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Factors Influencing Commuters' Use of Non-Designated Bus Boarding Locations in Rapidly Urbanizing Cities: A Case Study of Enugu, Nigeria

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Abstract: While significant empirical research has examined the use and benefits of designated bus stops in urban settings across Western and Asian countries, the factors influencing commuters' preference for non-designated bus boarding locations in developing cities remain understudied. This study investigates the determinants that lead commuters to board buses at non-designated locations in Enugu, a rapidly urbanizing city in southeast Nigeria. Data were collected through a questionnaire survey involving 424 commuters at 17 non-designated bus stop locations across three local government areas within Enugu metropolis. Descriptive statistics, Commuters' Perception Index (CPI) and principal component analysis (PCA) were employed to analyze the data. The analysis identified seven key factors influencing the choice of non-designated bus boarding locations: environmental and social conditions, cost-related considerations and diversity of routes, concerns over unsanitary conditions, bus availability and access to information, convenience and time-saving benefits, proximity to the desired destination, and perceived safety and comfort. These findings provide valuable insights for urban planners in designing effective and commuter-friendly bus stop infrastructures that encourage the use of designated boarding locations, thereby optimizing the multifunctional benefits of such facilities in Nigerian cities and similar urban contexts globally. It is recommended that targeted strategies be developed to address these factors, enhancing the overall efficiency and attractiveness of public transport systems in developing urban centers.

Keywords: Public transport; Urban planning; Non-designated bus stops; Commuter behavior; Enugu; Nigeria; Developing cities; Principal component analysis (PCA)

1 Introduction

Public transportation plays a pivotal role in the daily lives of urban residents worldwide, forming an essential component of their routines. Public transport services have remained lifelines to education, tourism, work, leisure, and tourism, especially for low-income households that cannot drive as well as people with disabilities [1]. Globally, the attempt to dissuade people from being car-dependent and reduce urban congestion as well as air pollution has been addressed by public transport [2]. Studies have shown that African countries, which were previously considered slow in terms of urbanization, have recently had an increased urban areas, with an urbanization growth rate of over 4% every year, which is considerably higher than the urbanization rate of about 0.75% annually in developed countries [3]. Again, further study has submitted that only about two percent of the earth's surface are covered by urban areas [4]. It has been reported that urban areas globally accommodate more than fifty-five percent of the world's population and contribute approximately 60% of the global GDP [5]. Furthermore, it was alluded that cities are responsible for over 60% of global greenhouse gas emissions [6], thus showing their significant global influence. This global occurrence of rapid urbanization has obviously led to various crises in urban centers like car dependency by urban dwellers and increased traffic congestion. This rapid and increased motorization as well as urbanization has grown the annual number of passenger cars sold in Nigeria from 1.5 million in 2010 to 2.1 million in 2021 [7]. This is not different from most African countries. Most African cities have been facing the phenomenon of "the paradox of intensification" [8]. This results in increasing urban density that promotes public transport, thereby causing a

concentration of heavy traffic. Transport has remained the backbone of urban survival and life. It is usually one of the determinants for the economic and social development of any urban area. It equally plays a crucial role in determining the sizes and forms of cities, influencing the location of economic and social activity, and shaping the countries [9]. Globally, there is extensive growth in the provision of transport infrastructure, most of which has undergone technological improvements cutting across the motive power, the means, as well as the tracks.

One of the recent concerns in urban transport is the travel attitude of commuters using public transport. The choices they make to travel are based on habits, options, opportunities and constraints. For example, how people travel to work, the duration and type of stops they make on the way, the time they leave, and the choice of where they alight or enter the buses that will convey them - these are crucial and vital parameters in travel behavior. The frequent use of designated bus stops by public transport commuters in urban areas has a significant impact on the life of urban areas [10]. In most countries of the world, it is generally a common occurrence for buses to be permitted to stop only at designated and official bus bay in urban areas, although in some countries, the practice is different as buses may be unofficially allowed to stop at any point, even on busy city streets [10]. However, in roads where there are very few passengers, it will be economically counterproductive to investment in bus stop infrastructure since the need for designated bus stops in any area is largely determined by usage.

In many cities, designated bus boarding locations have been established to streamline efficiency and ensure passengers' safety. However, the issue of "non-designated" bus boarding locations is a widespread problem, not confined to Enugu, Nigeria. In developing countries with inadequate infrastructure and disorganized transportation systems, informal bus boarding points, often referred to as "bush stops" or "make-shift terminals", have proliferated [11]. Unfortunately, these unofficial sites operate without regulation, giving rise to safety concerns and contributing to accidents, traffic congestion, and delays. The phenomenon of commuters and drivers choosing non-designated bus boarding locations over official bus stops has far-reaching consequences. It leads to traffic conflicts, delays, accidents, and customer dissatisfaction, all of which undermine the quality of urban life.

Nigeria, one of the developing countries in the sub-Saharan region of Africa, is experiencing rapid urbanization with its attendant social and transportation consequences [12]. Like other countries in the world, her population is gradually increasing, with many populations needing public transportation for movement. In Enugu, southeast Nigeria, for example, the percentage of the population that uses public transportation has reached 62% [13], and the number is still increasing. Hence, the prevalence of commuters picking up and alighting from buses at these non-designated public bus stops has been worrisome. This growing situation has cast doubt on the sustainability of the transport policies that have been enacted in the area. It has become imperative to identify the reasons for this increasing trend.

