

COMMUTERS' TRAVEL CHARACTERISTICS, MODAL CHOICE AND PERFORMANCE OF PUBLIC TRANSPORT OPTIONS IN LAGOS, NIGERIA

Wale Alade¹, Mobolaji Olaseni² and Olufemi Adeniji³

^{1 & 3} University of Lagos

²Yaba College of Technology

Correspondence email: femiadeniji@yahoo.co.uk

ABSTRACT

Received: 28 July 2018

Reviewed: 30 Dec 2018

Accepted: 18 Jan 2019

In the past decade-plus there has been a paucity of comparative studies of the performance of public transport options in Lagos. This study evaluates commuters' access to public transport modes (yellow bus, BRT and ferry), trip characteristics, factors influencing choice of, and the performance of each mode in Lagos to establish improvement priorities. Research data was obtained from 124 commuters through close-ended questionnaire at selected terminals on a major corridor during the morning peak period using incidental sampling technique. The performance of public transport modes was measured using seven variables on a 5-point rating scale. Analysis of variance show significant variation in commuters' trip cost to terminals. The BRT is the most affordable with respect to fare but has the worst boarding delay occurrence, the ferry is the most efficient with respect to trip time while 45% of yellow bus passengers spend more than one hour per trip. From the linear regression results, delay time at the terminals, travel time and travel cost to destinations accounted for about 55.8% of the total variance in the preferred mode of travel. From the relative performance analysis results, the BRT has the highest mean performance index of 3.72, followed by ferry (3.01) and the yellow bus (2.62). These findings facilitate our understanding of factors influencing the performance and choice of public transport modes in Lagos while providing insights into areas needing attention for improvement. Based on these findings, the study recommended the provision of more BRT buses to reduce the waiting time at terminals, and the review of ferry operations to reduce fare and enhance safety and introduce measures to upscale the services of the for better performance. Future studies should explore commuter waiting and comfort at bus stations and terminals and on-board time use.

Keywords: Commuter; Modal Choice; Public Transport; Travel Behaviour; Mobility; Performance

INTRODUCTION

Mobility has been identified as an essential component of life for humans, constituting an integral part of the daily round of activities (Albalate and Bel, 2010). In recent times and in most cities, the peoples' mobility needs have been adequately met by the public modes of transport (Sam et al., 2014), thus highlighting the services provided by these modes as specific and germane (Polat, 2012). As a basic instrument of mobility for larger proportion of the population in almost all countries, public transport ranks highly among the basics essentials of peoples' daily living and this explains why it is not only demanded but also required in modern times.

Globally and in Africa, public transport forms one of the driving forces of economic and social life as it defines the behaviors and living standards of public commuters. Implicitly, public travel refers to

the movement of passengers from a point of origin to another point of destination by group transport systems available for use by the public and operated on established routes with attached financial cost (Schofer, 2018). It could be inferred that commuters are people who exhibits the main characteristics inherent in this definition of public travel. This includes journeying from one place to another, use of systems/modes of group/public transport and the use of established routes for trips.

Commuters often find themselves in a public transport environment that is dynamic and even interactive. This environment is characterized by a combination of alternative transport modes, various types of passengers (such as students, workers and leisure commuters) with different travel purposes, different travel frequencies and different travel times (Polat, 2012). This situation is typical of what exist in cities of developed and developing countries of the world, including nations in sub-Saharan Africa, and Nigeria is no exception.

The performance of different modes of public transport has been closely associated with commuters' satisfaction which is a product of derived utility. It is also seen as a determining factor on modal choices as well as a vital means of analysing commuters' behaviour in the aspect of choice of mode (Mintesnot and Shin-ei, 2007). Besides, Cao and Cao (2017); de Oña and de Oña (2015); Zhang, Cao, Nagpure, and Agarwal (2017), reported that passenger satisfaction assessment helps service providers to set strategic development goals and to determine service improvement priorities within limited budgets, to ultimately improve the performance of service providers (Irfan, Kee, & Shahbaz, 2012).

Travel behaviour as an associate of choices of public transport and commuters' satisfaction is described as what people do over space, and how people make use of transport. Without a proper understanding of the system dynamics and more importantly the behaviors of public commuters, accurate forecasts and knowledge required for planning and policy making in public transportation would be difficult to realise (Taylor and Camille, 2012). Thus, an analysis and understanding of the performance of public transport, and the factors influencing modal choice and travel behaviors is germane for the attainment of an efficient and effective public transport system in cities with a high rate of population growth such as Lagos megacity.

In the past decade, Lagos state government has invested more in the expansion of public transport system with the introduction of Bus Rapid Transit (BRT) to complement and ultimately replace the conventional yellow (mini) bus and the development of water transport through public-private partnership as entrenched in the state's strategic transport masterplan (2002). The Lagos Rail project has not yet completed, hence, excluded in this study. Although evidence from literature indicates that a number of studies have explored the performance of the public transport system in Lagos (Olufemi, 2008; Adebambo and Adebayo, 2009; Bashorun and Rotowa, 2012; Amiegbebor, Akarakiri and Dickson, 2016), these existing studies have largely ignored the comparative analysis of the options available to commuters. This study therefore examines the performance of the three dominant public transport options (BRT, yellow bus and ferry) in Lagos, it evaluates commuter access to each mode and the factors that influence modal choice.

The paper adopts the relative performance analysis (RPA) to determine the performance of each mode. Then it employs linear regression to establish the factors influencing commuters' modal choice. Access to public transport and trip characteristics were analysed descriptively, however, analysis of variance was used to establish the significance of the variation in commuters' access to public transport. The limited number of studies on this subject has hindered the capacity of practitioners to design and enhance transport services with informed empirical knowledge, especially in respect of the yellow bus being the only informal mode among the options studied in this paper.

Following the introduction, the next section reviews the literature on determinants of commuter choice, travel behaviour and public transport performance. The methods of research and analysis are presented in the third section while section 4 discusses the results of commuters' access, travel characteristics, factors influencing modal choice and the performance of public transport modes. The final section summarizes the key findings and makes recommendations for future research.

