have already realized a large uptake of motorcycle use as a mode of transport in the country, since the lifting of taxes imposed on the import of motorcycles below 250cc. The access to credit facilities through microfinance has also increased acquisition of motorcycles and thus created employment for many youths (Ruathdel, 2020).

4.6 Conclusion

Nairobi has seen infrastructural changes toward a more bicycle-friendly city within the two-year governance period of the NMS. Several roads have been expanded to accommodate cycling lanes as a way of addressing the safety challenges for cyclists in Nairobi. We argue that bicycle activism has played a significant role in fostering infrastructure change to accommodate cycling and that recent governance changes with the formation of the NMS have created the momentum to implement the changes that activists have been promoting. However, at the same time, the infrastructure changes

implemented so far are not a sufficient solution when it comes to a broader shift toward cycling. This is because firstly, cycling is not considered in its entirety as a system that requires several factors to be considered in its development – just as with road infrastructure and motorized transport. As earlier mentioned with reference to Dupuy's (2008) observation of the automobile system, cycling in the city is a system that would effectively function when a.) continuous infrastructure networks are developed, when b.) local industries and markets are supported to make bicycles more affordable and when c.) considerably more people consider cycling as an appropriate and practical means of mobility for everyone. The latter condition is a broader social change, but we argue that if the first two conditions are met, this change has a chance to arise. This requires great effort and once again makes clear that cycling paths alone are not a solution but merely a façade that gives the appearance of progress without actually creating a safe cycling environment. Creating a bicycle friendly city will require a holistic approach that includes awareness through public education campaigns, traffic laws and regulations that prioritize cycling safety, bicycle parking facilities, access to affordable bicycles and other factors that promote cycling as a viable mode of mobility. The implementation however depends on collaboration between different actors and on broader political negotiations around budgetary allocations in the transport sector. The actions taken by the NMS hint towards the goodwill of the government, however, these measures alone are inadequate to address the underlying challenges of cycling in Nairobi. Concrete steps that holistically take into account the aforementioned conditions are necessary for a sustainable cycling friendly city.

In terms of the links to current debates in infrastructure studies, some scholars have argued that dynamics of infrastructure change rather happen through everyday appropriation such as tinkering with or modifying infrastructure networks beyond their planned purpose by a multitude of actors than larger transformations. In our case, the practices we see in relation to cycling are less a kind of cumulation of small everyday interventions by people trying to fulfil a basic need. Rather, they are concerted actions by activists who are mostly from the middle class and who have - within the current dynamic of governance change been able to influence formal infrastructure policies, planning and construction to some degree. Thus, what we observe in terms of cycling adds nuance to current research that understands technological interventions, their subversions and reinventions as a core political struggle "outside the conventional political sphere" (von Schnitzler, 2013) in that cyclists in Nairobi make intense use of the conventional political sphere in order to achieve infrastructural change.

Ultimately, considering the question of how far the provision of cycling infrastructure is a potential solution to Nairobi's urban mobility challenges, the provision of cycling infrastructure by the NMS may represent a move towards sustainable mobility in Nairobi. However, infrastructure alone is insufficient.

The transient form of governance, namely NMS, presents uncertainties in achieving complementarity between policy formulation and policy implementation. The success of NMS can potentially be linked to the supply of targeted financial resources towards achievement within specific sectors. Although Kenya is devolved with various counties, the central government still plays a prominent role particularly with support of financial resources. We postulate that the autonomy of counties, coupled with dedicated resources for infrastructure development and the decisions on the markets of bicycle production for accessibility at the county level presents a starting point towards the process of building a cycling city.

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Chapter 5: Assessing equity in mobility through shared risks and misfortunes

Dorcas Nthoki Nyamai

TU Dortmund University

Abstract

When relating mobility to justice and/or equity, research often centre on equitable distribution of resources encompassing material, spatial and financial resources. However, the inherent spatial differences between various localities means that resources cluster in some areas more than others, resulting in spatial inequalities. Assessing justice, therefore goes beyond merely considering fair distribution of resources and necessitates a focus on risks and misfortunes that individuals are exposed to and how these are distributed within society. This research delves into the shared risks and misfortunes inherent in daily urban travel, revealing the underlying injustices that some groups of commuters are exposed to more than others. Using road accidents data between 2015 and 2018, the research investigates the risks in mobility using a four-dimension network that encompasses spatial, modal, individual and temporal dimensions. The findings highlight the reality that pedestrians are exposed to higher risks of fatal road crashes annually. These risks exhibit spatial concentration along specific transportation corridors within neighbourhoods, with a discernible gender disparity, wherein more working-class men than women are exposed to fatal risks. The tragic misfortune of these road crashes is the loss of breadwinners or key contributors to their families, often leading to deeper poverty for the affected households. This disconcerting revelation emphasizes the imperative to address pedestrian safety as an issue of justice within Nairobi's urban mobility landscape.

Key words: mobility, justice, risks, misfortunes, pedestrians

5.0 Introduction

Mobility is an activity that is riddled with uncertainties that can derive from potential system failures, human behaviour that may result in accidents and road crashes, unpredictable weather conditions, and disruptions such as those induced by strikes. These uncertainties are present in cities with efficient mobility systems as well as those which lack well-functioning mobility systems. Planning for mobility is therefore a process that requires adaptive strategies to enhance the reliability and safety of mobility options. Additionally, it is crucial to understand the diverse individual mobility behaviour in order to mitigate potential risks.

Some modes of mobility are exposed to higher risks than others, with walking and cycling being particularly vulnerable. Unlike automobile users who have the advantage of advanced safety features such as airbags, seat belts and obstacle-detecting sensors, walking and cycling heavily depend on the design of infrastructure for safety. This situation raises concerns about equity in mobility, as inadequate infrastructure places a disproportionate burden of risk on specific segments of the population who rely on walking and cycling.

The concept of risk has been a subject of scientific exploration over the past few decades (Aven, 2016). The United Nations Office for Disaster Risk Reduction (UNDRR) defines risk as “the probability of an outcome having a negative effect on people, systems or assets”. According to the Oxford Dictionary, risk is defined as “the possibility of something bad happening at some time in the future; or a situation that could be dangerous or have a bad result”. Risk is therefore inherently associated with adverse repercussions for individuals. In the context of urban mobility, the risk posed by road crashes results leads to unfavourable outcomes capable of resulting in loss of lives and economic misfortunes.