Despite the evidence in the literature showing the incidences of non-designated bus boarding location usage by commuters in different cities, for example, studies by Pudāne and Correia [14] in Latin American countries and Joewono and Kubota [15] in Indonesian cities, only one study known to the authors has attempted to discuss reasons for non-designated bus boarding by commuters from the African context. The review by Behrens et al. [16] reported that most of the existing studies on this subject have thus far concentrated on Western cities, which have different urban structures and socio-cultural dynamics as cities in Nigeria. As a result, the findings of these studies do not have valid implications for urban areas in Nigeria. Therefore, further research is necessary to shed light on the various factors that lead commuters to select non-designated bus boarding locations, as there is currently a dearth of comprehensive studies on the behavioral aspects of bus users and their preferences for boarding locations, particularly within the African context.

Therefore, the present research aimed to determine the factors influencing commuters' choice of non-designated bus boarding locations in Enugu urban, southeast Nigeria, with a view to evolving transportation policies that are robust and sustainable in the area and in other emerging cities in the sub-Saharan African region. The study pursued two basic objectives. The first was to determine the dimension of the specific factors influencing commuters' choice of non-designated bus boarding locations in Enugu, Southeast Nigeria. The second objective was to analyze the influence of each of the identified factors on constraining commuters in utilizing designated bus stop locations in Enugu urban.

Among the significance of this study was the striking revelation of the variables that push and pull commuters to use non-designated bus bays in Enugu, a key metropolitan area in Southeast Nigeria. It also provides a fresh insight into the key factors responsible for this increasing trend, which studies have yet to explore. The study is valuable in revealing the predominant factors that play a key role in influencing commuters' choice of non-designated bus boarding locations in an emerging African city. Therefore, the outcome of this study will indeed inform urban planners and transport experts in Nigeria of the areas in bus bay provision and planning that need more attention when locating them for the optimal use of these bus stops and for the benefit of commuters. In addition, this research makes a contribution to the growing and burgeoning international literature on transportation planning from the angle of a developing country in the global South and sub-Saharan Africa. For emphasis, this study is valuable in revealing as well as uncovering the strategies for enhancing the contribution of designated bus boarding locations to

the transportation sustainability of urban environments.

2 Context of Study

Enugu is the capital of Enugu State. It is located in the southeastern geopolitical region of Nigeria (Figure 1). Enugu City is located between 06°27′N latitude and longitude 07°32′E (Figure 2).

Figure 1. Map of Nigeria
UN cartographic section, 2021

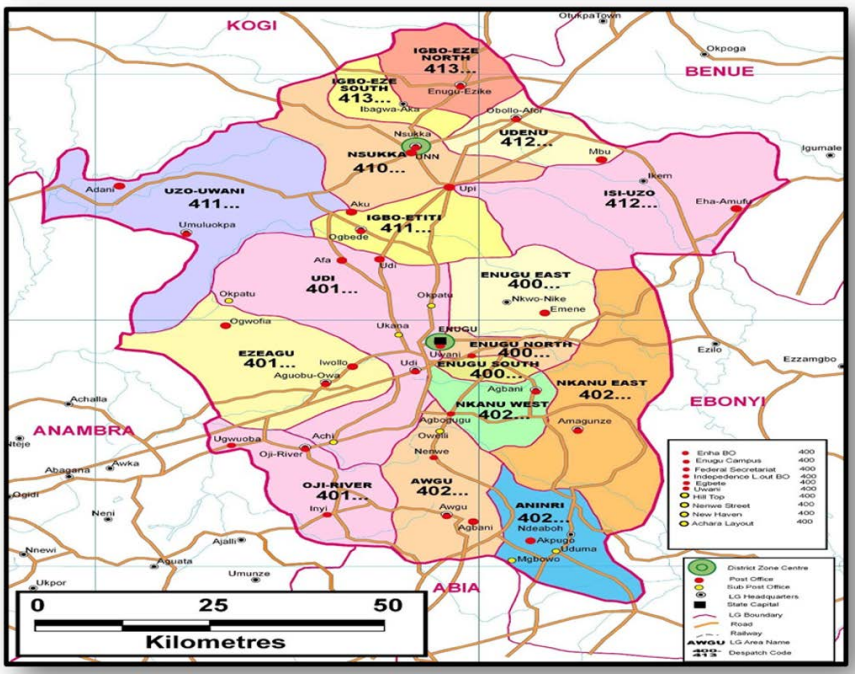

Figure 2. Map of Enugu State showing the local government areas
Source : www.enugu/map, 2023

Enugu urban has land area of about 55.6 square kilometers. This study area consists of 3 local government areas, namely: Enugu East, Enugu South and Enugu North. This was shown in Figure 2. There are 18 prominent residential neighborhoods. Enugu has an estimated population of 62,764 in 1952. The population figure as at the 1991 Census count stands at 462,514. The figure further increased to 722,664 in 2006 [13]. At the urban growth rate of 3.4%, the population figure is estimated to be 1,414,785 in 2023 [13]. The ministry involved in transport in Enugu State is the Ministry of Transport. The ministry is responsible for urban and mass transportation, vehicle inspection, enforcement and operation of traffic laws and rules, procurement and distribution of government plate numbers, registration and documentation of government vehicles, registration, accreditation and monitoring of driving schools, driver training, testing and certification, design, maintenance and traffic light installation, traffic monitoring, surveillance and decongestion, regulation of traffic on bus stops, design/maintenance of bus stops, road safety signs and markings, accident inspection, and court. The commonest type of public transportation vehicle in Enugu Metropolis are mini-buses that operate on fixed routes within the city. They are mainly privately owned and commonly known as "Okpara Keke". They are painted yellow as the official color and have the capacity to carry a maximum of 7 commuters.

3 Research Methods

3.1 Research Design and Study Population

The study utilized a cross-sectional survey research design, involving the distribution of questionnaires and conducting interviews with commuters who either alighted or were about to enter commercial buses from some observed non-designated bus boarding locations across the major roads in the study area. During the pilot survey, approximately 39 observed and steady non-designated bus boarding locations were systematically identified along the 17 major roads in the study area. The research population comprised commuters.

