Pathways to Sustainable Public Transport: Analysing Modal Choice in Johannesburg

Retsepile Charity Kalaoane, Trynos Gumbo, Alain Kibangou, Walter Musakwa, Innocent Musonda

(Retsepile Charity Kalaoane, Department of Town and Regional Planning, Faculty of Engineering and the Built Environment, University of Johannesburg, tshepytoya20@gmail.com)

(Trynos Gumbo, Professor, Department of Town and Regional Planning, Faculty of Engineering and the Built Environment, University of Johannesburg (tgumbo@uj.ac.za))

(Alain Kibangou, Professor, Department of Electrical Engineering and Industrial Informatics, University of Grenoble, France (alain.kibangou@univ-grenoble-alpes.fr))

(Walter Musakwa, Professor, Department of geography, environmental and energy studies, Faculty of science, University of Johannesburg (wmusakwa@uj.ac.za))

(Innocent Musonda, Professor, Department of construction management and quantity surveying, Faculty of Engineering and the Built Environment, University of Johannesburg (imusonda@uj.ac.za))

1 ABSTRACT

The incessant high rate of urbanisation in cities of the developing world continues to threaten mobility and access resulting in cities grappling to achieve sustainability. At the centre of this quagmire are concerns about the efficient functioning of public transport systems, particularly in African cities. Ostensibly, the quality of public transport services is deteriorating, more so in South African cities, resulting in constrained accessibility particularly for the urban poor and increased motor vehicle usage by the middle and high class households. This paper is based on a case study research design and a quantitative research approach to examine modal choice in public transport. Questionnaires were administered among the private vehicle owners and the public transport users to determine the factors affecting modal choice in the city. Preliminary findings reveal that the majority of commuters use public transport within the precinct but still quite a large number of people resort to private vehicle. The results highlight concerns within safety, convenience and stations that are highly polluted. Consequently, the challenges associated with conventional public transport, force those without their own vehicles to use paratransit modes of public transport which are often unregulated, major contributors of traffic congestion, reckless driving and hotspots for criminal activities. It is apparent that for people using public transport once they start affording to buy own vehicle, they would make a shift and this will increase environment consequences making our fight for sustainability far from over. The study concludes that public transport in a developing world needs to be understood from a holistic perspective to identify the leverage points which are critical points of intervention that may assist in planning for sustainable public transport.

Keywords: sustainability, public transport, modal choice, sustainable development goals, urban planning

2 INTRODUCTION

Cities are concentrated with a variety of economic activities and spatial structures that are supported by transportation. Nonetheless, increased urbanisation has perpetuated transportation challenges and deteriorated cities in the Global South, manifested through ineffecient public transport systems (Andreasen and Moller-Jensen, 2017; Chakwizira, et al. 2019; Moyo, et al. 2021). As a result, most African cities have been working towards sustainable development since the turn of the 21st century (Taghvaee, et al. 2020). One of the most important aspect in the sustainable development discourse is sustainable public transport. The need to achieve sustainable public transport has found its way into strategies and policies in many African cities. Ochoa-Covarrubias, Grindlay, and Lizarraga (2021) state that sustainable transport development and provision makes reference to "access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations".

However, despite the existence of Urban Agendas, Sustainable Development Goals (SDGs), African Agendas making their way into national policies in African cities, (Sam, Hamidu and Daniels, 2018), there is a continued reliance on private motor vehicle mode of transport (Risimati and Gumbo, 2019; Gumbo and Moyo, 2020). The increase in car ownership and informal public transport in South Africa have been identified as the main contributors of traffic congestion in Johannesburg (Gumbo et al, 2022; Moyo, et al. 2022). The existing mobility challenges patent by increase in traffic congestion has affected people's travel mode of choice . Therefore, this demands a shift in the mind-set to better understand reasons behind people's modal choices and their experiences with public transport.

Considering that public transportation is the main tool for socio-economic, physical, political and environmental development, this paper aims at analysing commuter's modal choice for an improved public transportation. This paper makes three key contributions to the practise and field of public transport studies. First, it extends the understanding of analysing complex issues in public transport for sustainable public transport. Secondly, the article gives rear mirror in the experiences of different demographics with public transport. Finally, the paper makes contribution to a small untapped research focus on public transport. This will be done by using Johannesburg commuters lived experiences of both private and public transport users while noting the different dynamics in different African cities. The paper commences with a brief background of the research topic and conceptual framework. Followed by description of Braamfontein, Johannesburg, the study area. The research methodology section outlines data collection procedure undertaken. The results section analyses findings from data collected. The policy recommendations and lessons learned section narrates lived experiences of people in Braamfontein and provides direction for policy making. Lastly is the conclusion.