Justice in the context of urban mobility emphasizes the importance of prioritizing the mode of mobility used by the least privileged (Lee et al., 2017; Martens et al., 2012; Nyamai and Schramm, 2023). Walking is a common choice of mobility among the poor in numerous African cities. In Nairobi, for example, a staggering 96% of school-going children in settlements primarily travel on foot (Salon and Gulyani, 2019). Additionally, walking constitutes more than 2.2 million daily trips across Nairobi city as a whole, making it the most prevalent mode of mobility (Odhiambo, 2021). Despite its popularity, the safety of pedestrians is a pressing concern, with road crash records consistently highlighting pedestrians as the primary victims each year. This situation is largely attributed to infrastructure inadequacies and the undisciplined behaviour of motorists (Nyamai, 2022; Odhiambo, 2021). Pedestrians in Nairobi predominantly belong to low-income groups, where walking is not merely a choice but an obligation due to affordability constraints. Regrettably, the tragic consequences of road crashes often involve the loss of breadwinners or key contributors to the family income, exacerbating

poverty in affected households. These distressing outcomes underscore the urgent need to address mobility risks, especially among pedestrians, as a matter of justice.

Applying a comprehensive four-dimensional framework encompassing spatial, individual, modal and temporal dimensions, this study adopts a risk-based approach to investigate road crash risks and provide an empirical perspective on pedestrian safety within in Nairobi city. Building on the example by Nyamai and Schramm (2023) in their exploration of accessibility and spatial justice in Nairobi, this research, as illustrated in Figure 24, posits that individuals, regardless of their chosen mode of mobility, face varying levels of risks and misfortunes that manifest spatially and recurrently over time.

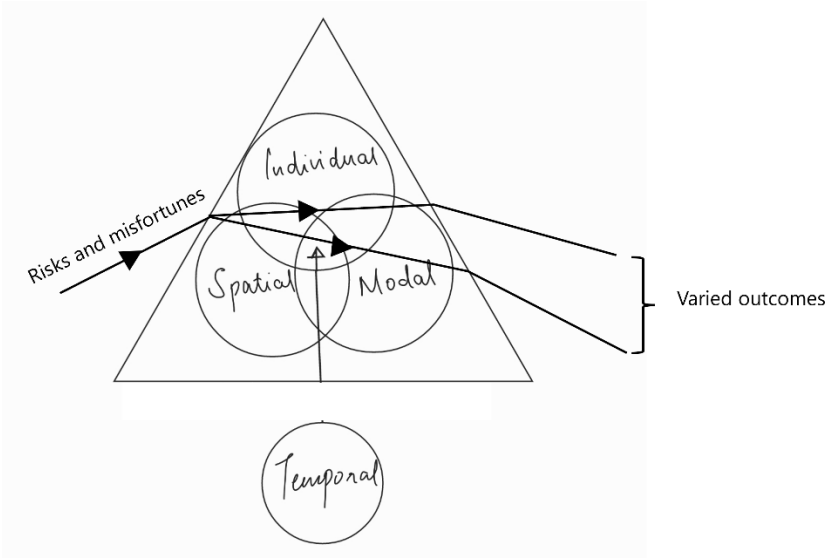

Figure 24: Framework for assessing risks and misfortunes in urban mobility. Source: Authors' modification of the framework by Nyamai and Schramm (2022).

The spatial dimension in this study focusses on the distribution of risks along transportation corridors in Nairobi to asses areas where risks of road crashes among pedestrians are spatially concentrated. The individual dimension and modal dimensions are interlinked as walking is a mode of mobility that actively engages the individual. Furthermore, given that walking often arises from financial constraints, it is closely tied to the individual's affordability. Within the individual dimension, the research further looks into aspects of gender and age of the pedestrian victims involved in road crashes. The temporal dimension is associated the variation of activities that result to risks being more prevalent at certain times of the day and the week than others. The interaction of these dimensions shapes the approach to understand how risks and misfortunes associated with active travel manifest and persist over time. By addressing risks at multiple levels and dimensions, the findings from this study offer valuable insights in identifying specific areas that would require intervention. They also provide a foundation for designing targeted measures aimed at improving pedestrian safety and enhancing equity within Nairobi's mobility landscape.

Two issues are pertinent to this research. Firstly, that pedestrians are exposed to the largest share of risks and misfortunes in their daily travel which results in an inequitable distribution of the risks. Secondly, the risks manifest spatially and can be mitigated by identifying areas where they are mostly concentrated.

5.2 Literature Review

Justice in relation to mobility emphasizes the crucial role of ensuring equitable distribution of resources. These include material, spatial, environmental, and financial resources, as noted by researchers such as Gössling (2016), Guzman et al. (2017), Kang (2015), Martens (2016), Sheller (2018) and Soja (2010). Martens et.al. (2012) particularly emphasize on transport being a social good that is subject to distribution. However, as argued by Soja (2010), geographical disparities, both within and between cities, result in certain services and opportunities clustering more heavily in specific areas. Mobility, therefore, becomes an essential prerequisite for individuals to access the unevenly distributed resources that can enhance their livelihoods. This means that justice in mobility goes beyond advocating for the equitable distribution of resources; it necessitates an examination of the risks and misfortunes that individuals are exposed to, as these factors can serve as impediments for access to the necessary resources.

Given that justice typically entails prioritizing the needs of the least advantaged in resource allocation, it becomes crucial to focus on the distribution of risks and misfortunes associated with the mobility of the least fortunate. Disparities in the provision of adequate infrastructure particularly for those with low economic means contribute significantly to the continuity of social and spatial inequalities and acts as a substantial barrier to inclusion (Cass et. al 2005; Guzman et al. 2017).

In many cities across sub-Saharan Africa, walking is primarily determined by economic constraints. This implies that a significant portion of pedestrians belong to a less fortunate group, and their mobility needs should be given priority. In Nairobi specifically, walking constitutes the largest share of trips compared to other large cities in the region. More than 80% of all trips in Nairobi involve walking as either primary or secondary mode of travel (Avner & Lall, 2016). The infrastructure, however, is not designed to accommodate this vast majority. An assessment conducted by the Climate Data Knowledge Network (CDKN), along 12 busy pedestrian corridors in Nairobi revealed the infrastructure deficits that pedestrians face in their daily travel. All corridors were found to be unsuitable for people with disabilities. They lacked sufficient pedestrian crossings and had inadequate footpaths, including design shortcomings where footpaths were present. Furthermore, with the exception of one corridor, none of them had protected and separated lanes for pedestrians (Odhiambo, 2021). As a result, pedestrians constitute the highest number of road crash fatalities each year, posing a heightened risks

to these users more than any other road user, necessitating the evaluation of justice in relation to the share of risks among pedestrians in Nairobi.