3.2 Sample Size Determination

Due to the lack of distinct population figures for these commuters who chose these non-designated bus boarding locations in the study area, a maximum variability of commuters was assumed, and Cochran's (1963) formula for the infinite population as given in Eq. (1) was used to determine the sample size for the survey.

Minimum sample size,

$$n_0 = \frac{z^2 pq}{e^2} \tag{1}$$

where, n_0 represents the minimum sample size, Z is the critical value for a 95% confidence level, which in this case is 1.96; p = 0.5; q = 1 - p, and e is the desired level of precision in the estimate. Substituting the above parameters in Eq. (2):

$$n_0 = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} \tag{2}$$

Previous studies [17, 18] abound that used these formulas where their distinct study population frame cannot be identified. The estimated sample size for the survey was 384 participants. Although the minimum calculated sample size for the study was 384, to accommodate incomplete and invalid questionnaires, 424 copies of the questionnaire were administered in the study. A total of 424, representing 11% of the calculated sample size, was added to accommodate for non-responses, invalid, or lost questionnaires. This was similar to previous works [17, 18], where the researchers added an extra 10% and 11%, respectively, to the calculated sample size. This means that the lowest number of commuters used in the study was 424 persons.

3.3 Data Collection Instrument and Variables Investigated

Previous study [17] submitted that a questionnaire with evaluation indices is the best instrument used for robust empirical studies on perceived commuter's satisfaction examination. Therefore, the data-gathering instrument used in this study was a structured questionnaire designed by the authors for this research. Data from this instrument were collected in three major categories: commuters' socio-economic profile, their habits while using the non-designated bus bay locations, and the factors that influence their choice of non-designated bus stops in the study area. A structured questionnaire was the data-gathering instrument used in this survey. Data on the demographic characteristics of the commuters as well as the factors that influenced their choice of non-designated bus stop was elicited from the questionnaire. The questionnaires were administered face-to-face to ensure that sampling across the respondents represented different backgrounds, educations, and genders. The questions in the questionnaire have responses that were either open in ranking scale or closed choices. A 5-point Likert scale response was used to ascertain the factors that influence their choice of non-designated bus stops in the study area. Responses seeking

degrees of agreement were posed to respondents, namely: Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA). The choice of this 5-point Likert scale instead of the normal 4 or 3-point scale was to ensure that participants gave definite answers and avoided fake answers [19]. A pre-test sampling was done using a few commuters along a particular road before administering it to the commuters across the 17 major roads in the study area.

Since the current study aimed to determine the dimensions of the factors that influence commuters' choice of non-designated bus stop in the study area, 20 factors identified from the review of the literature and presented in Table 1 were included in the questionnaire as the possible components that influence commuters' choice of non-designated bus stop in the Enugu urban.

Table 1. Factors influencing commuter choices variables identified

Variable Identity	Variables
X1	Convenience
X2	Time-saving
X3	Cost-saving
X4	Availability of buses
X5	Safety/security of commuters and belongings
X6	Proximity to destination
X7	Comfort
X8	Cultural or linguistic diversity
X9	Physical or mental disabilities
X10	Social norms or peer pressure
X11	Dirtiness of the designated bus boarding locations
X12	Home to mentally disable people
X13	Lack of enforcement or penalty
X14	Lack of information or awareness
X15	Weather conditions or environmental factors
X16	Lack of coordination or integration among bus operators
X17	Unpleasant odors at designated bus boarding locations
X18	Inadequate seating at designated bus boarding locations
X19	Presence of pests at designated bus boarding locations
X20	Noise pollution at designated bus boarding locations

Source: Elicited from the pilot study and reviewed literature, 2023

3.4 Data Collection and Analysis

The survey was conducted using the two-stage clustering sampling technique as well as the simple random sampling techniques. Enugu Urban was first clustered into the three administrative local government areas – Enugu North, Enugu South, and Enugu East. The major roads in the metropolis were identified according to their locations across these local government areas in terms of origin and destination of trip locations. The main survey was conducted between May 2022 and August 2023. Due to the target population of the research, the purposive sampling technique was used to determine the desired commuters. The survey was conducted by the researchers and the employed research assistants. The research assistants were engaged in the counting and administration of the questionnaires in each of the identified popular non-designated bus stop locations in the study area and to help interpret the content of the questionnaire to the very few commuters who were not able to read and write. The administration and retrieval of copies of the questionnaire were done on weekdays between 7 a.m. and 5 p.m. and between 6 a.m. and 1 p.m. on weekends. This is in line with methods adopted by previous studies [20]. Even though 424 copies of the questionnaire were administered, 401 copies were properly filled out and used for the study, representing a 92.6% response rate. The number of commuters that were administered questionnaires in the identified non-designated bus boarding location in the major roads in the study area were: Okpara Avenue (n = 25), Ogui Road (n = 25), Zik Avenue (n = 24), Abakiliki Road (n = 26), Agbani Road (n = 26), Bisalla Road (n = 23), Chime Avenue (n = 24), Trans Ekulu Road (n = 26), Mayor Road (n = 25), Gariki Road (n = 28), Achara Layout Road (n = 25), Artisan Road (n = 25), Coal Camp Road (n = 24), Abakpa Nike (n = 25), Uwani Street (n = 26), Enugu Club Road (n = 24), and Obiagu Road (n = 23).

For the analysis of the data, the Commuters' Perception Index (CPI) and PCA were explored.

