Analele Universităţii din Oradea, Seria Geografie **XXVIII**, no. 2/**2018**, pp. **185-196**
ISSN **1221-1273**, E-ISSN **2065-3409** Article no. **282105-775**

HOUSEHOLDS' TRIP-CHAINING BEHAVIOUR: EVENING INTERVENING STOPS ACROSS RESIDENTIAL AREAS IN IBADAN, NIGERIA

Olorunfemi Ayodeji OLOJEDE*
Human Settlement Unit, Research Directorate, Mangosuthu University of Technology, Umlazi, Durban, South Africa
e-mail: olojede.ayodeji@mut.ac.za

Kayode Julius SAMUEL
Human Settlement Unit, Research Directorate, Mangosuthu University of Technology, Umlazi, Durban, South Africa
e-mail: samuel.kayode@mut.ac.za

Abstract: The study examined the stop-making behaviour of households during evening commute across residential zones in Ibadan, Nigeria. 1,794 commuting household heads were selected from 15 wards in the city. Significant relationships were established between evening intervening stops and most socioeconomic characteristics. Moreover, a significant relationship was found between residential zone and time added to evening commute, while distance added to evening commute varied across the three residential zones. Unlike most previous studies, the study came up with some important findings that are capable of enhancing our understanding of the trip-chaining behaviour of households with no access to private vehicles.

Key words: commuting, trip chaining, intervening stop, residential density, Ibadan

* * * * * *

INTRODUCTION

Work trips account for over 20 per cent of all person trips (Jou et al., 1992). This is why transportation planners accord top priority to the study of commuting as an integral aspect of travel behaviour. In other words, what goes on in the course of morning and evening peak periods, intervening stops inclusive, as well as their implications for urban transportation planning are of interest to transport planners, especially now that it is gradually dawning on them that trip chaining has come to stay as an indispensable aspect that must be reckoned with in traffic forecasting modelling. This is because on a daily basis commuters have diverse reasons for making intervening stops on their way to work in the morning, on their way back from work in the evening, or on both occasions. Intervening stops are stops associated with chained trips (Liu, 2013). They form an integral part of trip chaining as they necessarily constitute trip legs or trip segments. By combining such discretionary trips for which stops are made with the nondiscretionary work trips, commuters engage in trip chaining. Reasons for intervening stops range from such chores shared among household members as shopping and dropping and/or picking up schoolchildren to such other trip purposes that constitute trip legs as social visits, recreational trips, and trips to places of worship, among others.

* Corresponding Author

Studies have shown that working household members share chores and engage in several non-work activities, and perform them before returning home (Ajay and Levinson, 1995; McGuckin and Nakamoto, 2004; O'Fallon and Sullivan, 2005, 2009). Besides, consolidating work and non-work trips can be viewed broadly within the paradigm of the concept of bounded rationality: people respond to changing urban form, demographic and life-cycle stages and rising congestion by pursuing several activities along a single trip chain to achieve travel economies (Ajay and Levinson, 1995). In addition, the growth in female employment and the increase in per capita income on the one hand, and the need to accommodate different daily chores within the 24-hour day on the other hand, have resulted in an emergence of complex travel patterns on a scale not known decades ago (Baldwin and Fagan, 2007; Ajay and Levinson, 1995; McGuckin and Murakami, 1999; Pekol and Brown, 2005).

While discretionary trips form part of the daily itinerary of many commuters, evening intervening stops have been reported to be more common, and take more time, than morning intervening stops (Jou et al., 1992; Ajay and Levinson, 1995; Jou and Mahmassani, 1997; American Association of State Highway and Transportation Officials (AASTHO), 2013). Reasons for this are not farfetched. Ordinarily, commuters would want to get to work without much delay in the morning. As such, they may not be able to afford to stop by. However, in the evening, on their way back home, there would be ample opportunities to accommodate a number of discretionary trips in the homeward journey. According to Ajay and Levinson (1995), this is especially applicable to commuters who live on the urban fringe, as they find it easier and more convenient to perform non-work activities before returning home in the evening.

Previous studies tend to support the argument that trip chaining is capable of explaining the rise in non-work (maintenance/discretionary) trips, which take place during the peak periods and posited as one of the reasons for increased congestion problems at rush hours. Therefore, better understanding of how commuters make trip-chaining decisions that are associated with their commuting constitutes a fundamental prerequisite for improving the validity of travel demand modelling as well as the development of congestion relief policies and strategies (Chu, 2003).

The literature of commuting is replete with studies that analysed series of trip-chaining behaviour in which intervening stops for non-work activities are introduced into the home-work-home travel pattern, and a few of these studies have isolated intervening stops with a view to advancing our understanding of the phenomenon. However, generally, there is a dearth of studies that focus the trip-chaining behaviour of commuters in the developing world. Thus, what obtains as far as intervening stops are concerned in this region of the world is yet to be extensively explored. More specifically, no known published research has looked into intervening stops among commuters in Nigeria. Meanwhile, it is apparent that not unlike the experience in other countries of the world, Nigerians, too, naturally combine several trips in one chain to achieve travel economies. This study is an attempt to examine evening intervening stops among commuters in Ibadan, one of Nigerian major cities. The examination of morning intervening stops has been carried out elsewhere (Fadare and Olojede, 2017).

Several methods and models have been developed to advance the cause of trip chaining in travel behaviour analyses. These include the Markov Process (Collins, 1975; Horton and Shuldiner, 1967; Howard, 1971a, 1971b; Kitamura, 1983; Nystuen, 1967; Wheeler, 1972), Entropy-Maximizing Model (Tomlinson et al., 1973), Random Utility Choice Model (Ben-Akiva et al., 1978; Horowitz, 1980; Lerman, 1979), Bernoulli Process (Mazurkiewicz, 1985), Gravity-Type Formulation (Borgers and Timmermans, 1986), Recursive Model (Konstadinos and Kitamura, 1989), Stochastic Model (Damberg et al., 1996; Drezner and Wesolowski, 1982; Hanson, 1979; Miller and O'Kelly, 1983; Southworth, 1983), and very recently Shannon Entropy (Scheiner and Holz-Rau, 2017), among other models.