The domain of risk generally revolves around comprehending the risks and exploring how they can be evaluated and navigated (Aven, 2015). It is defined by the consequences an activity may have on something valuable to humans (Ibid, 2015). In relation to mobility, risk is closely linked to the resilience and robustness of transportation infrastructure networks (Drovak et.al., 2020; Wan et.al., 2017) or the evaluation of risks in large transport infrastructure investments. According to Jenelius et.al., (2020), risk in relation to transportation networks encompasses a scenario involving an unwanted chain of events, including the probability of recurrence and the resulting damage due to lack of resilience. This definition adopts a system approach, where interconnected components work together to achieve common objectives or functions. In such a scenario, functionality of the system is enhanced to mitigate potential threats and uncertainties (Batty and Marshall, 2012).

These research however predominantly remain at a meso level and barely engage directly with the end-user. Yiannakoulias et.al., (2012) have, however, explored risks associated with non-motorized transportation, specifically focussing on collision risks among cyclists. Their study employs a range of metrics, including collision frequencies, collisions per capita, collision rates per cyclist, and collision rates per distance travelled, to comprehensively analyse the geographic variability of collision risks for cyclists. Through these evaluations, they present a nuanced understanding of the distribution and intensity of collision risks among cyclists in various spatial localities. This research draws inspiration from the approach taken by Yiannakoulias et.al., (2011) and adapts it to the context of walking in order to study road crash risks among pedestrians and their spatial distribution.

5.3 Methodology

5.3.1 Data

To analyse the road crash risks among pedestrians, the research used a database maintained by the National Transport and Safety Authority of Kenya. The database contains information on the number, age, and gender of victims involved in road crashes, the location of the crash, the cause of the crash, and the time and day the crash occurred. The cause of the crash was excluded from the analysis due to ambiguities in the data. The available data spans from 2015 to 2018 at a detailed level. Unfortunately, no data is available for the years 2019 to 2021. For the year 2022, the available data only consists of the count of road crashes per mode of mobility and lacks the detailed variables mentioned above.

The database for the mobility corridors was obtained from the County of Nairobi Planning Office, specifically generated for the development of the 2014 Nairobi Integrated Urban Master Plan. The shapefiles were used to spatially illustrate the corridors where pedestrian crashes are most prevalent. This spatial representation is based on statistical results derived from the generalized linear model of road crash data.

The road network in Kenya is categorized by the Kenya Roads Board according to hierarchy of connectivity between international, regional and local borders. Class A corridors connect international boundaries, Class B corridors link various counties and Class C are primary feeder roads that link to Classes A and B and so on. Class M represents the smallest unit in residential neighbourhoods. The analysis of the data encompassed all road classifications, considering that pedestrians are distributed along all the corridors including Class A highways.

5.3.2 Method

The study used the four-dimensional framework to carry out the analysis of road crash risks among pedestrians. The analysis first begun by looking into the statistics of road crash victims to establish the primary victims of road crashes each year including a recent observation of the available 2022 data as shown in Figure 25.

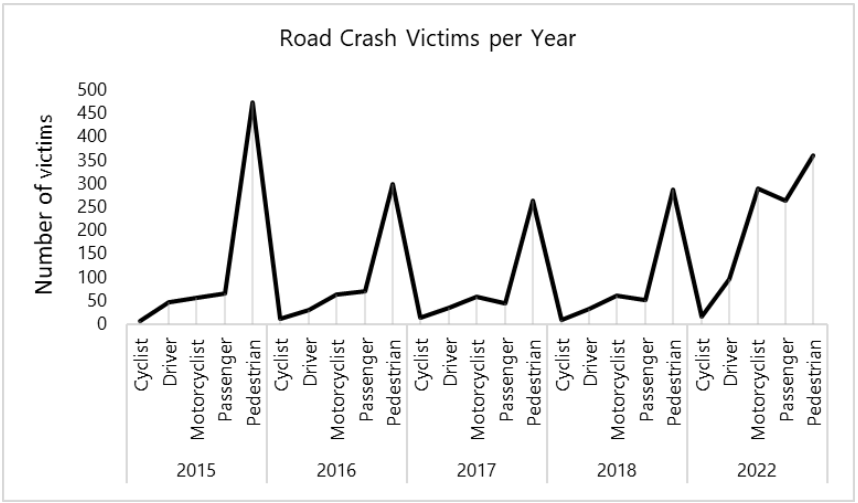

Figure 25: Road crash victims per year in Nairobi according to NTSA database

Having established that pedestrians as the primary victims of road crashes the data was filtered to include only pedestrians and collated into one database for the years 2015 to 2018. As mentioned, the year 2022 was excluded due to the unavailability of detailed data as that of 2015 to 2018.

The research applied a Poisson regression model to find out which indicators were predicted to have a statistically significant effect on the count of road crashes.

$$\log(\lambda) = \beta 0 + \beta 1 x \ldots n$$

where λ represents the response variable denoted by the observed crash count for the given predictor variables x…n, listed in Table 5.

Variable	Category	Dimension
Response Variable:	Count of road crashes (2015 to 2018) N=1322	
Predictor Variables:		
Gender	Male	Individual
	Female	
Age	5 to 15 years	
	16 to 25 years	
	26 to 55 years	Individual
	Over 55 years	
Time of day	Morning (4am -11am)	Temporal
	Afternoon (12pm – 5pm)	
	Evening (6pm - 9pm)	
	Night (10pm -11pm)	
Day of the week	Weekday (Monday – Friday)	Temporal
	Weekend (Saturday – Sunday)	
Year	2015	Temporal
	2016	
	2017	
	2018	
Corridor	Class A	Spatial
	Class B	
	Class C	
	Class D	
	Class E	
	Classes (F-M)	

Table 5: Response and predictor variables

The statistical analysis better represents the true variation in road crash risks than results based simply on values obtained from the overall crash data. In order to visualize the spatial distribution of the pedestrian risks, the statistical findings from the corridor indicators were used to develop spatial maps using ArcGIS to show risk-prone areas where pedestrian crash risks are most prevalent. The map was developed based on the road classification mentioned in the data section.

5.4 Findings and Discussion

The analysis of four years road crash data from 2015 to 2018 revealed compelling insights into the vulnerability of pedestrians in Nairobi. The results reveal a statistically significant impact of road crash

risks across all the indicators with some variations in various subcategories as shown in Table 6. The incident rate ratio as opposed to the logged coefficient results were preferred in reporting the results.