3 CONCEPTUAL FRAMEWORK

Sustinable public transport as explained in the introductory section is mostly aimed in satisfying the user. The lived experiences provide insights on the envisioned transportation modes from people's lense.

3.1 Modal Choice

Modal choice is an area of research that has taken interest in various disciplines. The usage of different mobility options depends on the user 's needs. Indeed, transportation users are the ones making decision on the type of transport mode to choose depending on their needs and requirements. In fact, research shows that the decision on the choice of mode depends on variety of factors (Tyrinopoulos and Antoniou, 2013; Cheng, et al. 2019; Samimi, et al. 2020). The determining factors are dependent on the user and the structure of the city. The factors affecting users of transportation differs from socio-economic attributes, transportation attributes, trip related and environmental attributes (Suaa, et al. 2022). The way the city is designed is dependent on the inability of existing policy and legislation framework to encourage public transport by initiating different strategies in a city and investment in public transport infrastructure (Gao, et al. 2022; Lee, et al. 2022). In an effort to understand modal choice, Mayo and Taboada, (2020) conducted a study on attributes affecting modal choice. Factors such as safety in public transport, lenient and unrelevant policies and legislative framework on private vehicle increased motor vehicle ownership making public transport less preffered modal choice. Jia et al. (2018) analysed users awareness of the impact caused by their modal choice on the environment, factors such as speed, comfort and safety were the determining factors for modal choice despite the harmful impact they cause to the environment. Moreover, socio-demographics contributed towards modal choice. Mehdizadeh, Nordfjaern and Mamdoohi (2020) enthisised that it is vital to analyse demographics and other related attributes affecting modal choice in policy and practice. Improved quality of services determined by factors affecting modal choice in transport significantly influences a shift to more sustainable mobility options. Consequently, analyzing modal choice is allows understanding people travel patterns in order to improve future public transport while making them sustainable.

3.2 Sustainable public transport in Johannesburg, South Africa

particularly in South Africa. The city of Johannesburg Integrated Master Plan aims for efficient integrated transport system to achieve sustainable transport. At the centre of this system is public transport with special focus on rail as the backbone for sustainable public transport (Department of Roads and Transport report, 2022/23). The Integrated transport systems goals gave birth to BRT (Bus Rapid Transit), High speed train and smart mobility (Department of Roads and Transport report, 2022/23). Conversely, there has been an increase in travelling time by public transport from 46 minutes in 2014 to 57 minutes in 2020 in the city of Johannesburg, this increase is estimated at 17% (Gauteng Household Travel Survey, 2020). In addition, walking to first public transport takes even longer, from 9 minutes to 14 minutes by the year 2020 (Gauteng Household Travel Survey, 2020). The estimated delay in trip duration has declined the economy of Johannesburg (Moyo, et al. 2022). Indeed Olvera, et al (2020) acknowledge that the existing mass transit is to some extend unable to give full user satisfaction.

The existing conventional public transport has not been able to meet the needs of the people and this is evident from increased usage of paratransit modes of transport (Dzisi, et al, 2022). Paratransit is a primary

mode of public transport in African cities often subsidizing conventional public transport (Cirella, et al. 2019). This informal mode of public transport is said to be used by more than 70% daily commuters (Tchanche, 2018). Examples are minibus taxis, tuk-tuk, motorcycles and bicycle taxis. However, these paratransit modes are often contributors of major pollution in cities and are usually referred to as unsustainable, unsafe, unlicensed informal, chaotic mode of transport (Tchanche, 2018; Abraham, et al. 2021).