CPI - The essence of this analytical tool is to appreciate the import of each of these identified factors that influence their choice of non-designated bus stop in the study area. The CPI was calculated based on the commuters' prioritized choices ranked according to their priorities as indicated by the commuters' computed relative perception values. Recall that the responses were weighed according to the degrees of agreement as posed to the respondents,

namely: extremely agreed (4), agreed (3), disagreed (2), and extremely disagreed (1) as assigned in the questionnaire Likert scale. The summation of the weight value (SWV) for each factor is obtained from the addition of the product of the weight value of each rating and the number of responses to each rating [21]. The CPI is finally obtained by dividing mean weight value (MWV) by the total respondents that rated each factor.

$$CPIij = \frac{\mathrm{MWV_{ij}}}{\mathrm{N_{ij}}}$$

where, CPIij = Residents' Perception Index i-j; MWVij = Mean Weight Value of factor i-j; Nij = Respondents' rating; each project i-j.

The average CPI denoted by

$$\mathrm{CPI} = \sum \mathrm{RPI}$$

where, n = the number of identified factors.

The data processing and analysis were performed using the Statistical Package for the Social Sciences (SPSS) version 22.0 for Windows.

PCA was used to collapse the 20 identified factors that influence commuters' choice of non-designated bus stops in the study area into fewer and more manageable factors. These factors were obtained through reviewed literature and a pilot survey. The co-relation matrix (Rmm) was obtained by transforming the data matrix (Dmm) into a matrix of standard scores (Z), where m was the number of variables and n the number of observations or cases. The formula was given as:

$$Rnm = \frac{ZnmT \times Zmn}{\mathrm{N}}$$

The factor scores (Spm) for the original n observation, on each of p components were computed from the formula below:

$$\mathrm{Snp} = \mathrm{Znm} \cdot \mathrm{LTpm}$$

PCA is a linear dimensionality reduction technique with applications in exploratory analysis, visualization, and data preprocessing. In PCA, the data is linearly transformed onto a new coordinate system such that the directions (principal components) capturing the largest variation in the data can easily be identified. However, before subjecting the data to PCA, the dataset was subjected to the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy test and Bartlett's Test of Sphericity. The results revealed that the KMO Measure of Sampling Adequacy was 0.738, which is greater than the recommended minimum value of 0.6, and Bartlett's Test of Sphericity is significant at 0.001. This result implies that the sampling for the study is adequate and the result of the PCA was robust and reliable. The PCA helped to identify the different dimensions (factors) in the study area. This was observed from the percentages, factor loadings, and eigenvalues of each component. The researchers adopted factor loadings of 0.500 and above. This is similar to the studies [22, 23].

4 Results and Discussion

4.1 Commuters' Socio-Economic and Demographic Characteristics

The study shows age, occupation, gender, educational status, occupation, monthly income, and other demographical characteristics of the commuters as presented in Table 2.

The result of the study on the commuters' socioeconomic characteristics (Table 2) indicates that 63.4% of the respondents are male, while 35.6% are female. This study shows that both genders use non-designated bus boarding locations, indicating a relatively balanced representation between males and females. The study shows that the largest portion, constituting 42.0% of the participants, falls within the 50+ age category, highlighting the presence of older individuals. Following this, 22.0% are in the 20-29 age range, indicating a substantial representation of young adults. Moreover, 18.0% belong to the 30-39 age group, while 14.0% are situated within the 40-49 range. Notably, 4.0% of respondents are under 20 years old. This distribution sheds light on the prominence of respondents in their fifties and twenties, showing potential generational influences on preferences for bus boarding locations. Among the respondents, 67.3% did not have informal education, while 31.7% had informal education. This indicates a diversity of educational backgrounds among those using non-designated bus boarding locations. The study further revealed the years of formal education among respondents; notably, 49.3% possess 16 years of education, placing them among those with the highest education levels. Following this, 23.8% have between 17 and 19 years of education, demonstrating a substantial presence of individuals with an extended educational background. Moreover, 9.9% fall into the 12-year educational bracket, which indicates completion of a standard secondary education. Similarly, another 9.9% possess 14 years of education, underscoring consistent attainment of higher education among participants.

Lastly, 9.9% have less than 12 years of education, but the majority have at least a secondary school education, reflecting the prevalence of literate respondents. This distribution reinforces the internal validity of the study by highlighting the educational diversity and literate nature of the surveyed population. The study revealed the occupation of the respondents, showing that 65.3% are employed, while 33.7% are unemployed. This distribution implies that both unemployed and employed individuals are utilizing non-designated bus boarding locations, showcasing a diverse user base. The examination of respondents' income distribution unveils significant insights. Notably, 36.1% fall within the 50,000-100,000 income range, underscoring a substantial presence of individuals within the middle-income bracket. Following closely, another 36.1% earn between 135,000 and 3,000,000, indicating a notable representation in higher income levels. Moreover, 27.8% of respondents earn less than $50,000, which signifies the prevalence of individuals with relatively lower income. This distribution accentuates the dominance of the 50,000-100,000- and 135,000-3,000,000-income brackets, indicating a diverse range of income levels among the surveyed population. The study additionally revealed the distribution of the number of years respondents have spent in Enugu. The highest number, constituting 35.6%, occurs within the 5-8 year range, indicating a significant presence of persons who have spent a reasonable amount of time in the city. Following this, 31.7% had spent less than 5 years in Enugu, demonstrating the substantial number of newcomers. Moreover, 22.8% of respondents have been in Enugu for 9-15 years, suggesting a considerable percentage of longer-term residents. Lastly, 9.9% of respondents had been in the city for 16 years or more, suggesting a lesser share of those with substantial acquaintance. This distribution underlines the significance of those in the 5-8 years and 9-15 years ranges, demonstrating a mix of relatively new arrivals and more established residents among those utilizing non-designated bus boarding spots.