	Incidence Rate Ratio	[95% conf.	interval]
Gender			
Male	1.039228***	1.031697	1.046814
Age			
15 to 25 years	.9965434	.9851432	1.008075
26 to 55 years	1.019008***	1.008582	1.029543
Above 55 years	.9928645	.9802827	1.005608
Day of the week			
weekend	1.028112**	1.022387	1.03387
Time of Day			
Afternoon (12pm to 5pm)	1.008075*	1.00037	1.015839
Evening (6pm to 9pm)	1.00024	.9935501	1.006976
Night (10pm to 12am)	.9969034	.9882931	1.005589
Years			
2016	2.787086***	2.761668	2.812739
2017	4.260314***	4.224251	4.296684
2018	5.537513***	5.494145	5.581223
Corridors			
Class B	1.185087***	1.175581	1.194671
Class C	.9190803***	.9115092	.9267142
Class D	1.270236***	1.259635	1.280927
Class E	1.394976***	1.382019	1.408054
Classes F to M	1.372697***	1.358267	1.38728
_cons 275.0043		271.2998	278.7593

Table 6: Poisson statistical regression results of the count of accidents

5.4.1 Individual/modal dimension

The analysis reveals a significant gender disparity in road crash risks. Male pedestrians face a 4% higher likelihood of being involved in a road crash compared to females (IRR=1.039 p>|z|=0.000). It is crucial to clarify that this observation does not align with the assumption that men belonging to low-income groups, in general, travel more than women. Rather, the mobility of low-income women tends to be confined within specific localities. This was found in a study by Salon and Gulyani (2010) which identified significant differences in the travel behaviour between men and women in various settlements in Nairobi. More men than women were likely to leave the settlement to access jobs, primarily travelling on foot, while women were more inclined to stay within the settlement for work. Moreover, occupational standards in Kenya, as highlighted by Wamuthenya (2010), indicate that more men than women are employed in both the formal and informal labour markets. This suggests that men, on average may be employed in sectors or engage in activities that require more frequent movement, exposing them to higher traffic volumes and escalating the likelihood of being involved in road crashes. Figure 26 visually reinforces this finding, illustrating that more men than women are exposed to road crashes with variations observed across different age groups.

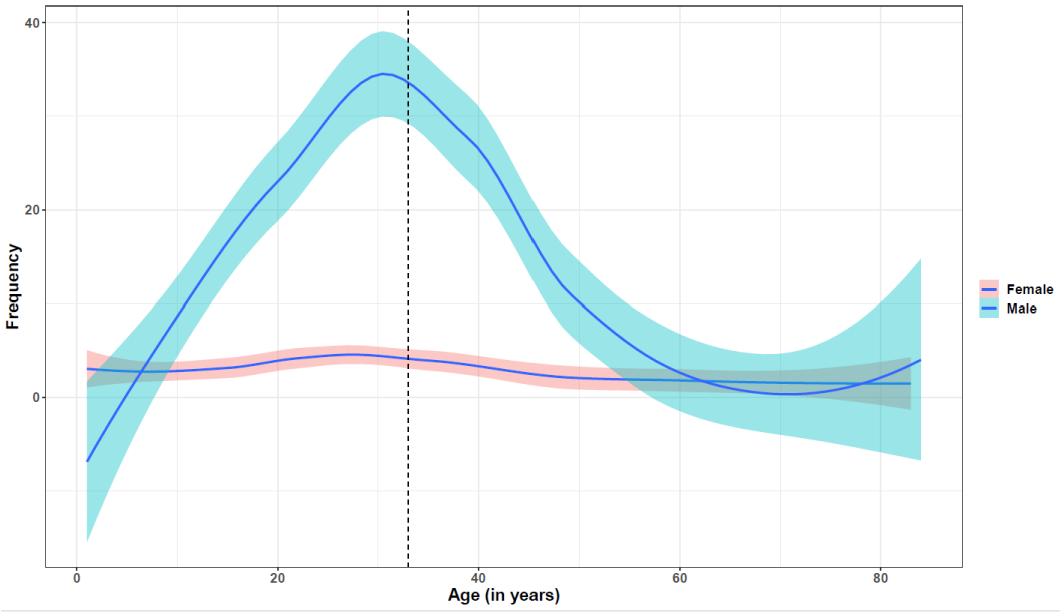

Figure 26: Demographic of road crashes among pedestrians. Men are exposed to higher risks of road crashes

This aligns with the findings in Table 6 that indicates significant exposure to road crash risks for the age group between 26 and 55 years. Pedestrians in this age group are predicted to be 1.02 times (IRR=1.019 p>|z|=0.000) more likely to be involved in a crash compared to other age groups. The statistical results imply that there are notably fewer crashes for age groups below 26 years and above 55 years with no significant impact. This does not imply that these age groups are entirely free from road crash risks. Rather, the emphasis here is that, given the prevalence of walking as a mode of

commute among low-income groups actively engaged in or seeking employment, the age group between 26 and 55 years represents a working age group that are more exposed to risks relative to other age groups.

These findings reveal that most working age men are exposed to higher risks and poses a disconcerting outcome when related to misfortunes. The implications of these crashes extend far beyond the immediate impact on the individual and resonate deeply with social and economic misfortunes. This is because a key contributor to the household income is abruptly cut off, leaving already impoverished families grappling with the harsh realities of financial instability. The cycle of poverty intensifies, and the most vulnerable members of the society are subjected not only to heightened risks on the road but also the enduring consequences of economic misfortunes. The persistent neglect of the mode of provision of safe infrastructure for the mode of mobility used by the vulnerable groups further widens the inequality gap. Addressing the needs of the most vulnerable should inherently involve efforts to reduce the risks associated with walking as a mode of commute in the pursuit of equity and justice.

5.4.2 Temporal dimension

It can be observed in Table 6 that the day of the week significantly influences the occurrence of road crashes. On weekends, the likelihood of crashes taking place on a weekend is 3% higher (IRR=1.028 p>|z| =0.000) than on a weekday. The increase can be attributed to the upsurge in leisure activities, social gatherings and events that mainly take place over the weekend. This translates to heightened traffic volumes and an increased likelihood of road crashes. In addition, the higher incidence of alcohol intake during weekend social gatherings poses an additional danger, when driving under the influence of alcohol becomes more prevalent.