LITERATURE REVIEW

Determinants of Commuters' Choice of Public Transport and Travel Behaviour

The preference of one mode of public transport over the other is unarguably dependent on a wide range of factors as commuters are wont to choose travel modes most likely to offer them maximum utility. As identified by Polat (2012) the factors of fare, travel time (walk access time and accessibility of transport, waiting time, in-vehicle (journey time), service quality, comfort, reliability, availability and costs of alternative travel modes, time of travel, purpose of travel and lastly the level of public transport dependency are the demand determinants of public transport. There are other factors aside the aforementioned that play significant roles in determining the choices and behaviour of passengers. Researchers have argued that perceived safety and security orientation of a transport service provider by commuters may also play active role in the decision of which service provider to patronize (Sam et al., 2014).

Transport fares are critical to the supply of public transport services since they serve as the main source of income for operators. Bresson et al., (2004) stated that the relationship between fares and public transport patronage tend to be inverse, where higher fares are associated with decreased patronage and vice versa. It is however, noted that the effect of fares on patronage is not similar in all modes of public transport and in all time frames. For instance, Crotte (2008) examined the factors that characterized travel demand in Mexico City and discovered that changes in fares did not explain changes in Metro demand in Mexico City. The study detected that rather service improvements had a more significant effect on patronage than changes in Metro fares or gasoline prices (Polat, 2012).

Travel time has been one of the significant factors that influence both the choice and use of one public transport mode to the other. The fact that commuters cannot increase their travel time indefinitely emphasizes its importance (Golob et al., 1972). There are several components of travel time within the purview of public transport (Polat, 2012). Walk (or access) time, waiting time and journey (in-vehicle) time are the three main components of travel time and the value attached to each of these components vary from one commuter to the other. For a typical public commuter, the price includes many of these cost components including access times to service points and final destinations, waiting times at stops and interchanges and travel times at vehicles which in its entirety influence the commuters' assessment of public transport services (Horn, 2003).

The quality of service delivery on each public travel by each mode of public transport is another variable with a direct and powerful influence on the choice and patronage of public commuters (FitzRoy and Smith, 1998). Service quality includes but not limited to waiting time, service frequency, operating speed, reliability and comfort (Sam et al., 2014). Despite the difference in the level of importance attached to comfort from one group of passengers to another based on the journey time, journey purpose and passenger type, comfort is a quality factor that should be considered. Comfort is expected to positively affect demand on a mode of transport (Polat, 2012) and determine the pattern exhibited by commuters on their trip. Another point to consider is the degree of overcrowding in vehicles as this is expected to affect comfort and invariably create unpleasant and uncomfortable travel experiences for commuters.

Seating arrangements in the vehicle and leg- room space as well as general vehicle cleanliness are other aspects of comfort a vehicle and other modes of public transport should provide (Sam et al., 2014). Koppelman and Lyon (1981) emphasized that people's perceptions about convenience and comfort as well as their normative beliefs associate positively with preference and hence the choice for a given mode of transportation. It is even thought that elements with the most physiological importance to comfort are those which affect quality of a ride as well as the effort of driving such as noise, vibration, ventilation, glare, odour and seating arrangement (Neumann et al., 1978). Scholars have suggested that

choice of mode for various trips is either directly or indirectly influenced by people's personal circumstances including their age, gender, household size, educational attainment and income (Buchanan et al., 2006).

Perceptions of safety as well as travel experience with a mode of transport are likely to influence travel decisions, behaviors and preference for one mode from the other (Ankomah, Crompton, and Baker 1996). The degree of reliability of the services on a mode of public transport is another important determinant of preference, patronage and travel behaviour. Reliability on a transport mode refers to the degree of dependability on and trust-ability of passengers in the services provided. It includes features such as accessibility and confidence because the passengers should be able to depend on those services and be able to see that they are obtainable on regular basis and are long termed. Longer waiting times due to late arrival of buses and excessive in-vehicle times due to traffic or system problems reduce reliability, one of the clearest measures of which is the degree of those services' following time schedules announced (Sam et al., 2014). Other factors such as service frequency and service capacity also determine the usability of public transport services and thus also affect the reliability. If the service capacity available is insufficient to meet the current demand, commuters are less likely to find those services reliable".

Public Transport Performance

Studies on performance of public transport abound in literature but largely skewed towards passenger satisfaction and largely concentrated in the global north than the south. Besides, majority of those studies concentrate on rail. Agunloye, Alade and Fadare (2010) investigated the performance of passenger train service in Lagos, Nigeria. The study adopts a descriptive analysis based on the perception of the intra-urban train passengers on service adequacy using six variables which include safety, comfort, accessibility, reliability, fare and efficiency. The study concludes that train service in Lagos is adequate and recommended the modernization of the system for better performance.

Similarly, Afolabi (2016) examined commuter perception and preferences on Lagos BRT. The study was purely descriptive and merely used two variables (quality of service and reason for patronage) to assess passengers' evaluation of the BRT service. The study noted that 37% of respondents chose affordability for patronage and about 50% rated service quality as good. In another study, Alade and Olaseni (2018) explored the performance of the BRT in Lagos using passenger satisfaction index using 13 variables. The study revealed that the BRT generally offers a good service but concludes that 10 years down the line, passengers are still not satisfied with waiting time to board and comfort in transit which are critical priorities as the government expands the BRT infrastructure.

In the global north, Zhen, Cao and Tang (2018) noted in their study of satisfaction with high-speed rail (HSR) in China that rider satisfaction is an important research topic in the field of transit which has received little attention, presumably because of its limited impact on transportation systems in English-speaking countries such as the Netherlands, Australia, Canada, the UK, and the US. Chou and Kim (2009) employed structure equations models (SEM) to compare HSR satisfaction of 418 passengers in Taiwan and 414 passengers in Korea. In the study, it was assumed that service quality affects satisfaction directly and indirectly through its influence on corporate image, and satisfaction in turn influences complaints and loyalty. In their models, service quality is a latent construct underlying five groups of observed service attributes including riding security, access convenience, service responses, tangible facilities, and riding comfort.