Table 2. Socioeconomic characteristics of respondents

	Socioeconomic Characteristics	**Frequency (N = 401)**	**Percentage** (%)
Gender	Male	257	64.0
	Female	144	36.0
Age range	Less than 27 years	152	38.0
	28-37 years	96	24.0
	38-47 years	80	20.0
	48-57 years	48	12.0
	58 and above	25	6.0
Formal education	Yes	388	97.0
	No	13	3.0
Years of formal education	12-16 years	182	48.6
	17-21 years	206	51.4
Employment status	Unemployed	136	34.0
	Employed	265	66.0
Monthly income (₦)	10,000-39,999	89	22.2
	40,000-69,999	-92	23.0
	70,000-99,999	42	10.4
	100,000-129,999	44	11.1
	130,000-159,999	33	8.3
	160,000-189,999	23	5.6
	Above 190,000	78	19.4
Years in Enugu	1-10 years	184	46.0
	11-19 years	80	20.0
	20-28 years	72	18.0
	29-37 years	9	2.0
	Above 37 years	56	14.0

Source: Field work, 2023

4.2 Dimensions of Factors that Drive Commuters' Choice of Non-Bus Boarding Locations

In order to determine the dimensions of the specific factors influencing commuters' choice of non-designated bus boarding locations in the study area, PCA was used to collapse the 20 identified factors that influence commuters' choice of non-designated bus stops into fewer and more manageable factors. Seven components were extracted from the PCA. To classify the identified components (dimensions), the factor loadings were placed on rotations that converged in seven iterations, and a properly classified rotated component matrix shown in Table 3 was observed. The factors that influenced the commuter choice of boarding buses at non-designated bus boarding were thoroughly examined and categorized into seven distinct components, which collectively accounted for 77.516 percent of the observed variability. These seven components that were clustered from the 20 indices/factors were the dimensions of the specific factors influencing commuters' choice of non-designated bus boarding locations in Enugu, Southeast

Nigeria. This presentation gives a realization to the first objective of the study.

Each of these components is described in detail in the following paragraphs. The first is environmental and social factors, which showed strong positive loadings with various factors, including the presence of mentally disabled people in most city bus bays (0.841), social norms or peer pressure (0.723), noise pollution at designated bus boarding locations (0.697), and dirtiness of the designated bus boarding locations (0.629). Collectively, these factors account for 27.935% of the observed factors that drive commuters' choice of boarding buses at non-designated bus boarding locations, and thus, they stand out as a prominent factor among the participants sampled in the study areas. The second component, which explains about 12.030% of the variance among the 20 variables investigated in this research, is cost and diversity factors. It is loaded with factors such as cost savings (0.783), cultural or linguistic diversity (0.703), physical or mental disabilities (0.665), and weather conditions or environmental factors (0.507). The third component identified is unsanitary/cleanliness concerns, accounting for about 10.560% of the variance in the 20 variables investigated. The four factors loaded on this are inadequate seating at designated bus boarding locations (0.861), unpleasant odors at designated bus boarding locations (0.839), lack of coordination or integration among bus operators, and presence of pests at designated bus boarding locations (0.547). This third factor has an eigenvalue of 10.560. Bus availability and information factors, which include availability of buses, lack of information on where to find the designated bus stops, and lack of enforcement or penalty, contributed 7.911% to the factor that drives commuters' choice of boarding buses at non-designated bus boarding locations in Enugu. The study noted equally that convenience and time-saving factors was the fifth predominant factor that moved commuters' choice of boarding buses at non-designated bus boarding locations in the study area. This accounts for 7.756% of the motivating factors that cause commuters to choose boarding buses at non-designated bus boarding locations in Enugu. A lot of the commuters were seen clustered in groups. The second least common factor that moves the commuters in Enugu to choose boarding buses at non-designated bus boarding locations is the proximity to the destination factor. It contributes about 6.130% of the aggregate factor. The safety/comfort factor was the least common (5.194%) factor that moved commuters' choice of boarding buses at non-designated bus boarding locations in the study area. This suggests that this attribute, which includes the safety/security of commuters and their belongings, and comfort, is the least on the participants' scale of preference for using non-designated bus boarding locations in Enugu urban.

Table 3. Rotated factors showing the components that influence choice of non-designated bus stop locations

Component Names	Factor Loading	Percent Variance
Factor 1: Environmental and social factors		27.935
Home to mentally disable people	0.841	
Social norms or peer pressure	0.723	
Noise pollution at designated bus boarding locations	0.697	
Dirtiness of the designated bus boarding locations	0.629	
Factor 2: Cost and diversity factors		12.03
Cost-saving	0.783	
Cultural or linguistic diversity	0.703	
Physical or mental disabilities	0.665	
Weather conditions or environmental factors	0.507	
Factor 3: Insanitary/cleanliness concerns		10.56
Inadequate seating at designated bus boarding locations	0.861	
Unpleasant odors at designated bus boarding locations	0.839	
Lack of coordination or integration among bus operators	0.675	
Presence of pest at designated bus boarding locations	0.547	
Factor 4: Bus availability and information factors		7.911
Availability of buses	0.858	
Lack of information or awareness	0.747	
Lack of enforcement or penalty	0.503	
Factor 5: Convenience and time-saving factors		7.756
Convenience	0.914	
Time-saving	0.669	
Factor 6: Proximity to destination factors		6.13
Proximity to destination	0.842	
Factor 7: Safety/comfort factors		5.194
Safety/security of commuters and belongings	0.891	
Comfort	0.69	
Total		77.516

Note: Extraction method. PCA; Rotation Method: Varimax with Kaiser normalization

In summary, these results show that the commuters understood the reason for using the non-designated bus

boarding locations during their trips in seven key dimensions, as presented in Figure 3, namely: 1) environmental and social factors; 2) cost and diversity factors; 3) insanitary/cleanliness concerns; 4) bus availability and information factors; 5) convenience and time-saving factors; 6) proximity to destination factor; and 7) safety/comfort factor. These dimensions collectively explain a substantial portion of the factors that cause commuters to choose the non-designated bus stop location in the study area, accounting for 77.516% of the observed variance in the 20 variables investigated.