4 STUDY AREA

Johannesburg is the economic hub of Gauteng, and number one destination for most Africans (Risimati, Gumbo and Chakwizira, 2021: 2). The paper focuses on Braamfontein, a suburb in the centre of Johannesburg (figure 1) and has gained popularity as the safer node for middle and creative class (Hoogendoorn and Gregory, 2016).
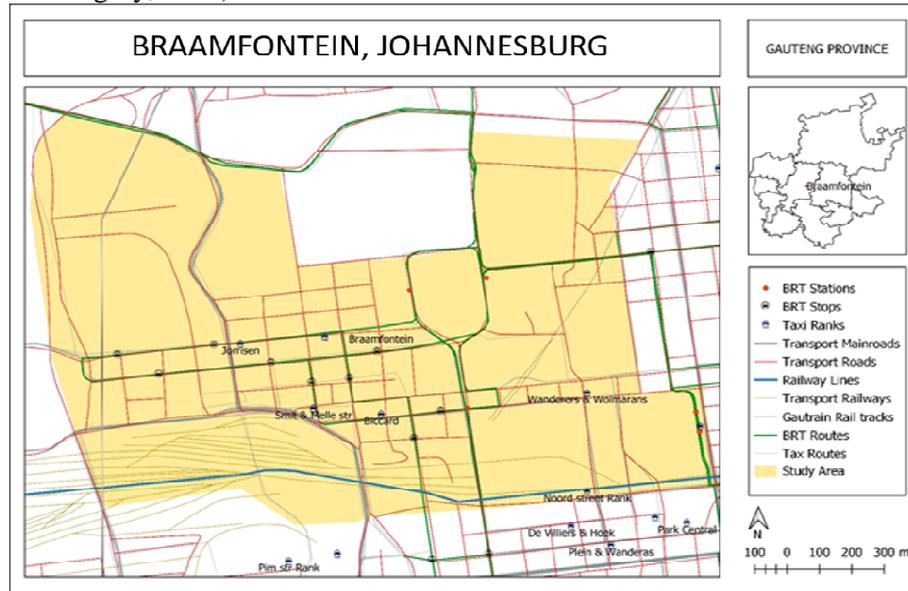

Figure 1: Location map of Braamfontein

Braamfontein has been one of the oldest suburbs in the city of Johannesburg dating back to 1886. As the city of Johannesburg developed, so did Braamfontein. Braamfontein reconstruction in the early 1950s, the regeneration projects and development of BRT, that later followed, attracted many investors in Braamfontein and made it one of the busiest places in Johannesburg (Gregory and Rogerson, 2019). Currently, what was once a small town has turned into the busiest, firm high density precinct that has attracted students, young professionals and low to high income households to the city. Approximately 3000 people visit Braamfontein on a weekly basis (Bank, Cloete and van Schalkwyk, 2018). The tourists and existing population makes it an interesting study area for public transport since public transport is an essential component for socio-economic growth for a city.

5 MATERIALS AND METHODS

The case study research design and quantitative data in a form of questionnaires were used to determine the commuters modal choice. It was noted that the travelling patterns for transport users varies throughout the day. Therefore, data was collected during morning rush, during the day and afternoon peak hours to rule out bias that may be caused by sampling time. This ensured that commuters using different modes of transport were interviewed. This paper used a cluster sampling technique to identify respondents to be interviewed for this research. Cluster sampling technique divides the population of interest in groups and randomly select from each cluster to represent the sample of the study (Ebeto, 2017). Following cluster sampling technique, questionnaire based survey were administered to 300 respondents.

The survey questions were divided into different sections to critically understand the topic in this paper. The first section of the questionnaire focused more on the socio economic aspects of the commuting population. The second section investigated both public and private car users to understand factors affecting modal

choice. Lastly, the respondents were probed on their travelling patterns. The data collection was done in three stages to avoid bias and increase variability for research results (figure 2):
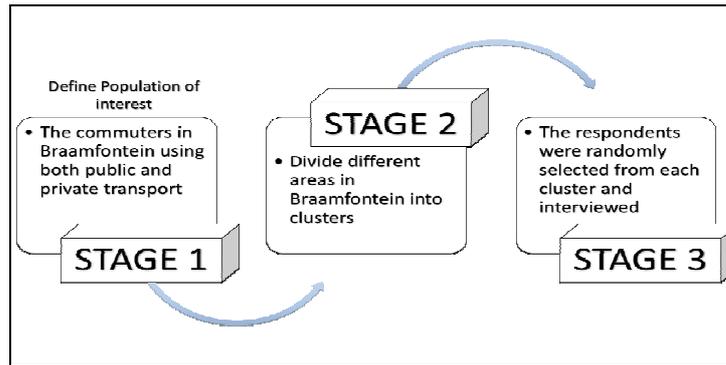

Figure 2: Framework followed for data collection

The data collected was analyzed through google forms. In google forms, the questionnaires were created and data from the 300 respondents was entered by storing all the responses in the created questionnaires. Furthermore, the analyzed data in google forms was then imported in both microsoft excel and matlab for more graphic analyzation of the results. Secondary data was used to complement the collected data.

6 FINDINGS

The findings presented in this paper are conveyed through the socio-economic profile, population ditsribution, preferences on transportation modes, factors determining mode of transport and travelling patterns of the respondents.