Cao and Chen (2011), following the research design of Chou and Kim (2009), examined satisfaction of 386 passengers of the Shanghai-Nanjing HSR. They reached the same conclusion on the relationships among service quality, corporate image, and customer satisfaction as Chou and Kim (2009). Although this study sheds light on HSR in China, it is also vulnerable to the limitation of Chou and Kim (2009). Zhen, Cao and Tang (2018) reported that Wu, Lin, and Hsu (2011) overcomes the limitation of a reflective SEM by explicitly measuring service quality, noting that, the study developed a conceptual

model to connect service quality, perceived value, corporate image, satisfaction, and behavioral intentions.

In another study reported by Zhen, Cao and Tang (2018), Lee, Jin, and Ji (2009) used 453 HSR passengers in Korea to explore the effects of ambient, seat, tunnelling effect, and motion sickness factors on human fatigue and ride comfort. The study appeared to employ a formative SEM as the latent construct of ride comfort as predicted by seat comfort, overall satisfaction, and ride comfort. The results showed that in terms of HSR attributes, both seat factors and ambient factors affect ride comfort; seat pitch and width influence it the most.

Finally, Zhen, Cao and Tang (2018) noted that studies (e.g., Chou & Kim, 2009; Chou & Yeh, 2013) examined the relationship between service quality and HSR satisfaction from a marketing perspective and substantiated the relationship. The studies shed light on the significant impact of service quality on customer satisfaction, loyalty, and behavioral intention. However, the reflective SEM used in these studies does not allow researchers to differentiate which service attributes have a more important role than others. A few studies assess the relative importance of different service attributes (e.g., Lee et al., 2009; Wu et al., 2011), however, this study extracts seven variables from literature for assessing the performance of public transport options using linear regression model to enable practitioners identify key influential attributes for service and system improvement.

METHODOLOGY

The study utilised both quantitative and qualitative research approach to achieve its goal of comparative analysis of commuters' modal choice, travel behaviors and the performance of the three major public modes in Lagos excluding rail transport on the Ikorodu-Lagos Island corridor. The corridor which connects the northern and southern parts of Lagos together is the only corridor that features the three public transport modes. The questionnaires are designed based on the literature and informed knowledge. Primary data on commuter's socio-economic access to public transport (travel mode, time and cost to terminals), travel characteristics (travel time and cost to destination, delay at terminals etc.), and, commuters' assessment of public transport options e.g. fare, reliability, safety etc. to measure performance.

Due to the nature of the research, selection of sample size is usually difficult since sampling frame cannot be easily determined, hence, data was obtained from 124 commuters through close-ended questionnaire at selected terminals during the morning peak period using incidental sampling technique. This is a method where all passengers met at the terminals were purposively selected and sampled as respondents. The performance of public transport modes was measured using seven variables (fare, safety, waiting time to board, trip time, convenience, efficiency and user friendliness) on a 5-point rating scale (1 = poor, 2 = fair, 3 = good, 4 = very good and 5 = excellent). The morning peak period was chosen as the time to obtain data at selected terminals. Further, participant's observation was also adopted, using the three means of transportation to fully understand, analyse and compare between the road and water modes of transportation.

Commuters' access to public transport and travel characteristics were analysed descriptively using frequency distribution. Analysis of variance was used to test the significance of the variation in commuters' access to public transport while linear regression analysis was used to determine the factors that influence modal choice and relative performance analysis (RPA) was used to measure the performance of each mode by calculating the mean performance index.

DATA ANALYSIS AND DISCUSSION

The analysis of data obtained from the field survey was carried out under four main categories. These categories are the central issues examined in the study, namely, the socio-economic attributes of

respondents (public commuters), users access to public transport, commuters' experiences with public transport and the performance of the selected modes of public transport in the study area.

Socio-Economic Attributes of Respondents

The analysis of the socio-economic characteristics of public commuters as compared among the preferred mode of travel of the respondents, present variations in the demographic attributes of the users as shown in Table 1. With respect to the gender distribution of public commuters, it was observed that there was an even distribution of the male and female users of the yellow buses, a slight variation in the gender distribution among the BRT users and a much wider disparity among users of the ferry services. Thus, there were more proportion of male users of the BRT and ferry modes of public transport in the study area as expressed in the percentage distribution of the respondents which was 50%, 59.1% and 70% of the user respondents of the yellow buses, BRT and ferry services respectively that were male.

The analysis of the age distribution of the respondents' modal choice of transportation indicates that more than half of the users who adopted road transport as a means of transportation were between the ages of 16 and 35 years. The age distribution of the users of water transport (ferry) also revealed that a sizeable proportion of the users were between ages 26 and 40 years. The age distribution of users of the yellow buses indicated that about 27.5% were in the 16-25 years' age group, 37.5% belonged to the 26-35 years' group and 20% were between ages 36-45 years. Other include 12.5% and 2.5% who belonged to the 46-55 years and 56-65 years' age groups respectively. Hence, it is evident that most public commuters within the study area irrespective of their modal choice were young adults between the age of 18 and 45 years, otherwise known as the active age group.

Further analysis of the socio-economic characteristics of the respondents as shown in Table 1 reveals that the modal choices of respondents varied in relation to their educational attainment and employment status. It was observed that public commuters by ferry had a minimum of secondary school education and almost 60% of these commuters were employed by the informal sector of the economy. The sizeable proportion of commuters engaged in informal activities further attest to the potential of the inland water ways for movement of bulk goods, thereby easing the stress on the highways. Public commuters by BRT were also noticed to have a minimum of basic primary education with about 65% of them employed formally and informally, while a reasonable amount of the unemployed were students. The users of the yellow buses were mainly literate people with about 85% of them having a minimum of secondary school education. More than 70% of these users were employed either formally or informally while the remain users than are less than 30% of the respondents were students and an insignificant proportion of the unemployed. The public commuters across the three identified modal choices that were sampled for the study were observed to be predominantly literates and employed. This is consistent with the nature of the metropolitan area that has been identified as a city with a high level of commerce and employment opportunities for skilled, semi-skilled and unskilled labour.