Regarding the time of day, it can be seen in Table 6 indicates a significantly higher risk of road crashes between 12pm and 5pm than at any other time of day (IRR=1.008 p>|z|=0.000). This can be attributed to the increase in pedestrian activity at this time of day. In a study by the International Labour Organization (ILO, 2020) travel behaviour among informally employed individuals, walking as a mode of mobility is prevalent, given that this group, characterized by financial instability, is less likely to afford a vehicle. Informal employment, marked by high activity and lacking fixed work hours typical of formal workplaces, leads to a more dispersed and varied commuting pattern. As a result, pedestrians may be on the move throughout the day, increasing the likelihood of encounters with vehicular traffic in the afternoon rush hour.

After accounting for variations in road crash incidences over the years, statistical analysis revealed that each year from 2015 to 2018 exhibited significant rising trend of road crash among pedestrians. The

chances of road crashes were most pronounced in 2018, being 5.54 times (IRR=5.537 p>|z| =0.000) higher than in 2015. This suggests a concerning escalation in the risks of road crashes over the examined period.

The continuous rise in predicted count of road crashes over the studied years, peaking in 2018, signals gaps in policy implementation and broader systemic issues that demand a justice-oriented perspective. Despite the introduction of a non-motorized transport policy in Nairobi in 2017, which called for increased funding for walking and cycling infrastructure, challenges in safe mobility within these modes persist. Efforts by the Nairobi Metropolitan Services (NMS) to develop infrastructure for pedestrians and cyclists have not entirely mitigated the risks associated with walking, which remain significantly high at the neighbourhood level as is illustrated in the spatial dimension.

Addressing these challenges requires a steadfast commitment to justice in the distribution of resources and the implementation of policies aimed at mitigating pedestrian risks. Equity considerations should guide the allocation of funds and the implementation of measures to ensure that the risks associated with road crashes are not disproportionately borne by a specific group.

5.4.3 Spatial dimension

The spatial analysis of road crash incidences revealed a statistically significant outcome across all road classifications, highlighting distinct patterns in the distribution of crashes. Notably, a higher prevalence of road crashes was observed along roads in neighbourhood areas. There is a 39% chance (IRR=1.394 p>|z| =0.000) of crashes taking place along Class E corridors than Class A corridors. Similarly, Classes F to M (IRR=1.372 p>|z| =0.000) demonstrate a 37% higher likelihood of road crash incidences. Neighbourhood roads often have higher pedestrian densities due to the density of residential areas, school and local businesses. This implies that neighbourhood corridors may lack dedicated pedestrian infrastructure such as sidewalks, crossings and traffic-calming measures, exposing then to higher risks. These findings suggest a pressing need for targeted interventions at the neighbourhood level.

To further illustrate these spatial dynamics, the research conducted a detailed spatial analysis using ArcGIS as shown in Figure 27 to highlight the specific corridors where most road crashes occur. This granular examination is crucial for identifying high-risk areas and directing resources and intervention effectively to enhance pedestrian safety along these corridors. The thicker lines represent areas where pedestrian accidents have mainly occurred across all the research years.

Figure 27: Spatial distribution of road crash risks along various mobility corridors.

The spatial distribution of the risks was then modelled for each year under study and there were little to no variations in the observed corridors, indicating a spatial recurrence of road crashes.

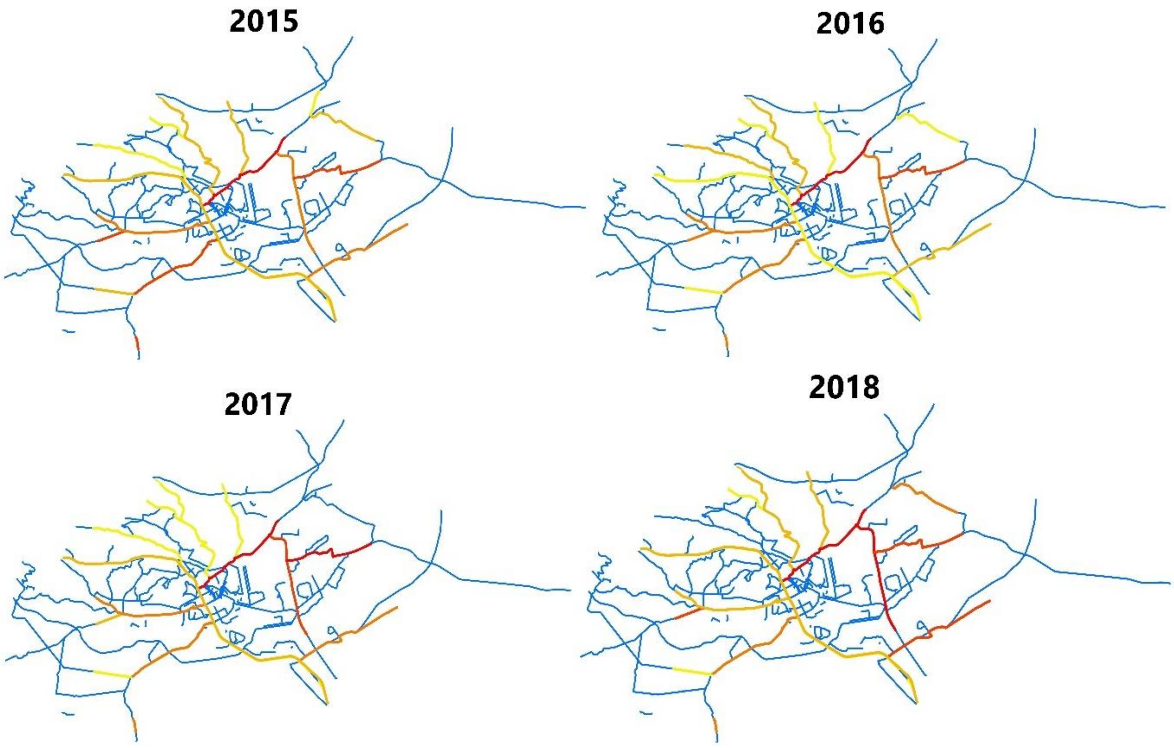

Figure 28: Pedestrians and cyclists' crash prone corridors. Source: Author's using accidents recorded data from the National Transport and Safety Authority of Kenya

In summary, the research reveals distinct outcomes within the various dimensions. Males and individuals aged 25 and 55 face a disproportionate exposed to higher road crash risks. This gender and age-related vulnerability emphasizes the necessity for targeted interventions to enhance road safety and mitigate the disparities in risk exposure among specific demographic groups. From an equity perspective, addressing these disparities becomes imperative to break the cycle of poverty and prevent the perpetuation of economic inequalities particularly when the working men in low-income groups are exposed to fatal risks. Within the temporal dimension, the escalating significance of road crash risks across the consecutive years emphasizes the systemic issues that demand attention. In addition, weekends and afternoons necessitate the need for heightened vigilance and pedestrian safety measures. In the spatial dimension, the findings highlights a consistent pattern in road crash risks along specific mobility corridors, with minimal variations observed across the years. This underscores the persistence of risks in these specific areas, suggesting the importance of understanding and addressing the unique challenges associated with these mobility routes to achieve long-term improvements in pedestrian road safety.