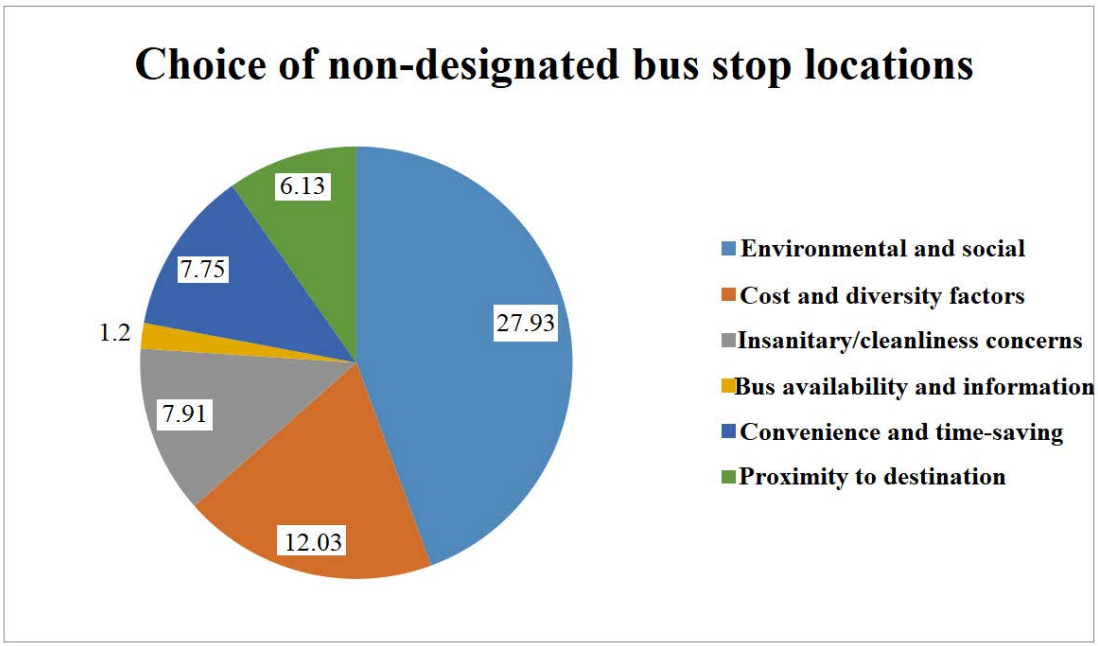

Figure 3. The PCA factors that influenced the choice of using non-designated bus boarding locations in Enugu urban

4.3 Commuters' Reasons for Choosing Non-Designated Bus Boarding Locations

In other to realize as well as appreciate the influence of each of the identified factor constraining commuters in utilizing designated bus stop locations in Enugu urban which was the second objective, the respondents were asked to state the degree to which they agree or disagree with the statement about the major factors that prompt their choosing of non-designated bus boarding locations. Commuters' Perception Index (CPI) was then used to appreciate the import of each of these identified factors that influence their choice of non-designated bus stop in the study area. It is a thumb of rule that the nearer the CPI to 4, the more influential the factors are considered by commuters.

Table 4 presents the results, highlighting various factors affecting respondents' perceptions of constraints in utilizing designated bus stop locations. The factors are ranked based on their mean scores, and the corresponding percentages of Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA) responses are provided. Availability of buses (Mean = 3.98), this factor ranked 1st, with 42% of respondents agreeing and 22% strongly agreeing that it influences their bus transportation usage positively. Convenience (Mean = 3.87), ranked 2nd, with 54% of respondents agreeing and 12% strongly agreeing that it affects their bus transportation usage positively. Inadequate seating at designated bus boarding location (Mean = 3.86), ranked 3rd, 54% of respondents agreed and 14% strongly agreed that this constraint impacts their bus transportation usage. Time-saving (Mean = 3.89), this factor ranked 4th, with 44% agreeing and 16% strongly agreeing that it influences their bus transportation usage positively. Unpleasant odors at designated bus boarding location (Mean = 3.79), Ranked 5th, 62% of respondents agreed and 6% strongly agreed that this constraint affects their bus transportation usage. Lack of coordination or integration among bus operators (Mean = 3.71), This factor ranked 6th, with 48% agreeing and 2% strongly agreeing that it influences their bus transportation usage. Cost-saving (Mean = 3.62), ranked 7th, 36% of respondents agreed and 8% strongly agreed that this constraint impacts their bus transportation usage. Noise pollution at designated bus boarding location (Mean = 3.60), this factor ranked 8th, with 32% agreeing and 12% strongly agreeing that it affects their bus transportation usage. Presence of pests at designated bus boarding locations (Mean = 3.60), ranked 9th, 40% of respondents agreed and 4% strongly agreed that this constraint influences their bus transportation usage. Weather conditions or environmental factors (Mean = 3.53), ranked 10th, 38% agreed and 6% strongly agreed that these factors impact their bus transportation usage. Proximity to Destination (Mean = 3.67), this factor ranked 11th, with 36% agreeing and 16% strongly agreeing that it influences their bus transportation usage. Comfort (Mean =

