

# UNIVERSITY COMMUNITY COMMUTING TRIP PATTERNS: TEMPORAL ASSESSMENT

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## ABSTRACT

The trip pattern of the university community is a vital component of the overall transportation demand of a province, but it is not well epitomized in travel demand models. This descriptive research assessed the temporal commuting pattern in the university environment, with special focus on universities in southwestern Nigeria. This study was achieved by using detailed questionnaires and oral interviews for data collection from both staff and students in the universities considered. Information on socio-economics, demographics, the frequency of trips, trip time, and transportation mode choice were analyzed. We adopted statistical software SPSS version 21 and Microsoft Excel for the data analysis. The results of our research showed that the use of the shuttle as a transportation mode declined as the trip time increased, among university staff, with an  $R^2$  of 0.9308. Conversely, bicycle use increased irrespective of the trip time for both student and staff, with a  $R^2$  value of 0.928. Universities' commuting patterns are important, because the commuting habits of students and staff have consequences on the motivation for both study and work. Ultimately, this data will help transportation policy makers work on the effective strategy required for efficient transportation planning in the university environment in similar cities in Nigeria and developing nations.

*Keywords:* college students, Nigeria, transportation planning, transportation demand, travel behavior, temporal assessment, trip frequency, trip pattern, university community, university environment.

## 1 INTRODUCTION

Despite the importance of university student trips in communities with university campuses, the trip-making patterns of university students are neither well understood nor well represented in travel demand models. According to Miller [1], growing consideration has been given to transportation planning within the university environment, which forms a unique case for transportation planning owing to the centralized control of land use, transportation, and other activities. In most developed countries, many universities have established transportation demand programs [2] or systematic approaches to more efficient use of the transportation resources. The same author asserts that some university community travel demand programs include UPASS, which offers free rides for students and in some cases, lecturers and staff. Transportation research in Nigeria showed that travel demand models have not been incorporated into the university system because research states that universities are foremost trip attractors that take a pronounced deal of structures to support a huge number of commuters [3]. More generally, the habits of using a specific mode of transport are a strong correlate of (active) travel behavior and thought to hinder behavior change [4]–[7].

Not all environments are equally supportive for all modes of transport, like in the case of the university environment that are limited to transportation by road. Goodman et al. [8] and Hooper et al. [9] provide stronger evidence for causal effects of environmental changes on travel behavior [10].



It would be erroneous to link the university travel behavior of low-income households to that of university students, this is because they do not reflect a similar trip pattern although they both have a high frequency of trips, as indicated by Busari et al. [11]. This is because commuting to school for lectures is obligatory, as compared to a regular one-person low-income household who may consider a work trip as optional or who may even work from home. Similarly, on the average due to the compactness of the university environment, the tendency to make more recreational trips is very high. Curtis and Perkin [12] also argue that various factors influence travel behavior in the university environment. Juarez [13] states that the campus shuttle provides a service which uses small buses, midi buses or vans for public transportation, usually for shorter distances. Universities are like towns and cities [14]: they are not immune to the challenges bedeviling major cities, and so should not be neglected in transportation planning, as is evident in Nigeria and some developing nations of the world. Travelers' behavior is heterogeneous, while their preferences are inconsistent [15], [16]. Moreover, socioeconomic factors are insufficient to explain the observed differences in behavior. The effect of time and space is paramount in travel demand modelling [17]–[19]. Additionally, car ownership also affects trip pattern and trip volume [11], [20]; likewise, the built environment [21]–[23].

In Nigeria, several studies have been done on the travel behavior by Busari et al. [11] and Handy et al. [23]; but the university community has been left out. Also, trip time is very crucial in travel demand modelling and forecasting; so there is a need for its evaluation in the temporal commuting pattern of this unique environment, which is paramount. Hence, this study assessed the commuting mode of the university community, in a bid to provide the most efficient and effective transportation scheme for the universities that were studied and similar universities around the world.

## 2 METHODOLOGY

In this study, questionnaires were constructed and distributed to respondents using the population size as the sampling unit [25]–[28]. The questionnaire forms contained information on socio-economic, demographic, trip pattern, trip time, modal split, per capita trip and more. These questionnaires were administered by the face to face method, during the semester time between December, 2014 and June, 2015. Those surveyed comprised all the faculty and department members in the university considered. Trip information for both students and staff were captured with an 80% return rate.