5.5 Conclusion

This study has attempted to comprehensively evaluate the risks linked to pedestrian mobility in Nairobi, employing a framework that considers individual, modal, temporal, and spatial dimensions. The risks associated with road crashes related to walking as a mode of mobility indicate a disproportionate distribution across gender, age, time, and space. To cultivate a safer and more equitable mobility landscape, it becomes imperative to address these disparities through normative efforts.

Within the spatial dimension, this necessitates the implementation of safety measures on neighbourhood roads. Such measures may encompass initiatives such as reducing speeds within residential areas as well as pedestrian crossings, which mainly lack at the neighbourhood level.

In the temporal dimensions, it is apparent that most risks are experienced during the weekends and in the afternoon hours. This necessitates enhanced traffic enforcement measures during weekends. This may include increased police presence especially for checks in driving under the influence of alcohol and more strict enforcement of speed limits

In the individual and modal dimensions, it becomes evident that road fatalities, predominantly affecting men, give rise to significant misfortunes that impact already vulnerable groups. This stems from the fact that non-motorized mobility often takes a backseat in the planning for mobility within Nairobi. As outlined in the 2017 Nairobi non-motorized transport policy, less than 2% of the transport

budget is allocated to enhancing non-motorized mobility, despite it being the most prevalent mode of transportation. Prioritizing pedestrian safety, therefore, requires a deliberate effort to elevate non-motorized mobility as a core component of equitable urban planning and to integrate non-motorized infrastructure in the development of road infrastructure. Addressing these specific risks associated with walking as a mode of commute holds the potential to disrupt the cycle of poverty, prevent economic disparities, and contribute substantially to a just and inclusive urban mobility landscape in Nairobi.

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6. Conclusion and Recommendations

This research has examined the interlinkage between mobility and spatial justice within a comprehensive four-dimensional framework. By studying the spatial planning of Nairobi the development and distribution of resources, the diversity in modal choice, the individual experiences of commuters and the temporal evolution of mobility dynamics, the research has presented a holistic understanding of spatial justice in urban mobility in a city facing rapid urbanization together with a youthful population.

6.1 Spatial dimension

Within the spatial dimension, I have assessed the trajectory of Nairobi's growth, considering both the development of infrastructure, the strategic location and spatial distribution of resources and the city's expanding residential areas. One of the key findings is that the monocentric development of Nairobi produces numerous disadvantages for its residents. The Central Business District (CBD) serves as a nucleus for various services, opportunities as well as public transit interchanges. However, the sprawling residential areas, extending over 30km from the CBD, introduce a discrepancy in the distribution of essential services and opportunities. Moreover, the CBD, functioning as a central conduit in linking other neighbourhoods, inadvertently leads to longer journeys for those attempting to circumvent the city centre. The overreliance on the CBD as the singular nexus for both transportation interchanges and access to vital resources manifests the inequitable distribution of resources. Consequently, this produces spatial injustices experienced by a significant portion of the city's inhabitants.

Recommendation

In essence, addressing spatial injustices within the spatial dimension necessitates a holistic strategy that reimagines Nairobi's urban space. Central to this is reducing the overreliance on the city centre. Distributing essential services and opportunities closer to residential areas would foster a more equitable spatial development of the city. This can be realized by strategically decentralizing public transit hubs to regions with higher population densities. This approach would not only provide alternatives for public transit users to navigate the city more efficiently but also holds the potential to enhance attractiveness of areas surrounding these transportation hubs. The increased foot traffic and connectivity has the potential to spur localized economic development, leading to growth of businesses, services, and amenities. This in turn would contribute to the creation of vibrant spaces and enhanced quality of life.

The identified strategic locations for transit-oriented development in the network analysis presented in Chapter 1 uncover a prospect for establishing self-sustaining urban spaces within the city's most densely populated areas. Specifically, the areas of surrounding Kariobangi Roundabout and Mutindwa in the eastern part of the city are not only characterized by their high population density but also serve as pivotal connectors to various destinations in the public transit network. They present a budding chance for transit-oriented development, where the strategic clustering of services and opportunities could transform these areas.

The area surrounding Nairobi Hospital also presents prospects for transit-oriented development. By capitalizing on the concentration of government services such as the National Health Insurance Fund, the National Social Security Fund, several Ministerial offices, educational institutions such as the public library and Daystar University, and healthcare facilities such as the Kenyatta National Hospital and the city mortuary, all within a 10-minutes walking distance, presents an opportune landscape for strategic spatial planning. Such planning could effectively encourage short-distance travel and reduce the overreliance on the central business district, aligning with the principles of sustainable urban development.

Another approach would involve developing residential areas within the city centre. With the emergence of additional commercial hubs within 5km radius form the city centre, the abandoned buildings that have remained as a result of shifting offices present an opportunity to repurpose these vacant spaces into residential areas. This would not only offer an eco-friendly approach to housing expansion by reducing the demand for additional land and resources but would also address the pressing need for housing in the city. Such a transformation could be instrumental in addressing spatial injustices by attracting inhabitants seeking proximity to essential services, income generating opportunities and convenient access to public transit connections. This would additionally contribute to mixed-use urban spaces that are hitherto meagre yet essential for sustainable development. However, deliberate and inclusive planning policies are essential to avoid that such transformations are financially out of reach for a significant portion of the population and avoid inadvertently exacerbating existing disparities. Moreover, the envisioned increase in residential spaces within the CBD would align with broader national development goals, contributing to the realization of Kenya's Vision 2030 'Big 4 Agenda,' particularly the aspect focused on providing affordable housing.

6.2 Modal dimension

6.2.1 Motorized mobility

Within the modal dimension, I have examined both motorized and non-motorized modes of mobility, pointing to the existing disparities between these categories. While public transit commands a larger share among motorized modes compared to private vehicles, the city's infrastructure development has paradoxically favoured the use of private vehicles over public transit. This preference is discernible in the dense route network illustrated in Figure 11 in Chapter 1, where public transit is constrained to a limited set of highways, whereas more extensive kilometres are designated for navigating the city using private vehicles. Notably, there has been a recent increase in the registration of paratransit vehicles; however, the radial pattern of the paratransit network poses challenges for public transit users. This issue is exacerbated by the inability to circumvent the city due to the radial pattern of the paratransit network. The consequence is a reduction not only in accessible locations within a given timeframe but also in the range of activities that can be undertaken. Mitigating these challenges necessitates the assignment of additional routes to promote circular mobility and collaborative efforts with paratransit operators in the city.