3.41), ranking 12th, 36% agreed and 8% strongly agreed that this constraint affects their bus transportation usage. Safety/security of passengers and belongings (Mean = 3.38), this factor ranked 13th, with 32% agreeing and 6% strongly agreeing that it influences their bus transportation usage. Lack of enforcement or penalty (Mean = 3.33), ranked 14th, 32% agreed and 2% strongly agreed that this constraint impacts their bus transportation usage. Lack of information or awareness (Mean = 3.31), this factor ranked 15th, with 32% agreeing and 2% strongly agreeing that it affects their bus transportation usage. Dirtiness of the designated bus boarding location (Mean = 3.29), ranked 16th, 32% agreed and 6% strongly agreed that this constraint influences their bus transportation usage. Social norms or peer pressure (Mean = 3.24), ranked 17th, 30% agreed that this factor affects their bus transportation usage. Cultural or linguistic diversity (Mean = 3.20), this factor ranked 18th, with 38% agreeing and 2% strongly agreeing that it influences their bus transportation usage. Home to mentally disabled people (Mean = 3.00), ranked 19th, 40% agreed and 14% strongly agreed that this constraint impacts their bus transportation usage. Physical or mental disabilities (Mean = 3.00). This factor also ranked 19th, with 40% agreeing that it affects their bus transportation usage.

Table 4. The mean scores for each of the twenty (20) factors or reasons studied

Factors	SD Freq(%)	D Freq(%)	N Freq(%)	A Freq(%)	SA Freq(%)	Mean	Rank
Availability of buses	2	12	22	42	22	3.98	1th
Convenience	4	10	20	54	12	3.87	2nd
Inadequate seating at designated bus boarding location	6	12	14	54	14	3.86	3rd
Time – saving	2	8	30	44	16	3.89	4st
Unpleasant odors at designated bus boarding location	6	16	10	62	6	3.79	5th
Lack of coordination or integration among bus operators	4	14	32	48	2	3.71	6th
Cost – saving	16	2	36	38	8	3.62	7th
Noise pollution at designated bus boarding location	8	24	24	32	12	3.6	8th
Presence of pest at designated bus boarding locations	8	16	32	40	4	3.6	9th
Weather conditions or environmental factors	8	18	38	28	6	3.53	10th
Proximity to destination	16	32	20	36	16	3.67	11th
Comfort	6	36	26	20	8	3.41	12th
Safety/security of passengers and belongings	10	30	32	20	6	3.38	13th
Lack of enforcement or penalty	18	20	32	26	2	3.33	14th
Lack of information or awareness	16	32	22	28	2	3.31	15th
Dirtiness of the designated bus boarding location	22	32	12	28	6	3.29	16th
Social norms or peep pressure	24	30	16	30	-	3.24	17th
Cultural or linguistic diversity	24	24	38	12	2	3.2	18th
Home to mentally disable people	32	40	10	14	4	3	19th
Physical or mental disabilities	30	40	26	4	-	3	20th

Source: Field work, 2023

5 Discussions

The study aimed to identify the factors that influenced commuters' choice of non-designated bus boarding locations in Enugu, southeast Nigeria. The major findings in this study, as presented earlier, are brought forward for further discussion. Firstly, it was observed that commuters sampled understood the factors that influenced their choice of non-designated bus boarding locations in Enugu urban from seven key dimensions: environmental and social factors; cost and diversity factors; unsanitary/cleanliness concerns; bus availability and information factors; convenience and time-saving factors; proximity to destination factor; and safety/comfort factor. Notably, these dimensions represent the factors associated with the use of non-designated bus boarding locations in Enugu's major roads sampled.

Second, the study found that environmental and social factors were the most important factors that drove the commuters to use these illegal bus stops in the study area. This factor, which involves the presence of mentally disabled individuals, social norms or peer pressure, and noise pollution at designated bus boarding locations,

had a significant influence on commuters' use of non-designated bus stops. These results lend credence to the findings [24, 25]. Møller-Jensen and Agergaard [24] explored the impact of introducing a bus rapid transit system on commuter behavior and welfare in Accra, Ghana, revealing that the presence of mentally disabled individuals at some bus stops could deter commuters. They suggested that providing adequate facilities and care for them could enhance ridership and social inclusion. This is understandable because of the steady presence of mentally derailed and disabled individuals in the bus stops. These people have virtually taken over the bays, asking for arms and aids from passengers. This is disturbing and uncomfortable to the commuters, as these findings sync with the findings of previous studies [26, 27].

It was also found that cost and diversity factors were the second most significant factors that cause commuters to choose boarding buses at non-designated bus boarding locations in Enugu (see Table 3). Economic considerations and diversity factors play a vital role in influencing transportation choices in Enugu metropolis. These factors include variables like cost-saving, cultural or linguistic diversity, physical or mental disabilities, and weather conditions or environmental factors. These variables have been found to be influential in shaping commuter preferences in various contexts. For instance, some studies identified cost-saving as a significant factor affecting commuters' preferences for bus stops in their respective studies in Kenya and Tanzania [28–30]. Additionally, another study investigated the effects of different rainy conditions on boarding lost time (BLT) at regular bus stops [31], and the finding revealed that heavy rainfall significantly increased BLT, affecting commuters' comfort and safety. Moreover, cultural and linguistic diversity was studied in South Africa's automotive component manufacturing industry [32], highlighting the influence of cultural diversity on business performance. Cultural diversity may also affect commuter preferences for non-designated bus boarding locations, as they seek interaction with diverse groups or aim to avoid potential conflicts or misunderstandings. This was in line with the findings of Kokt [33]. Furthermore, considerations of physical or mental disabilities in commuter choices are supported by the Department of Economic and Social Affairs, United Nations, on inclusive access to transport infrastructure, emphasizing the need to address barriers and ensure accessibility for disabled individuals [34–36].