6.1 Socio economic aspects

The results in figure 3 revealed that the age group with the highest secondary education beackgound is the Under 20 leading with 82%, followed by 21-30 age group with 43% and lastly, over 30 age group at 16%. The first entry category is made up of Certificate and Diploma holders. In this category, the leading age group with 40% is respondents between the age of 21-30. The over 30 age group takes the lead with 29% degree holders and 8% postgraduates.
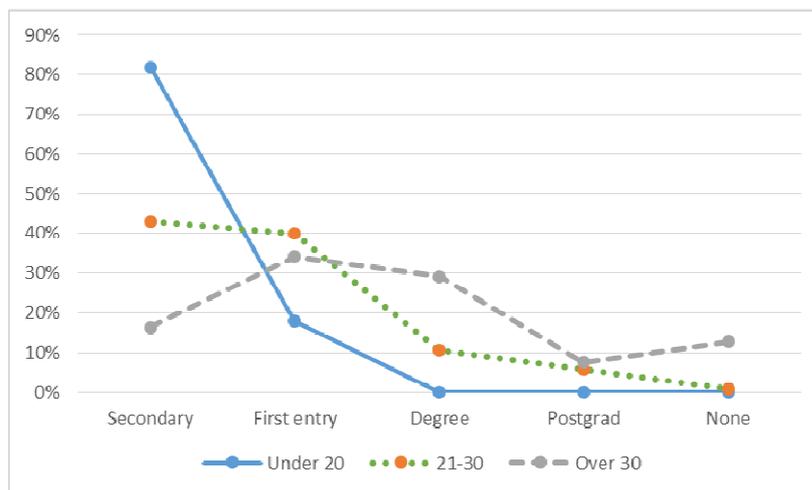

Figure 3: Education level of commuters from sampled population in Braamfontein by age

Therefore, it is eminent from the results in figure 3 that the sampled commuters in Braamfontein is composed of fairly educated population, with only 10% over 30 year old respondents with no educational background.

The respondents were further proped on their occupation status (Figure 4). The data shows that from the sample, most commuters (79%) are students between the age of 21-30 years. Although 45% aged over 30 are employed, a fair number of the respondents between age 21-30 are also employed with no record of the retired. In addition, the results also shows the diversity of the sample from the data collected.
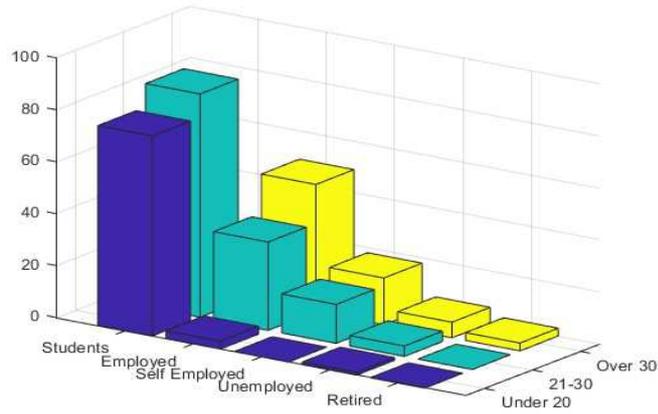
Figure 4: Occupation status of commuters from sampled population in Braamfontein by age

The sample as depicted in figure 4 is highly mixed with students, young professionals, the unemployed, self employed and retired. The results are in correlation with Bank, et al (2018) whose finding were that Braamfontein consists of different population dynamics. These makes Braamfontein an interesting place for this study.
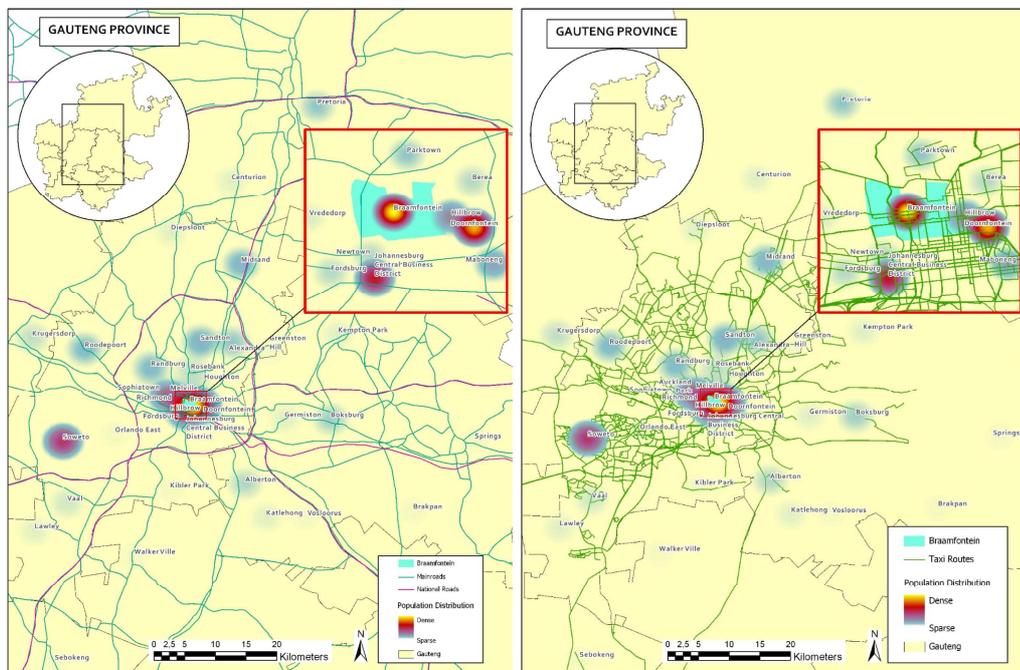