In this study, a rather simplistic approach has been used owing to certain peculiarities of the study area. For instance, in Nigeria, there are neither nationwide households travel surveys nor specially designed metropolitan personal travel survey on which such a study as this can be based. As such, the retrospective (stylised) questionnaire approach was employed whereby respondents were

asked questions on their activity/travel patterns for the previous day. However, conscientious efforts were made to obtain as accurate data as possible from the respondents. As such, even though the method employed was simplistic, important findings were made that are capable of enhancing our understanding of the phenomenon of commuters' intervening stops en route home in the evening.

LITERATURE REVIEW

A careful look at the existing literature affords us the understanding that commuting and trip chaining are related, and that trip chaining constitutes an integral part of commuting. The characteristics of the purposes for which intervening stops are made, otherwise known as trip legs or trip segments, have also been examined by other studies (McGuckin and Nakamoto, 2004; O'Fallon and Sullivan, 2005, 2009; Olojede, 2017). According to the literature, commuters chain their discretionary trips with their work trips in three major ways: by making intervening stops during the morning commute, by making intervening stops during the evening commute, and by embarking on discretionary trips that start and end in the workplace (Chu, 2003). The trips that start and end in the workplace are also referred to as loops (Valiquette and Morency, 2010). Meanwhile, morning and evening intervening stops have more direct link with commuting as they form part of the trip to work and the homeward trip.

By and large, studies have found that evening intervening stops are more common than morning intervening stops. For instance, in their study of chained trips in Montgomery County of Maryland, United States, Ajay and Levinson (1995) found, among other things, that commuters chain multiple discretionary trips made for non-work activities with the homeward trip in the afternoon more than in the morning. They also found that women chain their trips more than men, and that commuters who reside in areas closer to the central city are less likely to combine work and non-work trips relative to those living in the outer suburbs. These can be explained given the traditional roles of women which increase their propensity to make intervening stops, and the higher need of suburban dwellers that contribute to their tendency to make more intervening stops.

By a sharp contrast, in an empirical analysis of intervening stops among commuters in New York City, Chu (2003) found that commuters [in New York City] make more morning stops than evening stops. The study found that the primary determinants of intervening stop propensity in the city are arrival time and commuting in personal car for morning commute, while departure time and income influence intervening stops during evening commute. It was also found that an enhanced personal mobility, made possible by convenient public transit in the city, makes younger commuters to have a lower evening stop-making propensity since they can afford to undertake their non-work activities after a temporary home sojourn. In addition, the study revealed that during both morning and evening commutes, non-work activities pursued on intervening stops tend to be closer to home than work. Meanwhile, a longer commute travel time reduces the number of evening intervening stops because severe congestion on roadways in New York may outweigh activity opportunities to affect commuters' decision to make decisions on intervening stops. However, it is clear that this study features a number of obvious peculiarities that possibly account for the unusual results. Not every city has it as good as New York does, especially in terms of 'convenient public transit'. However, the study came up with an interesting finding that, all things being equal, the state of public transit influences commuters' decision as far as making intervening stops is concerned.

Jou and Mahmassani (1997) studied day-to-day trip-chaining behaviour of urban commuters in two cities. They investigated day-to-day variation in auto commuter trip-chaining behaviour. They developed models to relate trip-chaining patterns to three kinds of factors: socio-economic characteristics, workplace conditions and traffic system characteristics. They found that trip chaining was an essential feature of work trip commuting, and was more extensive in connection with the evening commute than with the morning commute. Activities completed at stops in the morning differed from those completed in the evening. The latter were longer and less likely to be routine. The results were similar in both Dallas and Austin, Texas. However, results pertaining to the relative locations of the stops in terms of their proximity to

home or workplace are different between the two cities reflecting the underlying differences in spatial and size characteristics between the two cities.

Using multi-day observations, Bhat (1999) examined the number of stops made by individuals during their evening commute. One important contribution of the study is that it applied a methodological framework that related stop-making to relevant individual, land-use, and work-related characteristics. The framework also accommodated unobserved variation in stop-making propensity across individuals in intrinsic preferences and in responsiveness to work-related attributes. The study also succeeded in providing a 'superior data fit' relative to a model that ignores unobserved variations in stop-making propensity across individuals. As such, it provided important behavioural insights which are often masked by the model that disregards unobserved variations. However, the study did not provide any empirical evidence as to whether or not evening stops are more common than morning stops. It is important to note that a good number of studies on commuting and trip chaining employed either specially designed surveys or national surveys that do not make for the availability of tangible travel characteristics and patterns for a large sample in any specific city. This made it impossible for them to analyze activity patterns as far as intervening stops are concerned in detail. McGuckin and Murakami (1999), for example, used the 1995 Nationwide Personal Transportation Survey to examine trip-chaining behaviour of adult men and women travelling Monday through Friday in the United States; Greenwald and McNally (2006) also examined how land use based substitution effects on travel behaviours manifest by examining the direct impact of land uses inducing trip-making behaviour in Portland, Oregon; while Noland and Thomas (2007) examined whether lower-density environments are related to more frequent reliance upon trip chaining and more complex tours.

Furthermore, Van Acker and Witlox (2011) used data from the 2000 to 2001 Travel Behaviour Survey in Ghent, Belgium; Zhao et al. (2012) traced the evolution of trip chaining patterns in London from 1991 to 2010; Ho and Mulley (2013) used a home-based tour dataset created from the Sydney Household Travel Survey; and Harding et al. (2015) used the 2010 Swiss Microcensus on mobility and transportation. In any case, these studies are very crucial to our understanding of how, why and when commuters make intervening stops.