Recommendation

To address the challenges in the public transit landscape, a shift in the perception of public transit operators in Nairobi is necessary. The persistent conflicts between the government and the Matatu operators have spanned several decades, dating back to the subsequent years after the country's independence. Matatus have long been perceived as a nuisance, often blamed for the perceived failures of public transit in the city. However, their significance in the economic development of Nairobi is undeniable, as evidenced by the chaos resulting from their strikes. Matatus not only serve as a means of transportation but also embody the identity of the city. Considering their historical importance, role in creating direct and indirect employment opportunities, knowledge of routes, areas of high demand, and understanding of passenger needs, it becomes imperative to integrate Matatu operators into public transport reforms rather than completely eradicating them as an important consideration for inclusivity (Klopp, 2021). The primary drawback associated with Matatus for city inhabitants is the fluctuation of fares, leading to the high prevalence of pedestrians in the city. Many individuals find it challenging to afford matatu travel, as fares are subject to market forces. However, government regulation of fares is essential for the benefit of users. Comparable efforts have been implemented, as seen in Manila, where fare regulation for Jeepneys has been successfully carried out (Mateo-Babiano et al., 2020).

Collaborating closely with matatu operators to identify additional operational routes and negotiate fares stands as a crucial strategy for promoting justice within Nairobi's mobility landscape. By leveraging the intimate knowledge that matatu operators possess regarding the city's complex network of roads and areas of high demand, this collaborative effort facilitates the identification of new routes that better cater to the diverse mobility needs of the public and expand the network for circular mobility. Engaging in fare negotiations with matatu operators not only recognizes their economic realities but also ensures that transportation remains affordable for the broader population. This approach involves establishing transparent mechanisms for fare adjustments based on factors such as fuel prices, maintenance costs, and economic conditions, striking a balance between the sustainability of operators and the accessibility of public transit for all city inhabitants. In addition, by involving Matatu operators in the decision-making process, this strategy would potentially foster a sense of ownership and responsibility within the transportation system, creating a platform for constructive dialogue. Public forums and consultations with the various SACCOs can be organized to gather input on route planning, fare structures, and overall improvements, ensuring that the mobility landscape is shaped by the needs of the users and the operators alike. Ultimately, this collaborative and inclusive approach not only sustains existing employment opportunities within the Matatu industry but also has the potential to create new jobs within the expanded operational routes, contributing to the overall social and economic well-being of the city.

6.2.2 Non-motorized mobility

Considering non-motorized mobility, walking remains the predominant mode of mobility for many individuals in Nairobi. However, the existing risks associated with pedestrian travel highlight the urgent need for a deliberate investment in safe infrastructure. This would entail provision of sufficient walkways and pedestrian crossing especially at the neighbourhood level where most accidents are found to occur as revealed in Chapter 5. Unfortunately, it is a common occurrence that direct routes for pedestrians are often overlooked, and allocated footpaths are situated next to major roads, exposing pedestrians to toxic fumes emitted by motor vehicles.

The construction of footbridges throughout the city has also provided an illusion for pedestrian safety. These footbridges often fall short of providing direct access to essential areas. They pose several challenges that impact the overall pedestrian experience, resulting in longer journeys. Furthermore, footbridges are susceptible to being appropriated by vendors, This unintended use not only compromises the intended purpose of the footbridge but also contributes to a less-than-ideal pedestrian experience. In addition, footbridges can become areas of antisocial behaviour, raising safety concerns and potentially deterring individuals from utilizing these structures altogether. Due to

these compounding unpleasant factors, numerous pedestrians risk crossing the busy highways to get access to more direct routes at street level. The inconvenience produced by the footbridges has resulted in a high prevalence of road crashes among pedestrians.

Ultimately, reimagining pedestrian infrastructure within the urban context requires a departure from conventional approaches that prioritize vehicular flow over the diverse needs of the community. By adopting a more inclusive and people-centric perspective, cities like Nairobi can develop solutions that not only ensure pedestrian safety but also contribute to the creation of dynamic, socially vibrant urban spaces.

Recommendation

Enhancing pedestrian safety goes beyond the provision of walkways; it necessitates a strategic approach that intentionally seeks out more direct access routes to places of necessity, steering away from main trunk roads characterized by heavy motorized traffic. A compelling example of a positive shift is the access routes through Uhuru Park and Central Park from the CBD to Upper Hill, which offer direct access through green areas, effectively removing pedestrians from the immediate vicinity of traffic. Providing such infrastructure would not only promote pedestrian safety but also advance equity in the mobility system, ensuring justice for pedestrians in Nairobi. Additionally, public awareness campaigns can play a vital role in promoting a culture of respect for pedestrian rights, reinforcing the idea that walking is a legitimate and essential mode of transport in the urban fabric.

A critical re-evaluation of the purpose and design of footbridges is imperative. Rather than focusing solely on ensuring uninterrupted vehicular travel on highways, there is a need to adopt a more holistic perspective that recognizes the multifaceted nature of urban spaces. In cities like Nairobi, highways are not mere transportation corridors; they represent vibrant spaces for social and economic interactions. Consequently, pedestrian infrastructure should be conceived not just as safety measures but as integral components that contribute to the overall livability and functionality of urban areas.

Thinking differently about pedestrian infrastructure involves a shift from a vehicle-centric approach to one that prioritizes the needs and experiences of pedestrians. This may entail exploring alternative solutions such as at-grade crossings, well-designed crosswalks, and pedestrian-friendly intersections that seamlessly integrate into spatial planning.

Cycling is another mode of mobility, less popular than walking but with great potential to improve the individual's level of accessibility. Investment in cycling infrastructure as well as the industry of cycling would also require deliberate efforts to create more direct routes that may not necessarily follow the

existing motorized transport lanes. Planning and providing safe cycling infrastructure on alternative streets apart from the major trunk routes could increase flexibility of movement and facilitate circular movement within the city, increasing the level of access to other areas. Safe infrastructure could potentially shift the perceptions of risks associated with cycling as well as supporting infrastructure such as parking facilities and access to affordable bicycles through local manufacturing to increase the uptake of cycling in Nairobi.