The average monthly income of the users of the yellow buses indicated that the respondents who earned ₦100,000 and below monthly constituted about 75%, while 30% and 7.5% earned average monthly incomes of ₦100,001 to ₦150,000 and ₦150,001 to ₦200,00 respectively. Similarly, about 90% of the users of the BRT earned ₦100,000 and below while 6.4% and 3% earned between ₦100,001 and ₦200,000 and a much insignificant proportion of about 3% earned above ₦200,000. Public commuters by ferry however, had a different average monthly earning from the road users as it was noticed that over 65% of these users earned more than ₦100,000 monthly. About 26.5% of respondents who travelled by ferry earned between ₦50,000 and ₦100,000, while less than 10% of the user respondents earned less than ₦50,000. Evidently, the occupation and monthly income of public commuters influence their preferences on modes of public transport.

Table 1: Socio-economic attributes of commuters

Demographic Attributes		Yellow Bus (N=40)		BRT (N=44)		Ferry (N=40)	
		Freq	%	Freq	%	Freq	%
Gender	Male	20	50.0	26	59.1	28	70.0
	Female	20	50.0	18	40.9	12	30.0
	Total	40	100.0	44	100.0	40	100.0
Age (years)	16 - 25	11	27.5	11	25.0	2	5.0
	26 - 35	15	37.5	21	47.7	12	30.0
	36 - 45	8	20.0	9	20.5	20	50.0
	46 - 55	5	12.5	2	4.5	5	12.5
	56 - 65	1	2.5	1	2.3	1	2.5
	Total	40	100.0	44	100.0	40	100.0
Educational Qualifications	None	3	7.5	-	-	-	-
	Primary	3	7.5	1	2.3	-	-
	Secondary	16	40.0	17	38.6	9	22.5
	Tertiary	18	45.0	26	59.1	31	77.5
	Total	40	100.0	44	100.0	40	100.0
Employment Status	Employed (formal)	9	22.5	13	29.5	23	57.5
	Employed (informal)	21	52.5	16	36.4	12	30.0
	Unemployed	3	7.5	3	6.8	1	2.5
	Student	7	17.5	12	27.3	4	10.0
	Total	40	100.0	44	100.0	40	100.0
Average monthly income	₦1,000 - 50,000	10	25.0	16	35.5	2	5.9
	₦50,001 - 100,000	12	30.0	25	54.8	11	26.5
	₦100,001 - 150,000	7	17.5	1	3.2	8	20.6
	₦150,001 - 200,000	1	2.5	1	3.2	6	14.7
	Above ₦200,000	-	-	1	3.2	13	32.4
	Total	40	100.0	44	100.0	40	100.0

Commuters' Access to Public Transport

Commuters' access to public transport was analysed with respect to travel mode, travel time and the cost of travel to the respective terminals. The various modes of travel to respective terminal identified include: walking, motorcycle, bus, taxi and cars. A cursory examination of Table 2 reveals that patrons of the yellow buses mainly accessed the bus service by walking (40%) while 30% and 25% accessed the terminals by motorcycle and buses respectively. The remaining 5% accessed the yellow bus terminals through the aid of cars and taxis. Similarly, a sizeable proportion (about 48%) of BRT users accessed the terminals by using motorcycles whereas 29.5%, 6.8% and 15.9% access the BRT terminals by buses, personal cars and walking respectively. With respect to ferry services, only about 10% of the user respondents accessed the terminal by walking. The remaining 90% comprised of 30% who accessed the terminals via motorcycle, 37.5% by cars, 15% and 7.5% who adopted buses and taxis as access modes to ferry terminals. The choice of access mode to the ferry terminals might not be unconnected with observation that most users of ferry services are high income earners given that majority of them earned above ₦100,000 per month.

Table 2: Respondents' access to public transport in the study area

Accessibility Variables		Yellow Bus (N=40)		Brt (N=44)		Ferry (N=40)	
		Freq	%	Freq	%	Freq	%
Travel mode to terminal	Walk	16	40.0	7	15.9	4	10.0
	Motorcycle	12	30.0	21	47.7	12	30.0
	Taxi	1	2.5	-	-	3	7.5
	Car	1	2.5	3	6.8	15	37.5
	Bus	10	25.0	13	29.5	6	15.0
	Total	40	97.5	44	100.0	40	100.0
Travel time to terminal	1 - 5 min	3	7.5	5	11.4	7	17.5
	6 - 10 min	26	65.0	19	43.2	13	32.5
	11 - 15 min	9	22.5	11	25.0	10	25.0
	19 - 30 min	2	5.0	6	13.6	6	15.0
	Above 30 min	-	-	3	6.8	4	10.0
	Total	40	100.0	44	100.0	40	100.0
Travel cost to terminal	₦1 - ₦50	7	18.5	11	25.0	3	7.7
	₦51 - ₦100	27	66.7	21	47.2	17	42.3
	₦101 - ₦150	2	3.7	9	19.4	6	15.4
	₦151 - ₦200	4	11.1	2	5.6	8	19.2
	Above ₦200	-	-	1	2.8	6	15.4
	Total	40	100.0	44	100.0	40	100.0

The analysis of the travel time to the various terminals of public transport as shown in Table 2 reveals that the yellow buses are the most accessible in terms of travel time. It was observed that more than 90% of the yellow bus public commuters access the terminals in 15 minutes or less while a little below 80% of the BRT users and about 75% of the users of the ferry commuters accessed their respective terminals within the same time frame. The proportion of users who spent more than 30 minutes to get to the terminal constituted 10% and 6.8% for ferry services and BRT users respectively. Perhaps, the fact that none of the respondents using the yellow buses spent more than 30 minutes as travelling time is related to the bus service which is characterized by fast paced and chaotic boarding and alighting process.

Table 2 also shows that over 85% of the public commuters by the yellow buses spent ₦100 and below as travel cost to the terminal while the remaining 14.8% spent between ₦101 and ₦200 as the travel cost. Similarly, the BRT users also had 72.2% of the respondents who travelled to terminals for a ₦100 or less, about 25% whose travel costs ranged between ₦101 and ₦200 and 2.8% whose travel cost was in excess of ₦200. Considering the mode, time and cost of travel to the terminals, it could be said that the yellow buses are the most accessible public transport mode available to commuters in the study area. This could be attributed to the long-term duration of operations they have had in the study area and how residents of the area have adapted to their unorganised and largely unregulated services. However, with consistency and constant improvement of the BRT and ferry services in the study area, it is expected that the patronage of these public modes of travel would increase over time.