From the foregoing, many researchers have examined a myriad of relationships between commuting, as it relates to trip chaining, and a number of influencing factors; conflicting findings abound, and it is quite difficult to reach a consensus on a number of issues that relate to the phenomenon of trip chaining. The aspect of intervening stops is another on which opinions differ but as made for by empirical findings. More importantly, the majority of studies available, as reviewed, on the trip-chaining aspect of commuting were carried out in developed countries. What obtains in the developing countries, especially in Africa, in this regard is scarcely available in the literature. Specifically, putting it very conservatively, there is surely or almost certainly not any known major published work on trip chaining in Nigeria. Meanwhile, trip chaining is no doubt a global phenomenon; and intervening stops are certainly inevitably made in less developed countries even as obtained in developed countries. Consequently, this study focuses homeward tours (evening commute), providing empirical evidence on evening intervening stops in a prominent Nigerian city. This is with a view to meeting part of the information need in the extant literature of trip chaining in the developing world.

STUDY AREA

Ibadan had been a capital city since 1939 when the Colony and Protectorate of Nigeria was trifurcated into three administrative units. Currently, the city is the capital of Oyo State. It is located approximately between latitude 7.37º and 7.67º North of the Equator, and between 3.88º and 4.17º East of the Greenwich Meridian. Ibadan is about 145 kilometres from Lagos (the former Federal Capital of Nigeria) by road, and about 345 kilometres northeast of Abuja (the current Federal Capital City) as the crow flies. Ibadan is directly connected to many towns in Nigeria and its rural hinterland by a system of roads, railways [moribund at present, though] and air routes.

Ibadan metropolis comprises the main city (municipality), made up of five local government areas, and its suburbs (also sometimes referred to as less city) with six local government areas.

The Ibadan metropolitan area can be divided into three distinct residential zones. This division can be linked to three historical periods, with their nature and characteristics determined by social, economic and physical patterns (Fadare, 1987, 1993, 1997; Onibokun, 1985; Sanni & Akinyemi, 2009). They are the pre-colonial residential development (high-density/traditional), the colonial/pre-Independence residential development (intermediate/ medium-density) and the post-Independence residential development (low-density). Even the more recent classification by Onibokun and Kumuyi (2004) of Ibadan metropolis into seven morphological regions can still be regrouped into these three residential zones. The zones are also as obtained in such other traditional Yoruba cities as Ilorin (Akorede, 1975) and Ogbomoso (Afon, 2005; Okewole, 1977).

Ibadan is an important socioeconomic, administrative, educational and industrial centre (Fadare & Wojuade, 2007a). The land use pattern compares with what obtains in other large cities in Nigeria. The general land use pattern of the Ibadan metropolitan area shows a clear distinction: purely non-agricultural use for Urban Ibadan, and agricultural use for Rural Ibadan. Residential land use is the most predominant among all land uses in the built-up part of Ibadan. The metropolitan area of the city has one of the highest population densities in the country, and the mostly densely settled areas remain the central and indigenous High of the city (Ayeni, 1994).

The first motorable road in Nigeria was constructed from Ibadan to Oyo in 1906, while the railway system which began in 1896 from Lagos to Kano in 1911 passed through the city. However, there is no internal rail system in the city. At present, there is no operational mass transit system in Ibadan. The implication of this is that there is high prevalence of automobile use among residents who can afford automobiles. Less financially buoyant residents, especially commuters, take taxicabs, minibuses (danfos), and commercial motorcycles (okadas).

According to Fadare and Wojuade (2007a) 5.3% of the roads in Ibadan are federal roads, 20.8% are state roads, while the remaining 73.9% are local government roads. Generally these roads are inadequate and in poor condition, especially the local government roads which are barely paved, and are in most cases not motorable during the rainy season. The federal and state government roads that are paved are in most cases not maintained. More often than not, these contribute to traffic congestion and delay in the city (Fadare, 1998; Fadare & Wojuade, 2007a, 2007b; Fadare et al., 2007; Olojede, 2015).

The choice of Ibadan for this study is strategic for a number of reasons. Among other things, Ibadan has a metropolitan status which makes commuting indispensable. Meanwhile, as big as the city is its transport system is best described as being mono-modal, the only operating mode being the road. Besides, there is no sustainable public transit; as such, paratransit modes are predominant. In fact, in spite of its safety and security implications, the commercial motorcycle (popularly called okada, named after Okada, a small town in Edo State of Nigeria where motorcycles were first used as a means of commercial transport in Nigeria in the 1980s) is quite pervasive, even along major roads and expressways. In fact, there are commuters who travel a distance of over 10 kilometres to work daily on commercial motorcycles! However we look at it, commuting in Ibadan is an interesting phenomenon with its unique peculiarities. As such, conscientious caution should be the watchword when what obtains in the city in terms of commuting is being compared with what obtains elsewhere.

SAMPLING PROCEDURE

The sample population for the study was made up of households in all the five local government areas of the Municipal Ibadan: Ibadan North, Ibadan Northeast, Ibadan Northwest, Ibadan Southeast and Ibadan Southwest. The Independent National Electoral Commission of Nigeria categorised these local government areas into political wards for the purpose of the 2011 general elections. These were further categorised by stratification into the High, Medium and low-density residential areas. For the purpose of questionnaire administration for this study, inasmuch

as the study area had been grouped into homogenous political wards, one ward was randomly picked without replacement from each residential zone. In all, 15 wards were selected across all the three residential zones of the study area. Using systematic sampling technique, 5% of the buildings in the selected wards were sampled. The first building was randomly picked; subsequently, every 20th residential building in each ward was selected for the survey. From each of the sampled buildings, a household was randomly selected, and the household head was the respondent. Where the household head was not available, any available adult who was a commuter was surveyed. Eventually, 1,794 commuters were successfully surveyed: 728, 592 and 474 in the high-, medium- and low-density residential areas respectively.