Figure 5: Analysis of population distribution using mini bus and ride hailing routes

6.2 Population distribution on respondents

The maps in figure 5 and 6 shows the respondents place of residence. Majority of the respondent resides from the west and in the centre of Braamfontein. Additionally, the maps represents the existing routes used by different public transport mode available in the city of Johannesburg.

In figure 5, the depicted routes are used by ride hailing services and mini bus taxis. The two modes based on figure 5 are the most accessible modes of public transport in and outside of the city. While the BRT is not far behind (Figure 6) interms of accessibility, most of the respondents have to take either a mini bus taxi or a ride hailing mode to drop them off at a Gautrain station to be able to access a train. Unlike a mini bus taxi and ride hailing, Gautrain does not have convenient routes based on reponses from respondents.
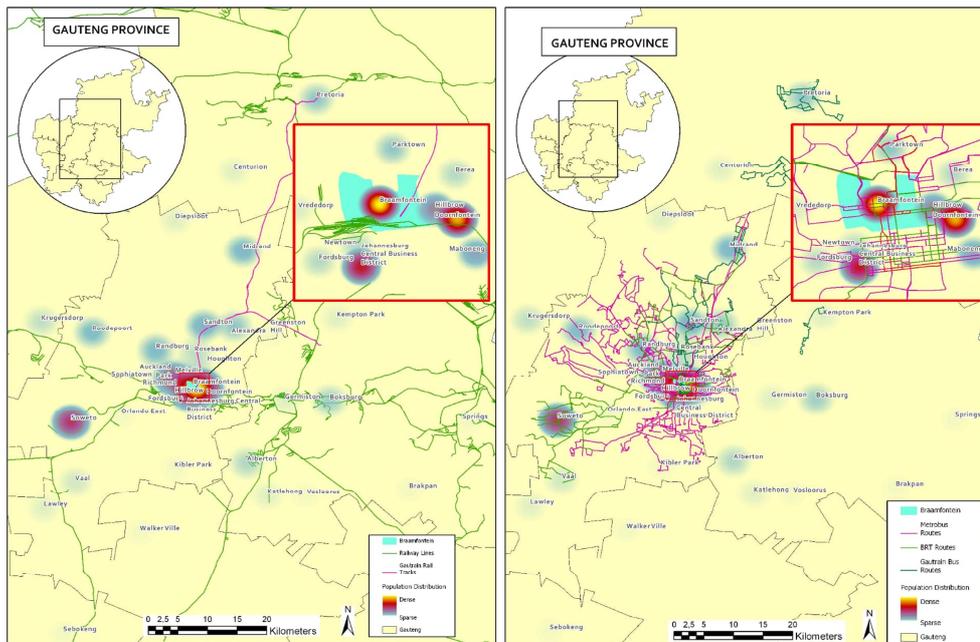
Figure 6: Analysis of population distribution showing railway and BRT routes
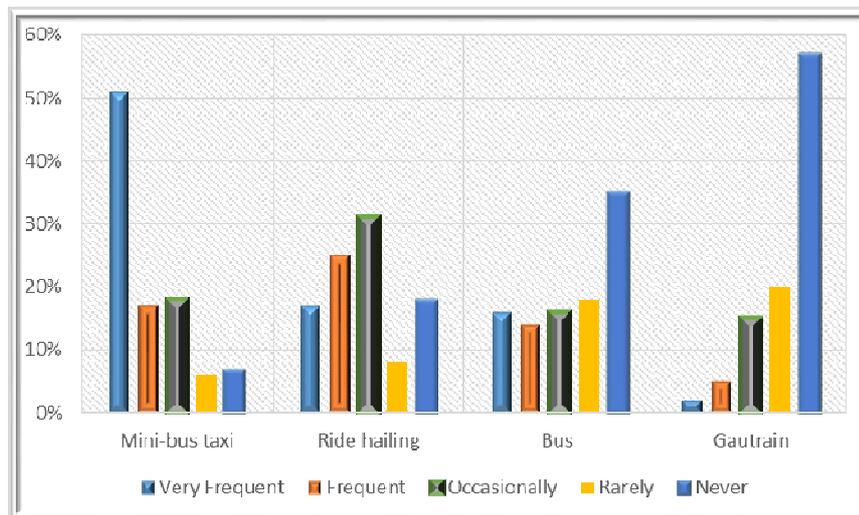