### 2.1 Sampling

The questionnaires were randomly distributed to both staff and students in the universities. All faculty and departments within the schools were represented. This research was restricted to age 15 and above, and for students and staff, only for consistency of results. We randomly distributed 1500 detailed questionnaires to the three categories of University in Nigeria:

1. Privately owned university
2. Government owned universities
  - State Government owned university
  - Federal Government owned university

### 2.2 Data analysis

We collected information on, trip time, frequency of daily and weekly trips, demographics, socioeconomic characteristics etc., and this was sorted and analyzed. Statistical software



SPSS was employed in the analysis of the data, to show the relationship between the variables considered. The major factors affecting trip patterns were also analyzed and discussed.

### 3 RESULTS AND DISCUSSION

#### 3.1 Relationship between trip time and mode of transportation choice among university staff surveyed

University staff (both teaching and non-teaching) surveyed for modal split showed that the use of a personal car is predominantly for both short-distance trip and long-distance trips, as seen in Fig. 1. Private car use accounted for the highest percentage of the total adopted modal choice, considering the frequency of trips, while the use of a bicycle accounted for the lowest, at 2% (Fig. 1).

The relationship between the use of personal car and trip length showed a linear relationship, as seen in Fig. 2. Conversely, from the research it was established that the higher the trip length the higher the use of personal cars. The use of shuttle as a transportation mode

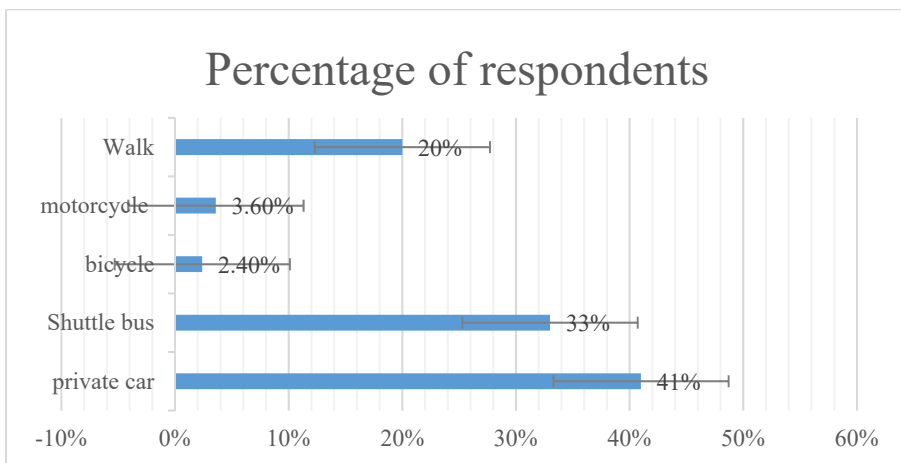


Figure 1: Preferred transportation mode choice by the university staff.

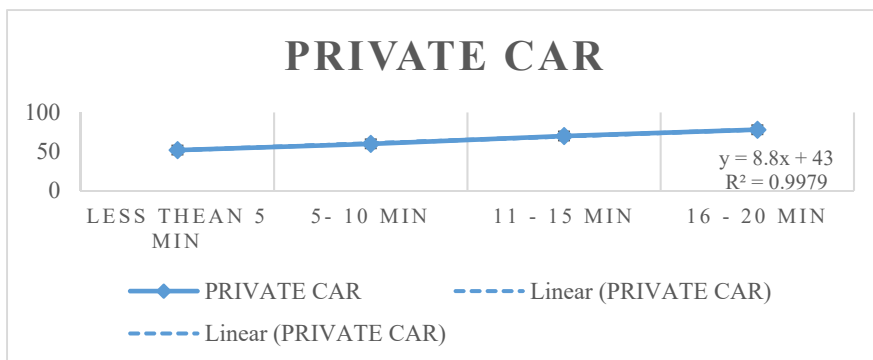


Figure 2: Relationship between the use of private car and trip length.