Although challenges of non-motorized mobility are evident in many parts of the city, a comprehensive mapping that leverages technology, such as Geographic Information System (GIS) to assess the quality of non-motorized infrastructure including sidewalks, pedestrian crossings, cycling infrastructure and other essential elements that contribute to a safe and convenient walking and cycling experience holds the potential to provide tailored interventions in infrastructure development for pedestrians and cyclists. This approach allows for the identification of spatial injustices within the non-motorized mobility landscape. For instance, it may reveal discrepancies in sidewalk width for large volumes of pedestrians, the presence of obstacles or obstructions especially for people with disabilities, inadequate crossings, or poorly designed intersections. Such detailed information can be used to rectify these spatial inequalities and advance spatial justice among non-motorized mobility users.

In addition, citizen engagement initiatives such as place making campaigns, public awareness campaigns, and collaborative efforts with local businesses to create a pedestrian-friendly environment would enhance inclusivity in spatial planning, advancing the pillar of a just city as highlighted by Susan Fainstein (2010).

6.3 Individual dimension

The individual dimension is closely linked to the modal dimension as the individual relies on the mode of mobility to obtain access to places of necessity. In evaluating mobility in Nairobi from an individual dimension, the pedestrian can be said to be an embodiment of both sustainability and risk. The pedestrian has emerged as a resilient individual, steadfastly navigating spatial inadequacies and travel risks. Despite these challenges, pedestrians have demonstrated a remarkable perseverance in their daily mobility experiences.

Historically, Nairobi's urban development envisioned motorized mobility, neglecting pedestrians in the future urban mobility landscape. This historical oversight has led to contemporary spatial inequalities in accessibility throughout Nairobi. The exclusion of the economically disadvantaged from affordable

public transport, a trend originating in the colonial era when buses were financially out of reach for many, persists today, compelling the poor to predominantly rely on walking as their only affordable mode of mobility. The lack of provision of adequate and safe infrastructure for walking has exposed pedestrians to a disproportionate share of mobility risks, particularly in terms of road fatalities, as the likelihood of pedestrian accidents is significantly higher than for other road users. Given that pedestrians constitute a substantial proportion of the urban poor, the resulting inequalities are further exacerbated due to their limited mobility options relative to other urban residents. Drawing from John Rawls' "Difference Principle'' (Rawls, 1971:75), injustices become evident when enhancing the well-off's advantage comes at the expense of the less fortunate. In the context of walking in Nairobi, prioritizing the interests of those with private vehicles, through investments in road network extensions without considering the needs of the most dominant mode of mobility, has incurred a costly toll on the lives of pedestrians.

Recommendations

Implementing structural changes in the pedagogy and standards of road design is also imperative for the comprehensive transformation needed to prioritize pedestrian safety and address historical mobility injustices. This involves a fundamental reevaluation of the principles, methodologies, and criteria guiding road design practices. The traditional approach that often prioritizes vehicular flow at the expense of pedestrian needs must undergo a paradigm shift.

Firstly, revising the pedagogy of road design necessitates a change in the educational and professional training frameworks for urban planners, architects, and civil engineers. Incorporating pedestrian-centric principles, such as the principles of "Complete Streets," into educational curricula will ensure that future professionals are equipped with the knowledge and skills to design roads that accommodate all modes of mobility.

Secondly, restructuring the standards of road design would involve revisiting existing guidelines and regulations governing the design and construction of urban infrastructure. This would entail incorporating safety features specifically tailored to pedestrians, such as well-designed and universally accessible sidewalks, pedestrian-friendly intersections, and sufficient lighting or safety.

The initiatives undertaken by the Nairobi Metropolitan Services (NMS) to establish safe infrastructure for pedestrians in the city centre highlighted that the prioritization of non-motorized mobility transcends mere spatial planning—it represents a critical political choice. This means that a genuine understanding of day-to-day realities faced by pedestrians when navigating the city will likely result in deliberate efforts in prioritizing non-motorized mobility. Without a proactive acknowledgment of pedestrians' experiences and a commitment to meaningful change in infrastructure development,

attempts to ensure safety will be slow to realize, perpetuating the mobility risks that pedestrians are exposed to. In addition, a shift in societal mindset associating car ownership with prestige and walking with poverty will be necessary for the prioritization of pedestrian infrastructure in Nairobi.

6.4 Temporal dimension

Examining the historical context of Nairobi's infrastructure development has revealed that a shift from investing primarily in motorized mobility, particularly the private vehicle results in the spatial injustices within Nairobi's mobility landscape. The ramifications of these investments have been the loss of lives of many non-motorized mobility users.

The injustices that pedestrians in Nairobi experience are deeply rooted in historical legacies that persist, contributing to a lack of recognition of the urgent imperative for pedestrian safety. Effectively addressing these issues will involve aligning with the efforts to prioritize safe infrastructure as recommended in section 6.2.2. This alignment is crucial for ensuring justice, particularly for non-motorized users who, historically marginalized, stand to benefit significantly from a deliberate focus on creating safe and accessible environments for pedestrian mobility.

Summary

In summary, this research has undertaken a nuanced exploration of the complex interplay between justice and urban mobility in Nairobi, providing a distinctive perspective that incorporates the viewpoint of commuters. The understanding of justice in urban mobility emerges as inherently dynamic and context-specific, reflecting a practical, lived reality deeply influenced by the social, cultural, and economic contexts in which individuals navigate their daily lives. This perspective highlights the crucial significance of taking into account the specific context and the real-life experiences of individuals when formulating and implementing policies and initiatives related to justice, particularly within the realm of urban mobility. Recognizing the multifaceted nature of justice in this context is essential for promoting inclusivity, addressing historical imbalances, and fostering sustainable urban development that truly meets the diverse needs of the community.

The distinctive mobility challenges experienced in Nairobi, ranging from the financial barriers associated with unaffordable public transit to instances of police misconduct and inadequate and unsafe infrastructure collectively underscore the injustices prevalent in the city's mobility landscape. The absence of well-designed pedestrian pathways, dedicated cycling lanes, and other non-motorized facilities intensify the risks and inconveniences faced by those who rely on these modes of mobility.

In such an environment, injustices manifest as vulnerable road users contend with compromised quality of life and heightened risks when sharing the road with motorized vehicles. The foundational principles of fairness for the most vulnerable in society therefore become compromised.

Effectively addressing these challenges necessitates deliberate and concerted actions. Investing in non-motorized mobility is crucial for creating a safer and more just mobility environment. Civic education also plays a pivotal role, involving comprehensive training for motorists on road safety and raising public awareness about regulations and mobility rights. By actively engaging with these multifaceted challenges, Nairobi can take significant strides toward rectifying injustices in its mobility landscape and creating a more inclusive and equitable urban environment.