RESULTS AND DISCUSSION

Some socioeconomic attributes deemed relevant to the evening commuting behaviour of household heads in Ibadan were examined. The summary is as shown in Table 1. According to the table, irrespective of the residential zone, there were more male than female household heads. This was most pronounced in the high-density residential area of the city where only about 23.1% of the household heads were women. In the medium-density residential area, there was only a marginal percentage difference of 2.8 between the proportion of male household heads and female household heads. Also, about 78.0%, 68.9% and 70.3% of household heads in the High, Medium and low-density residential areas of Ibadan respectively were married. It is thus clear that the highest proportion of married household heads was found in the high-density residential area of the city.

A large percentage (67.8) of the household heads fell in the 21-40 age group, followed by 27.0% household heads in the 41-60 age group. Table 1 also shows that 73.0% of household heads were married. Barely 2.7% and 3.0% were separated/divorced and widowed respectively, while 21.4% were single. The distribution of household incomes reveals that 46.7% of the households earned between 50,000 and 100,000 naira per month, 25.1% earned less than 50,000 while 28.2% of the households earned over a hundred thousand naira monthly. The highest percentage of households that earned over 100,000 naira (48.5%) lived in the low-density residential area.

From Table 1 it is further shown that in the low-density residential area 74.9% household heads had private vehicles. This is followed by 19.6% and 42.1% in the high- and medium-density residential areas respectively. As may be expected, a significant relationship was found between income and private vehicle ownership in the study area ($\chi 2 = 463.8$, $p < 0.001$). It is also found in this study that 50.4% of household heads in Ibadan travelled daily to their workplaces on commercial cabs and buses. This study found that no household head in any of the residential zones travelled by foot to work.

Table 2 shows the breakdown of the stops made by household heads in Ibadan in the course of their evening commute. Only 13.4 per cent of the household heads in the study area did not make any evening stop, while 33.7% and 52.9% of the household heads made one and at least two evening stops respectively. In the high-density residential area, 18.7% of the household heads did not make any stop, while 23.1% and 58.3% made one and at least two evening stops respectively. In the medium-density residential area, 13.5% of the household heads made no stop in the evening, while 33.8% and 52.7% made one and at least two evening stops respectively. In the low-density residential area, 5.1% of the household heads did not make any stop, while 50.0% and 44.9% made one and at least two evening stops respectively. Thus, the highest percentage (18.7) of household heads who did not make evening stops was found in the high-density residential area of the city, while household heads in the low-density residential zone made more evening stops than household heads in other residential zones. This finding supports those of Ajay and Levinson (1995), and Noland and Thomas (2007) who found that residential location of suburban dwellers influences intervening stops. A significant relationship was found between residential zone and the frequency of evening intervening stops ($\chi 2 = 126.4$, $p < 0.001$). The ANOVA test also showed that significant variation existed across the three major residential zones in the number of stops made during the evening commute ($F = 5.896$, $p = 0.003$).

Table 1. Socio economic Characteristics of Household Heads in Ibadan
(Data source: Author's Field Work, 2015)

Factor	Residential Zone			Total
	High	Medium	Low	
Gender				
Male	560 (76.9%)	304 (51.4%)	283 (59.7%)	1147 (63.9%)
Female	168 (23.1%)	288 (48.6%)	191 (40.3%)	647 (36.1%)
Age				
≤20	32 (4.4%)	8 (1.14%)	15 (3.2%)	55 (3.1%)
21-40	448 (61.5%)	416 (70.3%)	352 (74.3%)	1216 (67.8%)
41-60	224 (30.8%)	160 (27.0%)	100 (21.1%)	484 (27.0%)
>60	24 (3.3%)	8 (1.4%)	7 (1.5%)	39 (2.2%)
Marital Status				
Single	160 (22.0%)	136 (23.05)	88 (18.6%)	384 (21.4%)
Married	568 (78.0%)	408 (68.9%)	333 (70.3%)	1309 (73.0%)
Separated/Divorced	0 (0.0%)	24 (4.1%)	24 (5.1%)	48 (2.7%)
Widowed	0 (0.0%)	24 (4.1%)	29 (6.1%)	53 (3.0%)
Average Household Income (₦[1])				
<50,000	235 (32.3%)	165 (27.9%)	50 (10.5%)	450 (25.1%)
50,000-100,000	352 (48.4%)	292 (49.3%)	194 (40.9%)	838 (46.7%)
>100,000	141 (19.4%)	135 (22.8%)	230 (48.5%)	506 (28.2%)
Private Vehicle Ownership				
Owned	143 (19.6%)	249 (42.1%)	355 (74.9%)	747 (41.6%)
Not Owned	585 (80.4%)	343 (57.9%)	119 (25.1%)	1047 (58.4%)
Household Size				
1-2	160 (22.0%)	168 (28.4%)	142 (30.0%)	470 (26.2%)
3-4	160 (22.0%)	128 (21.6%)	54 (11.4%)	342 (19.1%)
5-6	304 (41.8%)	240 (40.5%)	222 (46.8%)	766 (42.7%)
>6	104 (14.3%)	56 (9.5%)	56 (9.5%)	216 (12.0%)
School-Age Household Members				
0	176 (24.2%)	168 (28.4%)	141 (29.7%)	485 (27.0%)
1	144 (19.8%)	96 (16.2%)	159 (33.5%)	399 (22.2%)
2	224 (30.8%)	192 (32.4%)	150 (31.6%)	566 (31.5%)
3	152 (20.9%)	96 (16.2%)	24 (5.1%)	272 (15.2%)
4	32 (4.4%)	40 (6.8%)	0 (0.0%)	72 (4.0%)
Working Household Members				
0	0 (0.0%)	0 (0.0%)	8 (1.7%)	8 (0.4%)
1	184 (25.3%)	224 (37.8%)	116 (24.5%)	524 (29.2%)
2	448 (61.5%)	296 (50.0%)	294 (62.0%)	1038 (57.9%)
>2	96 (13.2%)	72 (12.2%)	56 (11.8%)	224 (12.5%)
Usual Daily Mode				
Personal Car	36 (4.9%)	160 (27.0%)	311 (65.6%)	507 (28.3%)
Personal Motorcycle	73 (10.0%)	40 (6.8%)	11 (2.3%)	124 (6.9%)
Commercial Cab/Bus	463 (63.6%)	305 (51.5%)	137 (28.9%)	905 (50.4%)
Commercial Motorcycle	156 (21.4%)	87 (14.7%)	15 (3.2%)	258 (14.4%)