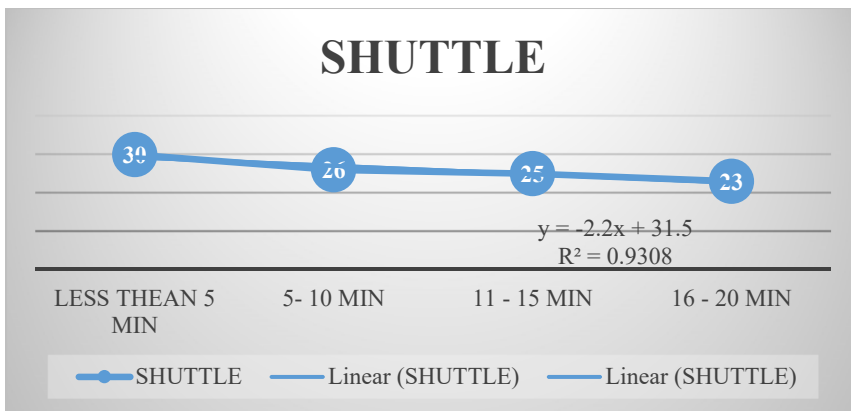


Figure 3: Relationship between the use of shuttle and trip time for staff.

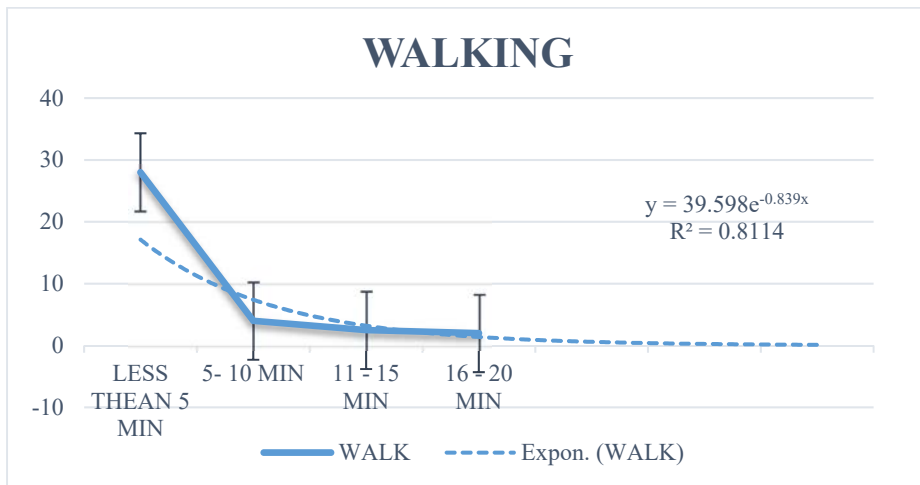


Figure 4: Relationship between walking and trip time (staff).

showed a decline. The higher the trip length, the lower the use of shuttle among university staff, with an  $R^2$  of 0.9308, which indicated that the proportion of the variance in the dependent variable is predictable from the independent variable.

Walking as a transportation mode was highly utilized for short trip lengths. The use of walking declined as the trip length increased. This may be as a result of the fact that not all the universities considered have walking facilities; also, age is a very important factor in considering walking as a mode.

Bicycle usage in the university system showed a contrary relationship. Its usage increased, irrespective of trip length. This may be as a result of the compact nature of the university environment. Our results showed that the university system has a different modal split pattern, as compared with other residential zones. This contradicted the research done by Owolabi in 2009 [24] and Busari et al. in 2015 [11], on the transportation mode split pattern of residential

zones, which show that bicycling is not a viable modal choice. The comparison was made because the universities considered, unlike other residential zones, lacked bicycle lanes and yet the use was evident. From the research results, the use of the bicycle increased, irrespective of the trip length, with a  $R^2$  value of 0.928 (Fig. 5). There is a need for government and university owners to put in place bicycle riding facilities within the university system.

### 3.2 Relationship between trip time and transportation mode choice for university students

The students' trip mode choice showed a different pattern compared with the staff. Based on the level of the students assessed: 500 level students had the highest percentage of use of private cars; while the 100 level students had the lowest, at 45% and 4%, respectively. This could be as a result of the age required for obtaining driver's license. The use of a private car is very low among students, as compared with staff. These results showed that in most privately owned universities in Nigeria, the use of privately owned cars is not allowed, especially for undergraduates, so the frequency of trips in a private car accounted for 10% of trips. Another factor responsible for this may be the fact that government-owned universities place a high parking charge for students with private cars; and as a result, use is not prominent, compared with other modes.