Figure 7: The highly used mode of public transport

In addition, the level of accessibility also depends on the availability of public transport at the time they are needed since they are not always available. Figure 7 depicts the mostly used mode of transport by respondents to travel in and out of Braamfontein.

The highly used mode of public transport (figure 7) is mini bus taxis with 52%. Ride hailing was the common used mode of public transport with 28% of the respondents used it very frequent. The majority of the respondents (58%) have never used a Gautrain and 35% have never used Bus to commute to Braamfontein. It was important to understand reasons for frequent use or lack of a mode of public transport. The frequent use of mini bus taxis was based more on affordability for mini bus taxis despite their criticism on attitudes of drivers for the mode. Ride hailing is occasionally used because of the unsafety associated with the mode and the cost people inquire. One respondent said:

"Ride hailing services are unpredictable, yesterday I requested, and on the mid way to the destination, the driver told me the amount will increase based on traffic on the road and these is common among ride hailing drivers".

Indeed the issue of safety in public transport is one of the factors determining mode choice as depicted in figure 8. Figure 8(a) represents the occurence of the determinging factors in mode choice. It is evident from the results that convenience (13%), safety (13%) and reliable (13%/) are not the determining factors of why

people choose public transport. In private transport, affordability (8%) does not contribute to the modal choice.

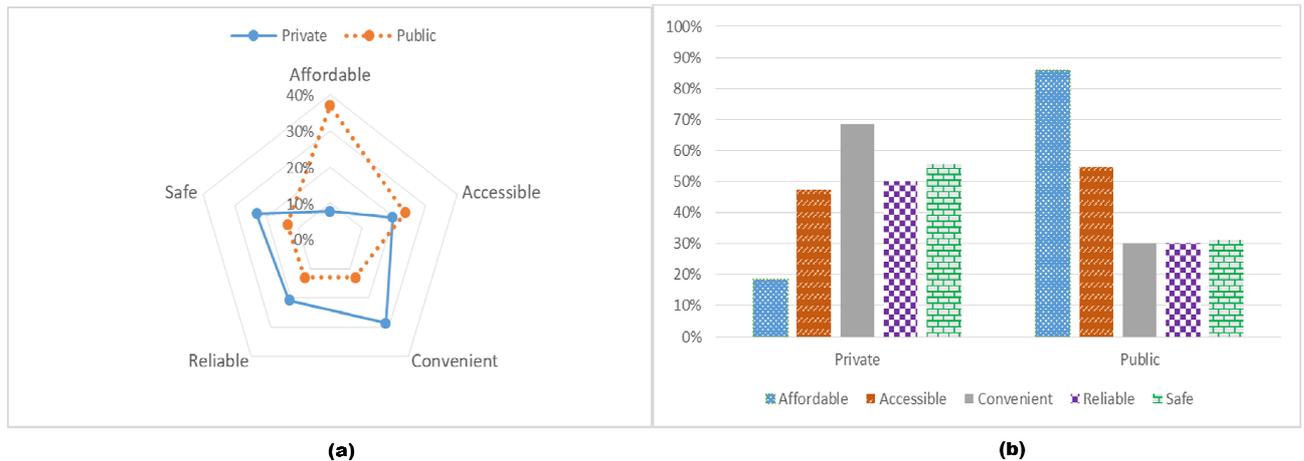(a)   (b)