As shown in Table 3, 68.9% of the household heads in the study area did not make any stop for others in the course of their evening commute, while 15.6% and 15.5% of the household heads made one and at least two evening stops for others respectively. In the high-density residential area, 64.8% of the household heads did not make any stop for others, while 15.4% and 19.8% made one and at least two evening stops respectively. In the medium-density residential area, 68.9% of the household heads made no stop for others in the evening, while 17.6% and 13.6% made one and at least two evening stops for others respectively. In the low-density residential area,

[1] As of 21st April, 2018, a US dollar (USSD1) exchanged for Nigerian 360.00 naira (₦360.00) officially.

75.1% of the household heads did not make any stop for others, while 13.5% and 11.4% made one and at least two evening stops for others respectively. It then follows that, generally, household heads in Ibadan do not usually make stops for others in the course of their evening commute.

Table 2. Stops during Evening Commute
(Data source: Author's Field Work, 2015)

Residential Density		Number of Stops				Total
		0	1	2	>2	
High	Count	136	168	288	136	728
	%	18.7%	23.1%	39.6%	18.7%	100.0%
Medium	Count	80	200	248	64	592
	%	13.5%	33.8%	41.9%	10.8%	100.0%
Low	Count	24	237	166	47	474
	%	5.1%	50.0%	35.0%	9.9%	100.0%
Total	Count	240	605	702	247	1794
	%	13.4%	33.7%	39.1%	13.8%	100.0%

Table 3. Stops Made for Others during Evening Commute
(Data source: Author's Field Work, 2015)

Residential Density		Number of Stops for Others				Total
		0	1	2	>2	
High	Count	472	112	112	32	728
	%	64.8%	15.4%	15.4%	4.4%	100.0%
Medium	Count	408	104	72	8	592
	%	68.9%	17.6%	12.2%	1.4%	100.0%
Low	Count	356	64	31	23	474
	%	75.1%	13.5%	6.5%	4.9%	100.0%
Total	Count	1236	280	215	63	1794
	%	68.9%	15.6%	12.0%	3.5%	100.0%

Further, a higher proportion (35.2%) of household heads in the high-density residential area made stops for other household members during their evening commutes than in either the medium- (31.1%) or low-density residential area (24.9%). The one-way ANOVA test established significant variation between residential density and number of stops made by household heads for others in Ibadan during the evening commute ($F = 26.042$, $p < 0.001$). Similarly, the Chi-square tests carried out showed a significant relationship between residential zone and number of stops made for others during the evening commutes of household heads in Ibadan municipality ($\chi 2 = 37.897$, $p < 0.001$).

According to Table 4, 40.5% of the household heads in the study area did not have any time added to their usual commuting time consequent on intervening stops made in the course of their evening commute, 23.6% and 16.9% had 1-15 minutes and 16-30 minutes added to their commute time consequent on stops made respectively, 10.9% and 5.2% had 31-45 minutes and 46-60 minutes added respectively, while 3.0% had over an hour added to their commute time as a result of intervening stops made. In the high-density residential area, 41.2% of the household heads had no time added to their evening commuting time, 28.6%, 17.3%, 6.2% and 4.8% had 1-15 minutes, 16-30 minutes, 31-45 minutes and 46-60 minutes added to their evening commuting time respectively, while 1.9% had more than one hour added to their evening commuting time consequent on the intervening stops made.

Table 4. Time Added to Evening Commute Consequent on Stops
(Data source: Author's Field Work, 2015)

Residential Density		Time Added (minutes)						Total
		0	1-15	16-30	31-45	46-60	>60	
High	Count	300	208	126	45	35	14	728
	%	41.2%	28.6%	17.3%	6.2%	4.8%	1.9%	100.0%
Medium	Count	187	128	106	88	51	32	592
	%	31.6%	21.6%	17.9%	14.9%	8.6%	5.4%	100.0%
Low	Count	239	88	71	62	7	7	474
	%	50.4%	18.6%	15.0%	13.1%	1.5%	1.5%	100.0%
Total	Count	726	424	303	195	93	53	1794
	%	40.5%	23.6%	16.9%	10.9%	5.2%	3.0%	100.0%

In the medium-density residential area, 31.6% of the household heads did not have any time added to their evening commuting time, 21.6%, 17.9%, 14.9% and 8.6% of the household heads had 1-15 minutes, 16-30 minutes, 31-45 minutes and 46-60 minutes added to their evening commuting time respectively, while 5.4% had more than one hour added to their evening commuting time consequent on the intervening stops made. In the low-density residential zone, 50.4% of the household heads did not have any time added to their evening commuting time, 18.6%, 15.0%, 13.1% and 1.5% of the household heads had 1-15 minutes, 16-30 minutes, 31-45 minutes and 46-60 minutes added to their evening commuting time respectively, while 1.5% had more than one hour added to their evening commuting time consequent on the intervening stops made.