Walking and shuttle buses are the most adopted transport mode split in university student's trips, at 40% and 43%, respectively (Fig. 6). Walking as a mode was based on the students' level: The 400 level accounted for the highest, with 27%; while the 500 level had the lowest, with 15%. The use of a shuttle is the most preferred mode in the university system for students, accounting for 43% of their total mobility. The distribution results based on level are seen in Fig. 7.

Contrary to the trip patterns of the university staff, students showed a different pattern of shuttle use. Patronage increased as the trip time increased; but shuttle usage also followed a linear trend, as shown in Fig. 8. This could be explained by the fact that it is cheap and readily available, and also that it is flexible. Walking is also predominantly adopted, but use declined based on the trip time, as seen in Fig. 9.

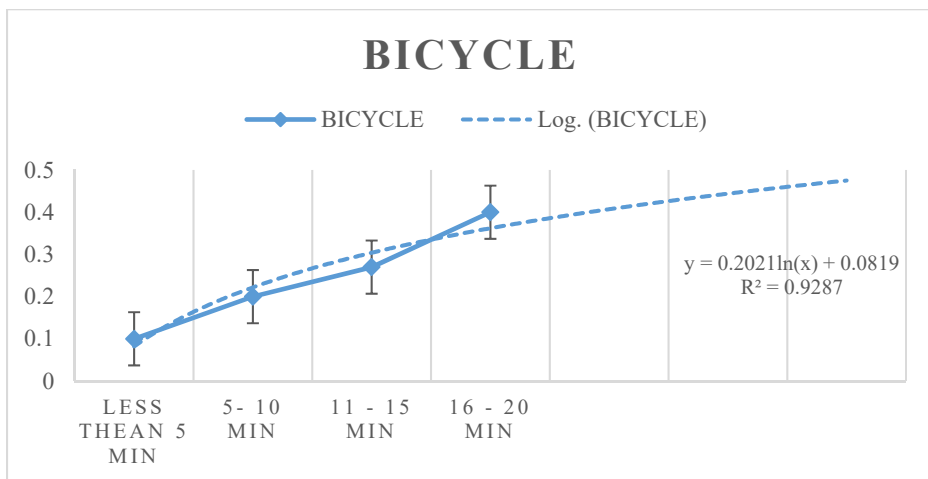


Figure 5: Relationship between bicycling and trip length (staff).

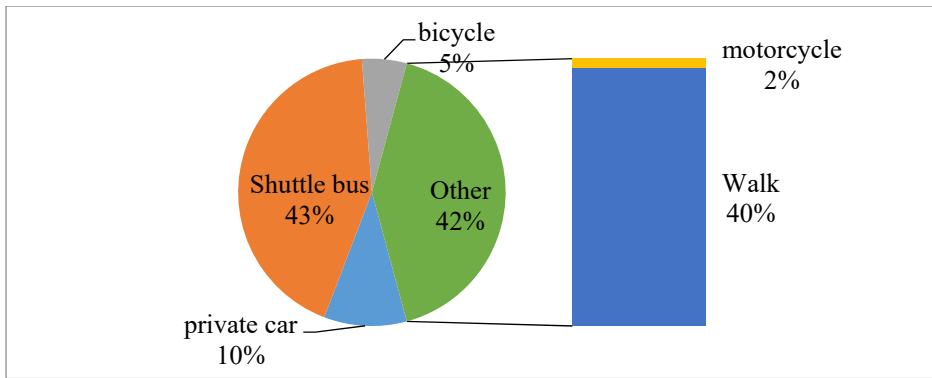


Figure 6: Student transportation mode split in university environment.