The analysis of variance test was conducted to check if there were significant differences between the variables used to measure the commuters' access to public transport modes in the study area. The analysis examined the cost and time of travel to the various terminal of public transport using the null and alternative hypotheses.

$H_0 =$ There is no significant difference between the cost and time of travel to the terminals of selected modes of public transport

$H_1 =$ There is significant difference between the cost and time of travel to the terminals of selected modes of public transport

Table 3: Analysis of Variance of differences in accessibility of various public transport modes

		Sum of Squares	df	Mean Square	F	Sig.
Cost of travel to terminal	Between Groups	12.199	2	6.099	5.828	.004
	Within Groups	90.004	86	1.047		
	Total	102.202	88			
Time of travel to terminal	Between Groups	4.056	2	2.028	1.922	.151
	Within Groups	126.643	120	1.055		
	Total	130.699	122			

The analysis of variance presented a level of significance that has a f-value that is greater than 0.001, both on the cost and time of travel to various terminals. This implies that the null hypothesis (H_0) was rejected, meaning that, a significant difference between the level of access to the modes of public transport was observed using the variables of cost and time. The degree of freedom the test of variance was also noticed to be significant as the results was based on analysis of more than 70% of the respondents' view on travel cost (total df=88), and more than 95% of the respondents' view on travel time to the terminals (total df=122).

The outcome of this analysis could be linked to the variance in location of the yellow buses, BRT and ferry terminal.

Terminals and bus-stops for these modes of public transport was observed to be available in varying numbers and places. While the yellow buses had the highest number of bus-stops and pick-and-drop points, the BRT had a fewer number of bus-stops and terminals compared to that of the yellow buses along the road transport corridor from Ikorodu-Lagos Island. However, there is only one ferry terminal located at Ikorodu and just a few jetty points on Lagos Island. This make the ferry mode of public transport, the least accessible among the selected modes as it takes time and money to access these terminal and jetty points.

Commuters' Travel Characteristics

Users' experiences with the identified modes of travel for this study was conducted examining variables like boarding delay, delay time, travel cost and time to the destination. It was noticed that boarding delay at terminals was mainly experienced by the BRT bus users, followed by the commuters using the yellow buses while most of the ferry users opined that they do not experience travel delay at the terminal. The analysis of the delay time at the terminals indicated that more than 95% of the yellow bus users do not experience delays at the terminals exceeding 30 minutes, while in rare cases for few of the respondents, the maximum delay time was 40 minutes. Similarly, about 95% of the ferry had terminal delay time of 30 minutes and below while at most the respondents experienced maximum delay time of 40 minutes at the ferry terminal. The experience of the BRT users was observed to be the worst among these public commuters as some the respondents do experience terminals' delay time as much as an hour. About 32.4% of the respondents had delay time of more than 30 minutes but not exceeding an hour while the remaining 67.6% of these users had delay time of 30 minutes and below at the terminals. The high delay time experienced at BRT terminals might not be unconnected with the need to expand BRT services and infrastructure along major corridors where demand seem to have outstripped available service.

The cost of travel to destination varied across the identified modes of transport with the BRT buses being the cheapest and the ferry being the most expensive. The analysis shows that more than 90% of the yellow bus commuters spent ₦300 and below while about 7.5% spent more than ₦300 but not exceeding ₦400. The cost of travel to various destination using the BRT was observed not to exceed ₦300 irrespective of the commuters' destinations. However, for the ferry users, the least travel cost to a destination was higher than ₦400 within the study area while more than half of the respondents spent more than ₦500 as the travel cost. To this end, it was noticed that public transport on road were more used and far cheaper than public transport on water.

Table 4: Public travel experiences of the respondents

Variables Indicating Travel Experience			Yellow Bus (N=40)		Brt (N=44)		Ferry (N=40)	
			Freq	%	Freq	%	Freq	%
Boarding delay at terminal	Yes	23	57.5	38	86.4	19	47.5	
	No	17	42.5	6	13.6	21	52.5	
	Total	40	100.0	44	100.0	40	100.0	
Delay time at the terminal	1-10 min	19	47.8	1	2.7	26	65.0	
	11-20 min	9	21.7	14	32.4	8	20.0	
	21-30 min	10	26.1	14	32.4	4	10.0	
	31-40 min	2	4.3	6	13.5	2	5.0	
	41-50 min	-	-	4	8.1	-	-	
	51-60 min	-	-	5	10.8	-	-	
	Total	40	100.0	44	100.0	40	100.0	
Travel cost to destination	₦101-₦200	2	5.0	38	86.4	-	-	
	₦201-₦300	35	87.5	6	13.6	-	-	
	₦301-₦400	3	7.5	-	-	-	-	
	₦401-₦500	-	-	-	-	16	40.0	
	Above ₦500	-	-	-	-	24	60.0	
	Total	40	100.0	44	100.0	40	100.0	
Average travel time to destination	1-30 min	1	2.5	8	18.3	11	27.5	
	31 min - 1 hour	21	52.5	32	72.7	29	72.5	
	1 hour - 1 hour 30 min	14	35.0	2	4.5	-	-	
	1 hour 30 min – 2 hours	4	10.0	2	4.5	-	-	
	Total	40	100.0	44	100.0	40	100.0	

The average time taken to destination was also observed to vary between the road and water means of public transport in the study area. The ferry services had the least travel time whereas the yellow buses had the longest/highest time of travel. The analysis of the average travel time indicated that almost half of the respondents using the yellow buses spent between 1 hour and 2 hours on their travels while the higher proportion of respondents (about 58%) had destination travel time of 1 hour and below. For the BRT buses, about 91% of the respondents estimated an average travel time of 1 hour and below while the remaining 9% travelled to their destination within the time frame of 1 to 2 hours. However, for the public commuters by ferry, all the respondents (100%) indicated a maximum travel time of 1 hour to their destinations within the study area. In terms of delay at the terminals and travel time the ferry was observed to have offered the best travel experiences to public commuters while with reference to cost, the BRT was noticed as the best option to the commuters.