It is thus clear that consequent upon the stops made during their evening commute, household heads in Ibadan had time added to their evening commute. However, household heads in the high-density residential area spent more time in aggregate than those in either the medium- or low-density residential area in addition to their normal trip time as a result of stops made for others in their evening commute. The Chi-square tests established a significant relationship between residential zone and time added to evening commute consequent on stops made ($\chi 2 = 108.3$, $p < 0.001$). The ANOVA test also established significant variation in the distance added to evening commute across the three residential zones as a result of stops made ($F = 9.458$, $p < 0.001$).

As shown in Table 5, 34.7% of the household heads in the study area did not have any distance added to their usual commuting distance consequent on intervening stops made in the course of their evening commute; 17.4%, 16.4%, 12.2%, 10.4% and 5.9% had less than 1 km, 1.0-1.9 km, 2.0-2.9 km, 3.0-3.9 km and 4.0-4.9 km added to their usual commuting distance respectively; while 3.0% had over 5 km added to their usual commuting distance consequent on stops made. In the high-density residential area, 18.7% of the household heads had no distance added to their evening commuting time; 26.9%, 17.0%, 13.7%, 14.6% and 6.6% had less than 1.0 km, 1.0-1.9 km, 2.0-2.9 km, 3.0-3.9 km and 4.0-4.9 km added to their usual commuting distance respectively; while 2.5% of the household heads had over 5 km added to their evening commuting distance consequent on the intervening stops made.

In the medium-density residential area, 22.0% of the household heads did not have any distance added to their usual evening commuting distance; 18.2%, 22.3%, 17.6%, 9.5% and 6.4% of the household heads had less than 1 km, 1.0-1.9 km, 2.0-2.9 km, 3.0-3.9 km and 4.0-4.9 km added to their usual commuting distance respectively; while 4.1% of the household heads had over 5 km added to their evening commuting distance. In the low-density residential zone, 75.3% of the household heads did not have any distance added to their usual evening commuting distance; 1.7%, 8.2%, 3.2%, 5.1% and 4.2% of the household heads had less than 1 km, 1.0-1.9 km, 2.0-2.9 km, 3.0-3.9 km and 4.0-4.9 km added to their usual commuting distance respectively; while 2.3%

of the household heads had over 5 km added to their usual evening commuting distance consequent on the intervening stops made.

Table 5. Distance Added to Evening Commute Consequent on Stops
(Data source: Author's Field Work, 2015)

Residential Density		Distance Added (kilometres)							Total
		0	**<1.0**	**1.0-1.9**	**2.0-2.9**	**3.0-3.9**	**4.0-4.9**	**≥5**	
High	Count	136	196	124	100	106	48	18	728
	%	18.7%	26.9%	17.0%	13.7%	14.6%	6.6%	2.5%	100.0%
Medium	Count	130	108	132	104	56	38	24	592
	%	22.0%	18.2%	22.3%	17.6%	9.5%	6.4%	4.1%	100.0%
Low	Count	357	8	39	15	24	20	11	474
	%	75.3%	1.7%	8.2%	3.2%	5.1%	4.2%	2.3%	100.0%
Total	Count	623	312	295	219	186	106	53	1794
	%	34.7%	17.4%	16.4%	12.2%	10.4%	5.9%	3.0%	100.0%

As obtained in Table 5, more household heads in the high-density residential area had considerable distance added to their evening commute than those in either the medium- or low-density residential area. ANOVA tests established this variation ($F = 18.222$, $p < 0.001$). Furthermore, the Chi-square tests established a significant relationship between zone of residence and time added to evening commuting ($\chi 2 = 523.6$, $p < 0.001$). In aggregate, more distance was added to the evening commute of household heads in the high-density residential area.

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

The underpinning for this study was the realisation that given the array of the socioeconomic and demographic attributes of households in Ibadan, coupled with spatial indices in terms of land use and accessibility factors, households in the city would have a high propensity to combine discretionary trips with nondiscretionary trips with a view to achieving travel economies. Thus, intervening stops, especially in the course of evening commute, would be expected. The examination of socioeconomic characteristics of the households revealed that they varied across the residential zones. For example, households in the high-density residential area were characterised by both a low level of average monthly income and private vehicle ownership. By contrast, households in the low-density residential area had a higher level of income and enjoyed a high level of vehicle ownership, while households in the medium-density residential area stood midway in terms of both household income and private vehicle ownership. Evening stops made by household heads varied significantly across the residential zones, with the highest proportion of household heads that made stops during the evening commute found in the low-density residential area.

The findings of this study have several implications. First, most of the previous studies available in the extant literature of trip chaining were conducted in the West and other developed economies, with just a few conducted in developing countries, and scarcely any in Nigeria. Therefore, the results from this study are expected to find better relevance in the context of developing economies, especially in Nigeria, than those of previous studies. For instance, variations in terms of personal and household socioeconomic characteristics, national economic profiles, and national transportation systems are known to vary between developed and developing economies. Meanwhile, they are important factors that come to bear on travel behaviour. Besides,

most of the previous studies made use of secondary data that were extracted from national surveys. These are unavailable in most developing countries, and definitely inexistent in Nigeria.

Moreover, almost all of the reviewed previous studies in the literature of trip chaining limited themselves to automobile-driving commuters. Meanwhile, as found by this study, not only car-driving commuters consolidate their discretionary trips with non-discretionary ones. Therefore, this study has come up with some important findings that are capable of enhancing our understanding of the trip-chaining behaviour of households with no access to private vehicles. However, this study considered mainly tours between the two anchor points of home and workplace. Therefore, other studies are needed especially on such other tour types as work-to-work (trips made during the workday or official/work-related looping) and home-to-home, which are non-work trips.