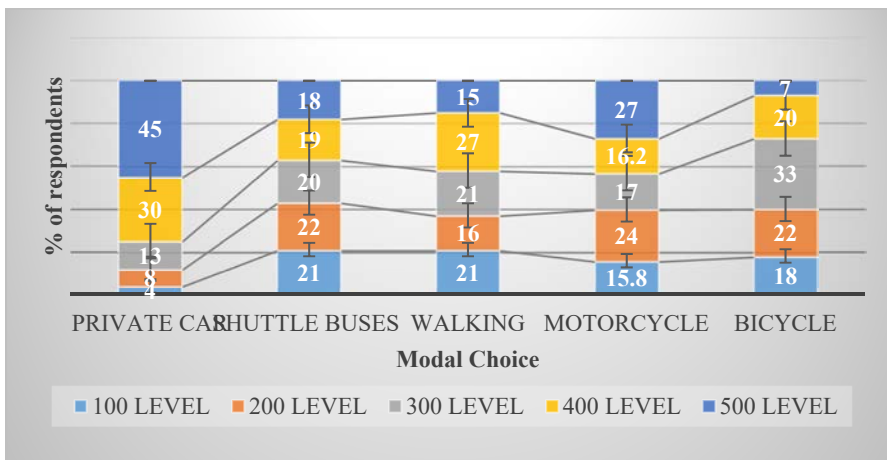


Figure 7: Transportation mode distribution split based on student level.

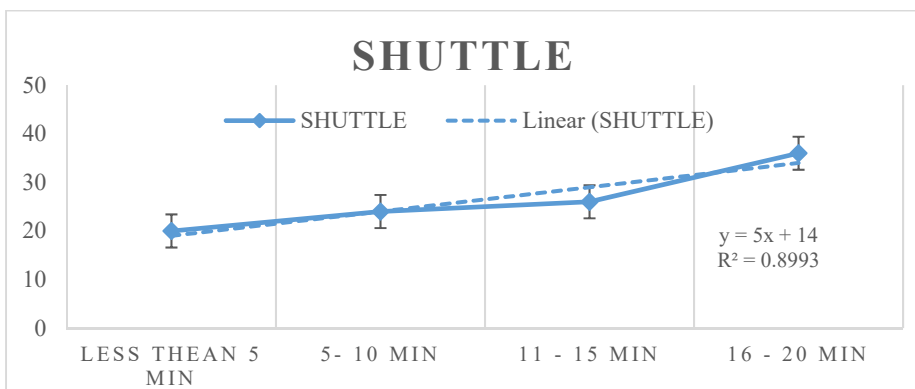


Figure 8: Relationship between trip time and shuttle bus.

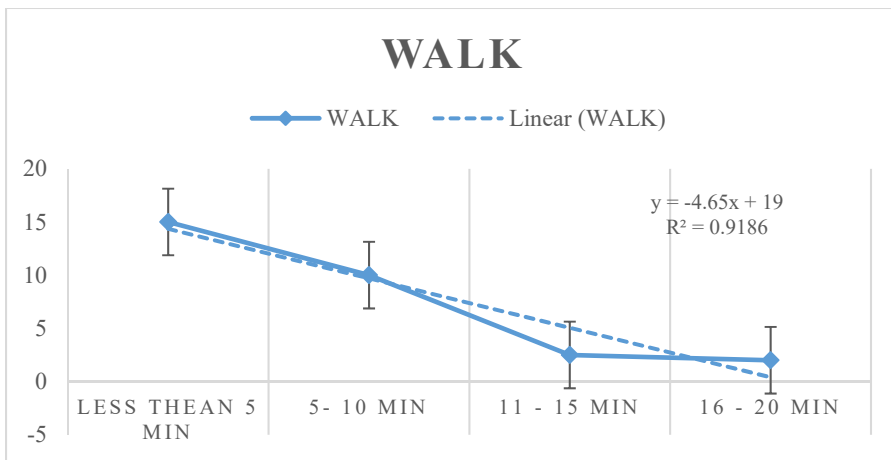


Figure 9: Relationship between trip time and walking, for students.

#### 4 FACTORS AFFECTING TRANSPORTATION MODE CHOICE SELECTION WITHIN A UNIVERSITY SYSTEM

According to research results, in a private university it is considered that having a bicycle restriction is one of the factors affecting the use of the bicycle as a mode of transportation, as stated by 75% of the respondents (Fig. 10). Traffic is one of the factors influencing the choice of modes in the government-owned universities, with 46% and 42% respectively for usage in state owned and federal owned universities, respectively; while in the privately owned university it was 8%. Parking space posed a serious problem in the government universities, as seen in the research, with results being 40% and 45% for state and federal universities, respectively.