A linear regression analysis was conducted to predict the effect of the experiences of public commuters on their preferred mode of public transport. The analysis examined their experiences from the terminals of boarding to the point of destination considering the travel time, travel cost, delay time and boarding delay at the terminals. The test was conducted using the stepwise method of linear regression, which made the analysis of be broken down as each predictor is examined with an eventual combination of all predictors. It was observed that the R^2 value on the analysis of the combined predictor is 0.558 with an adjusted R^2 value of 0.534. This means that the results obtained from the linear regression analysis explain about 55.8% of the total variance within the dataset.

Table 5: Model summary of the linear regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.552(a)	.304	.292	.589	
2	.725(b)	.526	.509	.490	
3	.747(c)	.558	.534	.478	1.044

a Predictors: (Constant), Average Travel Time to Destination

b Predictors: (Constant), Average Travel Time to Destination, Cost of Travel to Destination

c Predictors: (Constant), Average Travel Time to Destination, Cost of Travel to Destination, Delay Time at The Terminal

d Dependent Variable: Preferred Travel Mode

Since the regression analysis was carried out in a stepwise manner, the information presented in the third row of the table of coefficients was examined as it combined the predictors of commuters' preferred mode. However, the boarding delay at the terminal was excluded from the stepwise linear regression analysis as it had a p-value that is greater than 0.1. The table of coefficients was used to compare the effects of the predictors on the commuters' choice of public transport. It was noticed the cost of travel to destination was the most effective factor influencing the choice of public commuters with a standardized beta coefficient of 0.547 and a level of significance that is less than 0.001. The average travel time to destination was the next effective experience of the commuters that influenced their preference with standardized beta coefficient of -0.460 ($p < 0.001$) and the delay time at the terminal was another significant factor but the least among this three with a standardized beta coefficient of 0.195 ($p < 0.05$).

Table 6: Linear regression coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.040	.236		12.859	.000
	Average Travel Time to Destination	-.526	.104	-.552	-5.079	.000
2	(Constant)	2.183	.257		8.509	.000
	Average Travel Time to Destination	-.475	.087	-.498	-5.473	.000
	Cost of Travel to Destination	.242	.047	.474	5.204	.000
3	(Constant)	1.745	.330		5.287	.000
	Average Travel Time to Destination	-.438	.086	-.460	-5.070	.000
	Cost of Travel to Destination	.279	.049	.547	5.713	.000

Delay Time at the Terminal	.094	.046	.195	2.029	.047
----------------------------	------	------	------	-------	------

a Dependent Variable: Preferred Travel Mode

It could be inferred that the experiences of public commuters from the terminals to their various destinations were the key factors that influence their choices of public transport in the area. This is because other factors of access to terminals had lesser levels of significance compared to the users' experiences when analysed against their modal choices. These factors determine the utility derived by the passengers on their public travel.

Commuters' Evaluation of Public Transport

Table 7: Relative performance analysis of the selected modes of public transport

Assessed Variables		5	4	3	2	1	PWV	N	RPI	MPI	MPD
Yellow bus	Travel fare	5	20	78	16	-	119	40	2.98	2.62	0.36
	Waiting time	-	24	72	12	4	112	40	2.80		0.18
	Travel time	5	16	75	14	3	113	40	2.83		0.21
	Travel safety	-	4	54	40	1	99	40	2.48		-0.14
	Travel convenience	-	8	45	40	3	96	40	2.40		-0.22
	Travel efficiency	-	8	72	24	2	106	40	2.65		0.03
	User friendliness	-	8	33	40	7	88	40	2.20		-0.42
	Total								18.34		
BRT	Travel fare	55	80	33	4	-	172	44	3.91	3.72	0.19
	Waiting time	5	24	27	22	17	95	44	2.16		-1.56
	Travel time	50	92	27	4	-	173	44	3.93		0.22
	Travel safety	45	96	30	2	-	169	44	3.84		0.12
	Travel convenience	95	64	24	2	-	185	44	4.20		0.48
	Travel efficiency	85	64	24	6	-	179	44	4.07		0.35
	User friendliness	45	92	33	2	-	172	44	3.91		0.19
	Total								26.02		
Ferry	Travel fare	20	4	48	24	7	103	40	2.58	3.01	-0.43
	Waiting time	65	40	36	10	-	151	40	3.78		0.77
	Travel time	60	64	27	6	-	157	40	3.93		0.92
	Travel safety	-	4	27	38	11	80	40	2.00		-1.01
	Travel convenience	10	8	30	24	14	86	40	2.15		-0.86
	Travel efficiency	15	56	57	8	-	136	40	3.40		0.39
	User friendliness	5	64	42	16	1	128	40	3.20		0.19
	Total								21.04		

Performance Weight Value (PWV) = $1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5$

$$PWV = \sum_{i=1}^5 XiYi$$

Relative Performance Index (RPI) = $\frac{\text{Performance Weight Value (PWV)}}{\text{Total number of responses (N)}}$

Mean Performance Index (MPI) = $\frac{\sum RPI}{Nv}$

Mean Performance Deviation (MPD) = MPI – RPI

Where N = Total number of responses
n = Ratings of respondents
Nv = Count of identified assessed variables

Ratings of the impact of the public transport system on sustainable livelihood indicators
1 = Poor, 2 = Fair, 3 = Good, 4 = Very good, 5 = Excellent

The Relative Performance Analysis (RPA) conducted above was carried out to identify the assessed variables of public transport that had significantly performed across the three selected modes, based on the users' ratings. The analysis made use of the Mean Performance Index (MPI) as the threshold when compared with the Relative Performance Index (RPI) of each assessed variable. The assessed variables in the analysis were travel fare, time, safety, convenience, travel efficiency, waiting time and user friendliness. These variables were assessed and compared by the three identified public transport modes.