The third most important factor that influenced the use of non-designated bus stops among the population sampled in the survey was insanitary/cleanliness concerns. Respondents in the survey generally stated that they're not using the designated bus bays due to inadequate seating at designated bus boarding locations, unpleasant odors at these locations, lack of coordination or integration among bus operators, and the presence of pests at designated bus boarding locations. A study identified inadequate seating, unpleasant odors, lack of coordination among bus operators, and the presence of pests as significant factors affecting the commuters' preferences [37]. Moreover, a similar study investigated the preferences of wheeled mobility device users for bus boarding, highlighting the influence of pest presence on commuter choices and positing that ensuring adequate pest control measures can enhance ridership and accessibility [38]. This reinforces the relevance of these variables in analyzing commuter choices for non-designated bus boarding locations in Enugu metropolis.

Again, in support of the existing studies, it was also found that bus availability and information factors [39, 40], which include availability of bus, lack of information on where to find the designated bus stops, and lack of enforcement or penalty, these factors have been consistently found to impact bus ridership and compliance with traffic regulations in other contexts. For instance, a study investigated the effects of bus stop characteristics on bus ridership and found that the availability of buses, the level of information or awareness, and the enforcement or penalty were key determinants of bus ridership [41]. Similarly, Okafor et al. [42] assessed the awareness and compliance with traffic rules and regulations among commercial bus drivers in Lagos, Nigeria, revealing that low awareness and compliance were often linked to a lack of enforcement or penalty. These findings emphasize the importance of these variables in analyzing commuter choices for non-designated bus boarding locations.

Similarly, some convenience and time-saving factors, as well as proximity and destination factors, significantly influence commuter choices in the Enugu metropolis. Proximity to desired destinations is a crucial factor in shaping commuter preferences, as identified in a similar previous study [17]. This finding aligns with former research [43], where the study assessed the factors affecting public transport patronage in the Enugu metropolis and highlighted proximity to desired destinations as a key factor. Additionally, previous research on the influence of proximity to public transit on travel behavior revealed that proximity to transit stops or stations positively correlated with transit use [44]. Similarly, in investigating commuting behavior in the San Francisco Bay Area, it was revealed that proximity to transit stops or stations significantly influenced mode choice [34].

Finally, safety and comfort factors were another force that influenced commuter preferences for non-designated bus boarding locations in the Enugu metropolis. Variables such as comfort and safety/security of commuters and their belongings significantly influence choices. This finding was in line with previous studies that posited that comfort and safety/security considerations were strong drivers of commuters' behavioral preferences on where to board a bus [39, 45, 46]. Furthermore, findings also collaborate with this study that safety was one of the key concerns of the commuters that influences his/her choice of the particular spot to board bus for transit in many metropolises of the world [34]. These findings further synchronized with the study that posited the import of safety

and security in commuters' choice of a bus bay location to use [44]. Ensuring the safety and security of commuters and their belongings is essential for promoting the use of public transportation in the Enugu metropolis.

6 Conclusions and Study Implications

The present research investigated the factors influencing commuters' underutilization of designated bus boarding locations and using the non-designated bus stops in Enugu urban, southeast Nigeria. Based on the findings, two key conclusions are made. Firstly, it can be concluded that the commuters sampled in the survey understand the variables that influence the use of the non-designated bus stop locations in seven key dimensions: environmental and social factors; cost and diversity factors; unsanitary/cleanliness concerns; bus availability and information factors; convenience and time-saving factors; proximity to destination factor; and safety/comfort factor. Secondly, the factor with the most significant influence on constraining commuters in utilizing designated bus stop locations in Enugu urban is the availability of buses in these non-designated bus stops (in other words, commercial buses are always at hand in these areas since they do not need to queue in the designated areas); this is followed by convenience. The least significant factor is the steady presence of the mentally and physically challenged people who had made these designated bus stops their abode.

These findings have some noteworthy implications. Firstly, the study implies that the seven dimensions of factors that cause the use of these non-designated bus stop locations by commuters are the aspects this segment of society can easily relate to in their understanding and assessment of what factors increase this worrisome trend in the study area. Hence, researchers and scholars interested in this subject area should pay attention to these dimensions if they must understand the perspectives of the commuters on what drives them to use these non-designated bus stop locations and similar spaces. In addition, the knowledge of these dimensions will improve the validity of research findings on this subject and the effectiveness of bus bay location planning and development in Enugu and other cities that have similar demographic and sociocultural experiences.

Secondly, the findings also imply that to create commuter-friendly bus bays, urban planners and architects need to also pay attention to factors identified to have influenced the use of these unofficial bus stops in the major roads sampled in this survey. To this end, urban policymakers, planners, designers, and transport managers should consider locating bus stops in locations that are not only accessible to homes but also ensure that they are neat and devoid of miscreants and other unwanted persons in these public facilities. In addition, such spaces should be adequately equipped with modern facilities, properly managed and maintained, and provided with adequate security.

Lastly, even though the present study has achieved its goal, it has some noteworthy limitations and weaknesses. First, this study is limited to 424 respondents and 20 variables. Further study should consider more commuters that cut across all the neighborhoods in any study area as well as not limiting the study only to commuters that use the major roads. Furthermore, many more variables could still be fetched, thereby making for more robust findings and conclusions. Second, the study is based on a cross-sectional survey and captures a snapshot of the existing situation and cannot account for what will happen thereafter. To circumvent this, it is suggested that future studies should consider adopting longitudinal surveys for an adequate understanding and more dependable and enduring insights into the factors that influence the use of non-designated bus stop locations. The study was focused on major urban roads and did not consider suburban areas. Hence, it is recommended that similar studies be extended to both urban and suburban spaces in the study area.

Data Availability

Not applicable.

Conflicts of Interest

We have no conflicts of interest to disclose.

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