Additionally, the pavement condition to a large extent affected the selection of transportation mode in the three categories of institution considered, especially in the government-owned universities. There is a need for the government to improve the maintenance of the transportation facilities within the university system.

#### 5 CONCLUSIONS

The use of a shuttle as a transport mode showed a decline: the higher the trip length, the lower the use of a shuttle among university staff (with an  $R^2$  of 0.9308). From the results of the research, the use of the bicycle increased, irrespective of the trip, for both student and staff (with a  $R^2$  value of 0.928). The use of a private car is very low among students, as compared with staff. The results showed that in most privately-owned universities in Nigeria, the use of privately-owned cars is not allowed, especially for undergraduates. On account of the frequency of trips, private car use accounted for 10%. Walking as a transportation mode was based on the students' level: The 400 level accounted for the highest, with 27%; while the 500 level had the lowest, with 15%. Overall, the use of a shuttle is the most preferred mode of transport within the university system by students, accounting for 43% of total mobility. In the private university, it is considered that the bicycle restriction is one of the factors affecting the use of the bicycle as a transport mode, as stated by 75% of the respondents. Based on the level of the students assessed, the 500 level student had the highest percentage of use of private cars, while the 100 level students had the lowest (45% and 4%, respectively).

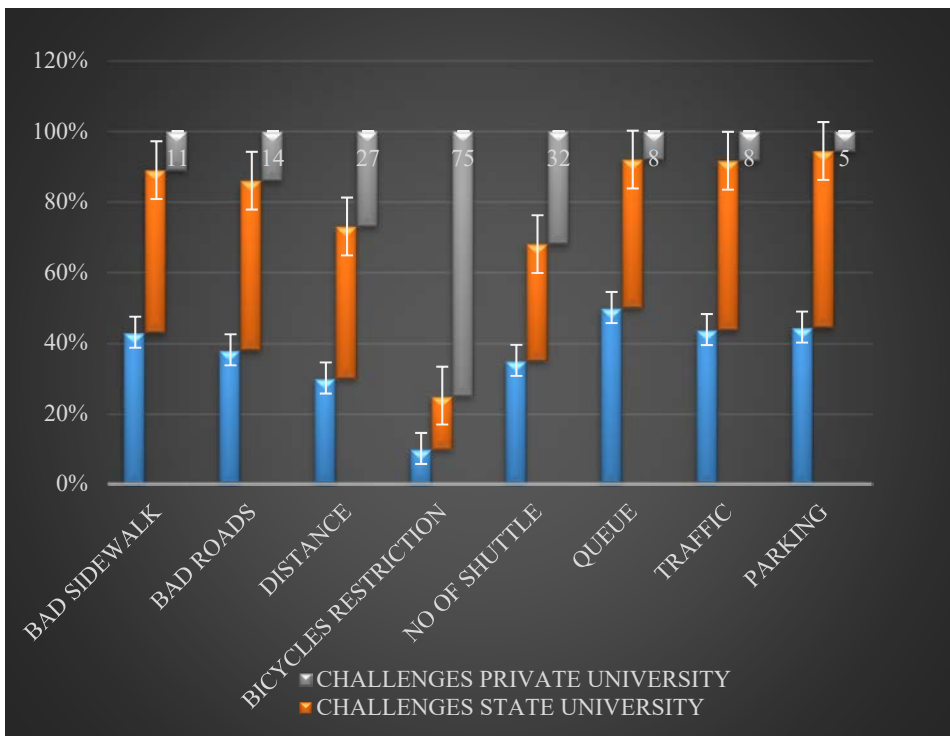


Figure 10: Factors affecting the choice of modes: challenges.

The relationship between the use of a personal car and trip length was shown to be a linear relationship. Traffic is one of the factors influencing the choice of transportation modes on the government-owned universities, with 46% and 42%, respectively for the state-owned and federally owned universities; while the privately-owned university had 8%. Parking space poses a serious problem in government universities, as seen in the research, with 40% and 45% for state and federal universities, respectively. We recommend developing a better understanding of the travel behavior of students and staff, as it is paramount because most university trips are compulsory trips, either for lectures or office work. Moreover, a good maintenance culture is important within the university environment, to make commuting easy. The use of the bicycle should be encouraged, in a bid to improve on air pollution in the environment and to reduce transportation cost.

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