Figure 8: Factors determining mode choice

Additionally, in figure 8(b), In private transport, convenience was rated at 69% as the most important attribute and in public transport, affordability at (86%) is the most important factors to respondents.
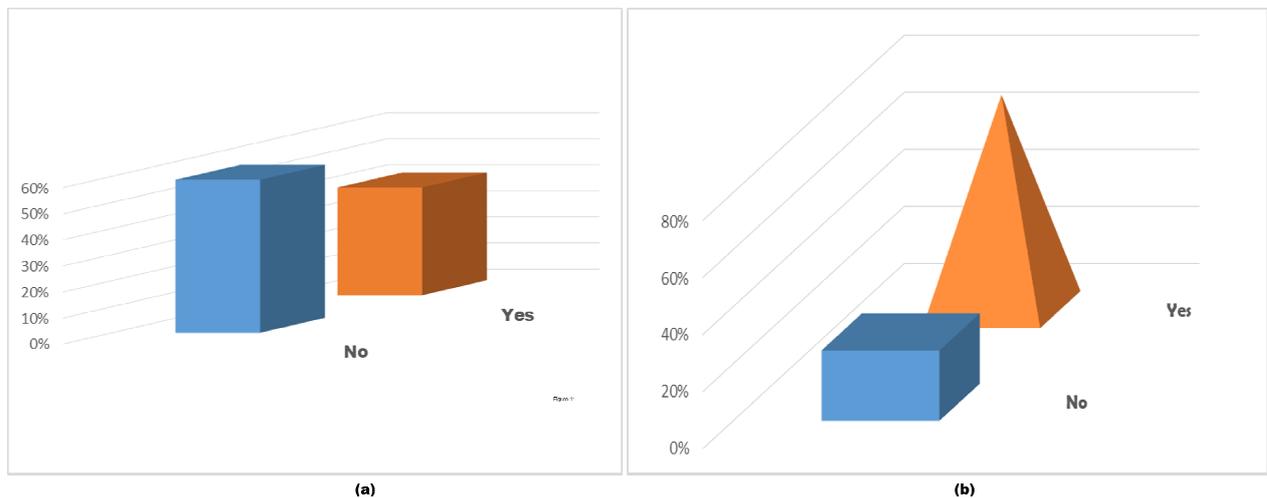

(a)   (b)

Figure 9: (a) Respondents responses to car ownership, (b) respondents preference on using own motor vehicle to commute

6.3 Motor vehicle ownership

The majority of the respondents (59%) have no access to own motor vehicle while only 41% have motor vehicles in figure 9(a). Furthermore, out of the respondents that have motor vehicle, 75% prefer using their own motor vehicle to commute to Braamfontein while 25% prefer to use public transport (figure 9b).

The respondents in figure 9(b) who prefer to use public transport stated that because of the unsafe environment in Braamfontein, they are afraid of their motor vehicle being stolen while some respondents complained of the lack of parking spaces due to congestion in the city.

6.4 Travelling patterns

In a city faced with increasingly usage of private motor vehicle, it was important to analyse travel patterns of users of both transportation modes. It is is evident from figure 10 that the respondents find it extremely difficult travelling around the city using public transport at night, with 50% of the respondents ranking it below 10, and 75% ranking it at 10.

It is equally difficult to travel using private transport in the moring with 50% of the respondents ranking the difficulty at 8 or less than 8.

7 DISCUSSIONS

The analysis of the results was delivered as a road map into understanding respondents experiences with different transportation modes. The daily commuters from the sampled population are educated, young adults who commutes for educational activities and work related activities. Most of these respondents are young adults between the ages of 21-30 years old from all works of life, mostly living in the city centre and outskirts of Johannesburg city. Those living in the city centre were also part of the respondents using public transport and private transport to travel to work and school. This is because according to the repondents, the city is deemed an unsafe environment for people walking with valuable things like electronics and money. The population distribution reveals Braamfontein as a meet point for most of the respondents.
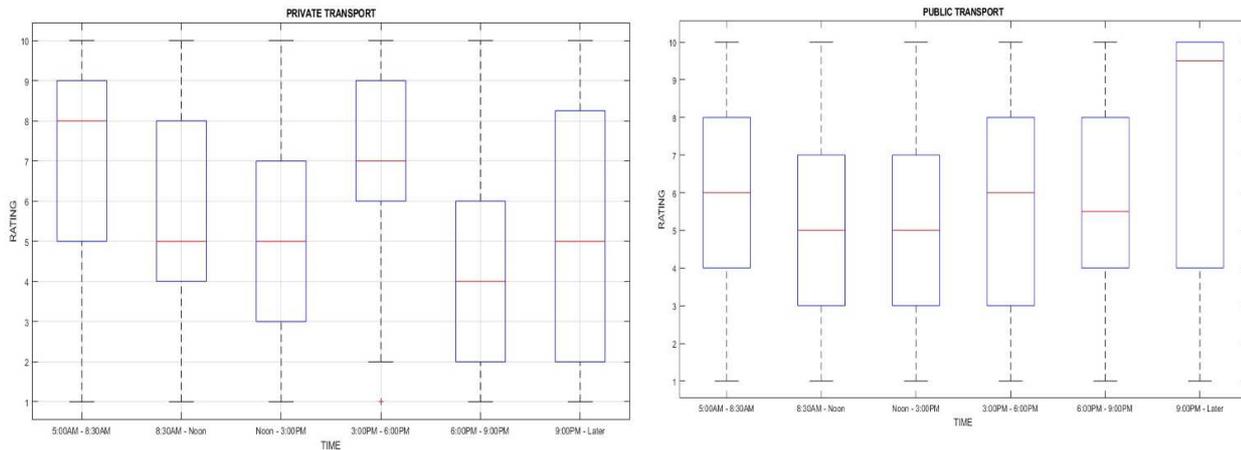