REFERENCES

AASTHO (2013). *Commuting in America 2013: The National Report on Commuting Patterns and Trends*. Brief 10: Commuting Mode Choice, http://traveltrends.transportation.org/Documents/CA10-4.pdf, accessed 08.04.2018.

Afon, A. O. (2005). *Solid Waste Management in Selected Cities of Oyo State*, An unpublished Ph.D. Thesis Submitted to the Department of Urban and Regional Planning, Obafemi Awolowo University, Ile-Ife, Nigeria.

Ajay, K., & Levinson, D. M. (1995). Chained trips in montgomery county, Maryland. *ITE Journal*, May, 27-32.

Akorede, V. (1975). *Ilorin - A City in Urban Geography*, An unpublished M.A. Thesis Submitted to the Department of Geography, University of Lagos, Nigeria.

Ayeni, B. (1994). The metropolitan area of Ibadan: its growth and structure. *Ibadan region*, 72-84.

Baldwin, G., & Fagan, S. (2007). Trip chaining while driving–comparing men's and women's behaviour. *Statistics Canada, EnviroStats*, 1(3), 8-11.

Ben-Akiva, M., Sherman, L., ... & Kullman, B. (1978). Disaggregate Travel Demand Models for the San Francisco Bay Area: Non-Home Based Models. *Transportation Research Record*, 673, 128-33.

Bhat, C. (1999). An Analysis of Evening Commute Stop-Making Behavior Using Repeated Choice Observations from a Multi-Day Survey, *Transportation Research Part B Methodological* 33(7), 495-510.

Borgers, A., & Timmermans, H. (1986). City Centre Entry Points, Store Location Patterns and Pedestrian Route Choice Behavior: A Micro-level Simulation Model. *Socio-Economic Planning Science*, 20, 25-31.

Chu, Y. L. (2003). Empirical analysis of commute stop-making behavior. *Transportation Research Record: Journal of the Transportation Research Board*, (1831), 106-113.

Collins, L. (1975). *An Introduction to Markov Chain Analysis*. Norwich: Geo Abstracts.

Damberg, O., Lundgren, J. T., ... & Patriksson, M. (1996). An Algorithm for the Stochastic User Equilibrium Problem. *Transportation Research*, 30B, 115-131.

Drezner, Z., & Wesolowski, G. (1982). A Trajectory Approach to the Round-Trip Location Problem. *Transportation Science*, 16, 56-66.

Fadare, O. (1993). Homogeneity Test of Social Areas in Ibadan-The Application of the Chi-Square Test of Significance, *African Urban Quarterly* 6 (3 & 4), 357-363.

Fadare, O. (1998). Analysis of Formal and Informal Public Transport Demand at Ibadan, Oyo State, Nigeria. *Journal of Environmental Design and Management* 1(1 & 2), 55-66.

Fadare, S. O. (1987). *Intra-Urban travel characteristics: A study of Socio-economic attributes in Ibadan* (Doctoral dissertation, University of Sheffield, Department of Town and Regional Planning).

Fadare, S. O. (1997). Urban Sprawl and Trip Length Characteristics in Ibadan, Nigeria. Ife *Planning Journal* 1(1), 55-69.

Fadare, S. O., Wojuade, C. A. (2007a). Study of Traffic Delay Situation in Ibadan, Nigeria. *Ife Planning Journal* 3(1), 1-15.

Fadare, S. O., Wojuade, C. A. (2007b). Socioeconomic Effects of Traffic Delay in Ibadan Nigerian. *Urban and Regional Planning Review* 1(2), 100-107.

Fadare, S. O., Wojuade, C. A., ... & Durodola, G. A. (2007). Contribution of Commercial Vehicles to Traffic Congestion in High Area of Ibadan, Nigeria. *LAUTECH Journal of Engineering and Technology* 4(2), 63-74.

Fadare, S., Olojede, O. (2017). Morning Intervening Stops across Residential Areas in Ibadan, Nigeria. *Journal of Environmental Design and Management* 9(1), 4-14.

Greenwald, M. J., & McNally, M. G. (2006). *Land Use Influences on Trip Chaining in Portland, Oregon*, Institute of Transportation Studies, University of California, Irvine, CA 92697-3600, U.S.A.

Hanson, S. (1979). Urban-Travel Linkages: A Review. In Hensher, D. and P. Stopher (eds) *Behavioral Travel Modelling*, pp 81-100. London: Croom Helm.

Harding, C., Miller, E. J., Patterson, Z., ... & Axhausen, K. (2015). Multiple Purpose Tours and Efficient Trip Chaining: An Analysis of the Effects of Land use and Transit on Travel Bahavior in Switzerland. *Transportation Research Board, 94th Annual Meeting*, January 11-15, Washington, D.C.

Ho, C. Q., & Mulley, C. (2013). Multiple purposes at single destination: A key to a better understanding of the relationship between tour complexity and mode choice. *Transportation Research Part A: Policy and Practice*, 49, 206-219.

Horowitz, J. (1980). A Utility Maximizing Model of the Demand for Multi-Destination Non-Work Travel. *Transportation Research B*, 14, pp 369-386.