An evaluation of the performance of the yellow buses by public commuters resulted in a mean performance index of 2.62, which was compared with the various indices of the variables. It was noted that of these variables, there were significant performance ratings on the waiting time, the fare, time and efficiency of this travel mode. It was also observed that the relative performance indexes of the variables clustered around the mean performance index with mean deviations ranging from -0.42 to +0.36. This means that there were no wide variations between the performance rating of the respondents using the yellow buses. The performance of the BRT mode of public transport as rated by the respondents was observed to be better than that of the yellow buses. From the performance analysis, the mean performance index was 3.72 and when this was compared to the relative performance indexes, all the assessed variables had significant performance ratings except for the waiting time at the terminals. A wide variation was noticed between the mean performance index and the performance index of the waiting time with a mean performance deviation of -1.56. However, the respondents' performance ratings on all the other variables did not have wide variations.

The assessed variables under the ferry mode of public transport with significant performance rating include the waiting time, travel time, travel efficiency and user friendliness. Considering the mean performance index of the ferry mode of transport, it was observed that this mode received more performance ratings than the yellow buses but not up to the ratings of the BRT. This means that based on the users' ratings, the BRT had the best performance considering the user friendliness, waiting time, the travel fare, time, safety, convenience and efficiency with a mean performance index of 3.72. This was followed ferry mode of public transport with mean performance index of 3.01 and the yellow buses were least rated in performance with an index of 2.62.

CONCLUSION

This study has compared the choices and behaviors of commuters/commuters using three selected modes of public transport on the Ikorodu-Lagos Island axis of Lagos state. Having examined the access to, travel experiences with, and performance of the yellow buses, BRT and ferry modes of public transport in the study area, the study discovered there were significant variances in the issues influencing choices and behaviors of public commuters. While the yellow buses were the most accessible mode of public transport within the study area followed by the BRT and ferry in sequence of accessibility, the ferry offered the best travel experiences in reference to delay at the terminals and travel time to various destinations with the BRT and yellow buses following in ranks. However, with reference to travel cost, and performance of public transport using the identified utility functions/variables of assessment, the BRT had the highest performance rating on these variables and offered the best option in terms of travel cost. The ferry and the yellow buses followed in sequence of performance ratings behind the BRT.

Since each of these modes of public transport has its strengths and weaknesses, there is the need to improve of service delivery and quality of travel experiences for these selected modes of public travel in the study area. These improvements will help to increase patronage by residents, enhance standard of living of the people and developed the public transport systems within the study area. This study therefore recommends that the BRT should try to improve their service delivery by providing more buses to mitigate boarding delay and reduce the delay times at the terminals. Longer waiting times due to late arrival of buses and excessive in-vehicle times has been identified by Sam et al., (2014) as a factor that reduces reliability. Improving on this service aspect will help to ensure that public commuters have confidence and trust in the services of the BRT thereby promising bus reliability to the users.

Similarly, this study recommends the provision of more safety measures (in terms of policy and equipment) in the services of the ferry such that commuters will have better travel experience of safety, comfort and convenience on the ferries. Also, more jetty points could be provided at Ikorodu and Lagos Island to increase accessibility to water transport by ferry, such that the time and cost of travel to jetty points and ferry terminals would be reduced. The residents and the public can also be sensitized on the safety, importance and need to embrace water transportation in the study area to relieve the pressure on road infrastructure.

Finally, the improvement of the BRT and ferry services is paramount now considering the population growth in Lagos state, particularly within the study area. This will help to increase commuters' preference on these modes of public transport that will support the existing traditionally yellow buses and keep the forces of demand and supply of public transport balanced and effective. This is expected to bring about a sustainable and efficient public transport system within the study area in the long term.

Future studies should explore passenger on-board time use and their satisfaction with waiting time comfort at bus and ferry terminals. Travel time is generally considered a cost. Making travel time productive has the potential to enhance travel satisfaction (Ettema, Friman, Gärling, Olsson, & Fujii, 2012; Lyons, Jain, & Holley, 2007). Studying on-board time use patterns can help planners understand the needs of BRT and ferry passengers (Lyons, Jain, Susilo, & Atkins, 2013). Further, waiting time is an essential component of any BRT and ferry journey. This makes waiting-related studies even more pertinent.

ACKNOWLEDGEMENTS

We would like to thank Iyeton Diyaolu for her contribution in data gathering and Ojo Benjamin for editorial work.

REFERENCES

- Adebambo, S., & Adebayo, I. T. (2009). Impact of bus rapid transit system (BRT) on passengers' satisfaction in Lagos metropolis, Nigeria. *International Journal of Creativity and Technical Development*, 1(3), 106-119.
- Afolabi, O. J. (2016). Commuters perception and preferences on the bus rapid transit in Lagos state, *Jorind* 14(2), 34-41.
- Agunloye, Alade and Fadare (2010). Perception of intra-urban train passengers on services in Lagos metropolis. *Journal of Environmental Sciences*, 14(1), pp 105-113.
- Alade and Olaseni (2018). Passenger satisfaction of bus rapid transit and bus franchise scheme in Lagos, Ife Planning Journal, Department of Urban and Regional Planning, Obafemi Awolowo University, Ile-Ife.
- Albalade, D. and Bel, G. (2010). What shapes local public transportation in Europe? Economics, mobility, institutions and geography. *Transport Research Part E*, No. 46, 775-790.
- Amiegbebor, D. E., Akarakiri, J., & Dickson, O. (2016). Evaluation of Technical Innovations in Bus Rapid Transit System in Lagos State, Nigeria. *Advances in Research*, 6(2), 1-12.
- Ankomah, P., Crompton, J.L. and Baker, D. (1996). Influence of cognitive distance in vacation choice. *Annals of Tourism Research*, 23(1), 138-150.
- Basorun, J. O., & Rotowa, O. O. (2012). Regional assessment of public transport operations in Nigerian cities: The case of Lagos island. *International Journal of Developing Societies*, 1(2), 82-87.
- Bresson, G., Dargay, J., Madre J.L., and Pirote, A. (2004). Economic and structural determinants of the demand for public transport: An analysis on a panel of French urban areas using shrinkage estimators. *Transportation Research Part A*, No. 38, 269-285.
- Buchanan, N., Barnett, R., Kingham, S., and Johnson, D. (2006). The effect of urban growth on commuting patterns in Christchurch, New Zealand. *Journal of Transport Geography*, Vol. 14, 342-354.