Figure 10: Difficulties in travelling using private and public transport by time travelled

The frequent use of public transport by respondents is in line with findings by Moyo et al. (2022) pointing that mini bus taxis and buses are used by the majority of population in the city of Johannesburg. Although praised by most respondents as the most comfortable and convenient mode of public transport, ride hailing is unsafe and very costly. Most of the respondents experienced a life threatening moment, encountered abuse or had their friends and family experience such traumatic experience using ride hailing services. The stories of respondents are also evident with their experiences in mini bus taxi ranks, where difference in language is asking for threats and humuliations from the mini bus taxi drivers. One lady was quoted saying

"One day I was in MTN taxi rank when two guys came from nowhere and took all my belonging, while the taxi drivers and people watched, pretending they are not seeing what is happening in their presence. Instead of getting help after I screamed for help, one man passed by me and told me to stop showing off, this is Gauteng, the city of lions".

There were so many stories told of respondents experiences with public transport. Most of the respondents using private transport understand the effects of increased car ownership but they are determined to pay the price for their own convenience and safety. The factors determining usage of both private and public transport paints a picture of what public transport lacks that explains the increasing usage of private transport. The unavailability of public transport after 6pm makes it difficult for frontline workers to travel to and from work for their night shift. The results are clear indication that for this study, socio-demographics does not have a direct influence on modal choice, however, occupational status does. Most of the respondent choice to use public transport relies more on affordability, availability and majority of those living in the outskirts of town rely heavily on mini bus taxis. The conventional mode of transport to the respeondents are often expensive, not convenient to an extend where once the repondents afford to buy own motor vehicle, they will make a shift of modal choice to private vehicle.

8 POLICY IMPLICATIONS AND LESSONS LEARNED

Sustainable public transport is a vision that can be achieved. However, questions remain:. Are our strategies in line of our realities? Are we being fully inclusive? The questions bears answers in this study. Public transport is used by different demographics, and policy needs to understand the reasons for modal choices by contextualising the strategies locally. The existing policy aimed in promoting sustainable public transport continues to put rail as the backbone of this initiative but according to the respondents, it is few people ,s

mode of choice. The master plan for integrated transportation is therefore not inclusive to the majority of the respondents. The development of our policies based on the respondents is continually ignoring the lived realities on the ground. The involvement of private transport users in this study was set to give an example of what aspects of private transport are people drawn to that could possibly be inherited by public transport. There was concensus during data collection where respondent had the same idea that as soon as they get employed into better paying jobs, they will make a shift to private cars. These provide lessons for the future of sustainable public transport.

Moreover,as technology advances, it becomes very hard to control different dynamics in our society.This is evident from horrific experiences of ride hailing users. Thus, it is important to formulate policies that are futuristic so that as our cities develops, technology advances, people are not threatened rather eager to take part in the economic life using different public transport mode of choice that are sustainable.

9 CONCLUSIONS

The paper pursued to understand user's modal choice of different transportation modes and the factors determining modal choice. The highly used mode and travelling patterns were also analysed. Although it is clear from the article that there is no size fits all solution to sustainable public transport. However, studying demographics of the place, investigating people's experiences in a city is a step in a right direction in improving public transport that does not only include the vulnerable groups but also attract private motor vehicle users to use as well for the future of sustainable African cities. Moreover, the findings focused more on the descriptive analysis, however, there is a potential to explore different machine learning techniques to uncover key insights for an improved public transport. It will be interesting to explore gender dynamics in public transport as well, to be able to map the gender differences and experiences with different public transport modes.

10 ACKNOWLEDGEMENT

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