Horton, F., & Shuldiner, W. (1967). The Analysis of Land-Use Linkages. *Highway Research Record*, 165, pp 96-107.
Howard, R. (1971a). *Dynamic Probabilistic Systems. Vol. 1: Markov Models.* New York: John Wiley & Sons.
Howard, R. (1971b). *Dynamic Probabilistic Systems. Vol. 2: Semi-Markov and Decisions Processes.* New York: John Wiley & Sons.
Jou, R. C., & Mahmassani, H. (1997). Comparative analysis of day-to-day trip-chaining behavior of urban commuters in two cities. *Transportation Research Record: Journal of the Transportation Research Board*, (1607), 163-170.
Jou, R. C., Mahmassani, H. S., ... & Joseph, T. (1992). *Daily Variability of Commuter Decisions: Dallas Survey Results*, Center for Transportation Research, The University of Texas, Austin, Texas 78712-1075.
Kitamura, R. (1983). A Sequential, History-Dependent Approach to Trip-Chaining Behavior. *Transportation Research Record*, 944, 13-22.
Konstadinos, G. G., & Kitamura, R. (1989). Recursive Model System for Trip Generation and Trip Chaining. *Transportation Research Record 1236*, 59-66.
Lerman, S. (1979). The Use of Disaggregate Choice Models in Semi-Markov Process Models of Trip Chaining Behavior. *Transportation Science*, 13, pp 273-291.
Liu, H. (2013). *What Affects the Number of Non-Work Stops Made During Commute Tours?* A Study Based on the 2009 US National Household Travel Survey in Large Metropolitan Areas (Doctoral dissertation, UCLA).
Mazurkiewicz, L. (1985). A Statistical Model of a Multitrip Spatial-Interaction Pattern. *Environment and Planning A*, 17, 1533-1539.
McGuckin, N., & Murakami, E. (1999). Examining trip-chaining behavior: Comparison of travel by men and women. *Transportation Research Record: Journal of the Transportation Research Board*, (1693), 79-85.
McGuckin, N., & Nakamoto, Y. (2004). Trips, Chain, and Tours-Using an Operational Definition, In *National Household Travel Survey Conference on Transportation*, Nov 1-2, 2004.
Miller, E., & O'Kelly, M. (1983). Estimating Shopping Destination Choice Models from Travel Diary Data. *Professional Geographer*, 35, 440-449.
Noland, R. B., & Thomas, J. V. (2007). Multivariate Analysis of Trip-Chaining Behaviour, *Environment and Planning B: Planning and Design* 34(6): 953-970.
Nystuen, J. (1967). A Theory and Simulation of Intra-urban Travel. In *Quantitative Geography. Part I: Economic and Cultural Topics*, Garrison, W. and D. Marble (eds), pp. 54-83. Evanston, Ill.: North-western University Press.
O'Fallon, C., & Sullivan, C. (2005). Trip Chains and Tours: Definitional Issues Associated with Household Travel Surveys, *Presented at 28th Australasian Transport Research Forum*, Sydney, September.
O'Fallon, C., Sullivan, C. (2009). Trends in Trip Chaining and Tours: Analysing Changes in *New Zealanders' Travel Patterns Using the Ongoing New Zealand Household Travel Survey*, Wellington: New Zealand Transport Agency, Research Report 373.
Okewole, I. A. (1977). *An Approach to Integration between the Traditional and Contemporary Areas in Ogbomoso*, An unpublished M.Sc. Thesis Submitted to the Department of Urban and Regional Planning, Ahmadu Bello University, Zaria, Nigeria.
Olojede, O. (2017). *An Exploratory Analysis of Discretionary Trip-Leg Purposes across Residential Zones of Ibadan, Nigeria*, Advances in Built Environment Research: Proceedings of Environmental Design and Management International Conference (EDMIC 2017), Aluko B.T., Odeyinka H.A., Ilesanmi A. O., Ademuleya B.A., Daramola O.P. (Eds), Obafemi Awolowo University, Ile-Ife, Nigeria, 22nd-24th May, pp 778-787.
Olojede, O. A. (2015). *Trip-Chaining Behaviour of Households in Ibadan, Nigeria*, An unpublished Ph.D. Thesis Submitted to the Department of Urban and Regional Planning, Obafemi Awolowo University, Ile-Ife, Nigeria.
Onibokun, A. G. (1985). *Urbanisation in the Emerging Nations: A Challenge for Pragmatic Comprehensive Regional Planning, Housing in Nigeria*: A Book of Readings, Onibokun A.G. (Ed.), Ibadan: Nigerian Institute of Social and Economic Research (NESREA) pp 5-18.
Onibokun, A. G., & Kumuyi, A. J. (2004). *Ibadan, Nigeria*, The International Development Research Centre.
Pekol, A., & Brown, G. (2006). Balancing Work, Life and Family Demands–Trip Chaining in South East Queensland. In Australasian Transport Research Forum (ATRF), 29th, 2006, Gold Coast, Queensland, Australia, Vol 29.
Sanni, L., & Akinyemi, F. O. (2009). Determinants of households' residential districts' preferences within metropolitan city of Ibadan, Nigeria. *Journal of Human Ecology*, 25(2), 137-141.
Scheiner, J., & Holz-Rau, C. (2017). Women's Complex Daily Lives: A Gendered Look at Trip Chaining and Activity Pattern Entropy in Germany. In *Transportation*, 44(1), 117-138.
Southworth, F. (1983). Circuit-Based Indices of Locational Accessibility. *Environment and Planning B*, 10, 249-260.
Tomlinson, J., Bullock, N., Dickens, P., Steadman, P., ... & Taylor, E. (1973). A Model of Students' Daily Activity Pattern. *Environment and Planning A*, 5, 231-66.
Valiquette, F., & Morency, C. (2010). Trip chaining and its impact on travel behaviour. *World Transport Research*, 12th WCTR, July 11-15, Lisbon, Portugal.
Van Acker, V., & Witlox, F. (2011). Commuting trips within tours: how is commuting related to land use?. *Transportation*, 38(3), 465-486.
Wheeler, J. (1972). Trip Purposes and Urban Activity Linkages. *Annals, Association* of *American Geographers*, 62, 64-54.
Zhao, Z., Chua, G., ... & Zhao, J. (2012). Evolution of trip chaining patterns in London from 1991 to 2010. *In Innovations in Travel Modelling Conference*, Tampa.

Submitted:	Revised:	Accepted and published online
May 07, 2018	July 20, 2018	September 11, 2018