- Cao, C., and Chen, J. (2011). An empirical analysis of the relationship among the service quality, customer satisfaction and loyalty of high-speed railway based on structural equation model. *Canadian Social Science*, 7, 67–73.
- Cao, J., and Cao, X. (2017). Comparing importance-performance analysis and three-factor theory in assessing rider satisfaction with transit. *Journal of Transport and Land Use*, 10, 65–82.
- Chou, J.-S., and Kim, C. (2009). A structural equation analysis of the QSL relationship with passenger riding experience on high speed rail: An empirical study of Taiwan and Korea. *Expert Systems with Applications*, 36 (6), 945–6,955.
- Chou, J.-S., and Yeh, C.P. (2013). Influential constructs, mediating effects, and moderating effects on operations performance of high-speed rail from passenger perspective. *Transport Policy*, 30, 207–219.
- Crotte, A. (2008). *Estimation of transport related demand elasticities in Mexico city: An application to road user charging*. United Kingdom: MSc Thesis, Centre for Transport Studies, Department of Civil and Environmental Engineering, Imperial College.
- de Oña, J., and de Oña, R. (2015). Quality of service in public transport based on customer satisfaction surveys: A review and assessment of methodological approaches. *Transportation Science*, 49, 605–622.
- Ettema, D., Friman, M., Gärling, T., Olsson, L. E., and Fujii, S. (2012). How in-vehicle activities affect work commuters' satisfaction with public transport. *Journal of Transport Geography*, 24, 215–222.
- FitzRoy, F. and Smith, I. (1998). Public transport demand in Freiburg: Why did patronage double in decade? *Transport Policy*, Vol. 5, 163-173.
- Golob, T.F., Canty, E.T. and Gustafson, R.L. (1972). An analysis of consumer preferences for a public transportation system. *Transportation Research*, Vol. 6,, 1-7.
- Horn, M. (2003). An extended model and procedural framework for planning multi-modal passenger journeys. *Transportation Research Part B*, No. 37, 641-660.
- Irfan, S. M., Kee, D. M. H., and Shahbaz, S. (2012). Service quality and rail transport in Pakistan: A passenger perspective. *World Applied Sciences Journal*, 18, 361–369.
- Koppelman, F.S. and Lyon, P.K. (1981). Attitudinal analysis of work school travel. *Transportation Science*, Vol. 15, 233-254.
- Lagos Bureau of Statistics. (2016). *Digest of Statistics 2016*. Alausa, Ikeja, Lagos: Ministry of Economic Planning and Budget.
- Lee, J. H., Jin, B. S., and Ji, Y. (2009). Development of a structural equation model for ride comfort of the Korean high-speed railway. *International Journal of Industrial Ergonomics*, 39, 7–14
- Lyons, G., Jain, J., and Holley, D. (2007). The use of travel time by rail passengers in Great Britain. *Transportation Research Part A: Policy and Practice*, 41, 107–120.
- Lyons, G., Jain, J., Susilo, Y., and Atkins, S. (2013). Comparing rail passengers' travel time use in Great Britain between 2004 and 2010. *Mobilities*, 8, 560–579.
- Mintesnot, G. and Shin-ei, T. (2007). *The Effect of Commuters' Level of Satisfaction on Transport Mode Choice: An Input for Policy Analysis*. California: World Conference on Transport Research.
- National Population Commission. (2009). *Population by Sex and Local Government Area. Social Statistics in Nigeria, Lagos State Population Figure 2009*. Lagos, Nigeria: National Bureau of Statistics.
- Neumann, E.S., Romansky, M.L. and Plummer, R.W. (1978). Passenger car comfort and travel decisions: A physiological study. *Journal of Transport Economics and Policy*, Vol. 12, 231-243.
- Ogunola, C.O., Omole, F.K., Okoko E.E., Soyinka, O.A., and, Bako, A.I. (2014). Ferry Transport Service in Lagos Metropolis: A Panacea for Movement in the Mega City. In J. A. Joseph A. Fadamiro, *Urban Environmental Sustainability: Liveable Cities* (pp. 193-212). Akure, Nigeria: Urban Design Research Team, Department of Architecture, School of Environmental Technology, Federal University of Technology Akure.
- Olufemi, O. A. (2008). Public transport innovation: the impact of BRT on passenger's movement in Lagos metropolitan area of Nigeria. *Pakistan Journal of Social Sciences*, 5(8), 845-852.
- Polat, C. (2012). The demand determinants for urban public transport service: a review of the literature. *Journal of Applied Sciences*, Vol. 12, No. 12, 1211-1231.

- Sam E.F., Adu-Boahen K., Kissah-Korsah K. (2014). Assessing the factors that influence public transport mode preference and patronage: Perspectives of students of University of Cape Coast (UCC), Ghana. *International Journal of Development and Sustainability*, 3(2), 323-336.
- Schofer, J. L. (2018). *Mass Transit*. Chicago, Illinois: Encyclopaedia Britannica.
- Taylor, B.D. and Camille, N.Y. (2012). *Factors influencing transit ridership: A review and analysis of the ridership literature, working paper*. Los Angeles: Department of Urban Planning, UCLA Institute of Transport Studies.
- Wu, J. H.-C., Lin, Y.-C., and Hsu, F.-S. (2011). An empirical analysis of synthesizing the effects of service quality, perceived value, corporate image and customer satisfaction on behavioral intentions in the transport industry: A case of Taiwan high-speed rail. *Innovative Marketing*, 7, 83–99.
- Zhang, C., Cao, X., Nagpure, A., and Agarwal, S. (2017). Exploring rider satisfaction with transit service in Indore, India: An application of the three-factor theory. *Transportation Letters*, 1–9.
- Zhen, Cao and Tang (2018). Exploring correlates of passenger satisfaction and service improvement priorities of the Shanghai-Nanjing High Speed Rail. *The Journal of Transport and Land Use*, 11(1) pp. 559–573, <http://jtlu.org>