

# **Understanding Car Ownership among Households in Developing Countries: A Case Study of Accra, Ghana**

By

Samuel Adjei Appiah

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The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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## ABSTRACT

Household car ownership is a widely researched area due to the trade-offs between the benefits of the mobility provided by the car and the numerous negative impacts the car has on the environment. Most of the studies on car ownership have been conducted in developed countries, although more recently there are studies in emerging economies of the world. There are, however, very few studies on car ownership in developing countries, especially cities in Sub-Saharan Africa. The literature has some key commonalities as drivers to increased car ownership such as rising income and positive attitudes towards the car as a status symbol. There are, however, some important gaps with regards to understanding car ownership in the developing world. First, the household structures and social norms can sometimes be quite different. This may influence the propensity of different parts of society to want to own a car. Secondly, the context in which an ownership decision is being considered can be very different. In the case of developing country city like Accra, few have the opportunity to buy a new car with most being older imports and it may be that the issues such as status a car affords someone are different. Third, the context of public transport is very different. Levels of access to informal public transport could be so high generally that limited service provision does not offer the same explanatory power in understanding car ownership as witnessed in developed countries. The quality of the services and their informality may also be a factor in explaining the relative attractiveness of the car. More recent literature from developed countries is often looking to understand what might be effective in undoing mass car ownership whereas developing countries are trying to understand growth. The context of growth in developing countries is very different to that of the growth periods post the Second World War in the developed world and so new insights are required. This research seeks to bridge those gaps by understanding the factors that influence car ownership in a low car owning economy by researching on potential variables which are identified to affect car ownership.

The research utilises both qualitative and quantitative methods. Using Accra, the capital of Ghana as a case study, a focus group discussion was undertaken to gain insight into the study area by understanding contextual issues to help in the development of questionnaires. Further to this, a household data collection was undertaken using questionnaires targeting specifically households in high-income communities followed by households in middle-

income and low-income communities. In all 547 usable responses were obtained after the survey which provided data relating to household socio-demographic characteristics, trip characteristics, public transport accessibility and attitude towards car and public transport.

The results from the research indicate strong influence of income and number of people employed within a household on car ownership. Other household characteristics like household size, type of household and number of children with household are identified not to be significant factors in understanding household car ownership. The research indicates that car is largely a utility purchase in the city of Accra indicating that life is difficult without owning a car. Also, whilst there exists universal coverage of the informal public transport which appears to be the dominant means of transport in the city there exist numerous negative attributes of the services they provide. Efforts to reduce the rate of car ownership will need to follow a twin track of significantly improving the quality of journeys on public transport along with restraining the use of cars to prevent the gridlock which will otherwise result as incomes grow.

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**ABBREVIATION**

AMA	Accra Metropolitan Assembly
ANOVA	Analysis of Variance
BRT	Bus Rapid Transit
BTS	Barlett's Test of Sphericity
CES	City Express Service
DVLA	Driver Vehicle Licensing Authority
GAMA	Greater Accra Metropolitan Area
GAPTE	Greater Accra Passenger Transport Executive
GDP	Gross Domestic Product
GEV	Generalized Extreme Value
GLSS	Ghana Living Standard Survey
GPRTU	Ghana Road Transport Union
GSS	Ghana Statistical Service
KMO	Kaiser Meyer Olkin
MLE	Maximum Likelihood Estimation
MMDA	Metropolitan, Municipal and District Assemblies
MMT	Metro Mass Transit
MMTL	Metro Mass Transit Limited
MNL	Multinomial Logit
MOT	Ministry of Transport
MPT	Material Possession Theory
NL	Nested Logit
OSA	Omnibus Services Authority OSA
PCA	Principal Component Analysis
PT	Public Transport
QBS	Quality Bus System
RP	Revealed Preference
RUM	Random Utility Maximization
SP	Stated Preference
SSA	Sub Saharan Africa

TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
VAI	Vehicle Availability

## CHAPTER ONE: GENERAL INTRODUCTION

### 1.1 Introduction

The global vehicle population has been increasing significantly over recent decades. While 246 million vehicles were registered in 1970, that number had grown to 709 million in 1997 (Powers and Nicastrì, 2000, Timilsina and Dulal, 2011). By 2018, over 97 million new vehicles were being produced annually, adding to the existing global vehicle fleet (WAG, 2019). Rapid growth in vehicle ownership is not taking place in developed countries alone. Consistent economic growth has led to the rapid growth in vehicle ownership and usage in developing countries as well (Shen, 1997, Dargay and Gately, 1999, Timilsina and Dulal, 2011). This assertion is confirmed by Dargay et al. (2007), who project that by 2030, 56 percent of the world's vehicles will be owned by non-OECD countries, compared to 24 percent in 2002. Increase in vehicles represents increase in mobility, enhanced quality of life and flexibility for a lot of people. However, road transport is one of the sectors where environmental and resource pressure keep mounting over and above already unsustainable levels (Luke, 2018)

The transport sector has been identified as a major contributor to various environmental externalities such as local air pollution and greenhouse gas emissions and traffic congestion particularly in urban areas. Transport currently makes up to 23 percent of energy related to greenhouse gas emissions with road transport accounting for three-quarters of the CO<sub>2</sub> emissions globally (GFEI, 2016, Ashnani et al., 2015, Watson et al., 2005). Also emissions from motor vehicles have been identified to contribute 37% for nitrogen oxides (NO<sub>x</sub>), and 18% for carbon monoxide (CO) (Forster et al., 2007, Fuglestvedt et al., 2008, Biscoff et al., 2012). As a result of rapid motorisation and the high emission rates from vehicles, there have been adverse effect on health and the environment (Verma et al., 2016). According to Candiracci (2009), air pollution associated with transport is estimated to cost around 2% of GDP in developed countries and 5%-20% in the developing world. WHO (2009), estimates that urban air pollution caused by transport emissions leads to the death of 2.5 million people annually mostly in low and middle income countries.

The current trend of motorization in developing countries differs from that of the developed world. Rapid motorization is witnessed in most developing countries though the numbers of cars are still below the ones seen in the developed world. However, Davidson and Mackenzie

(2006) asserts that the rate of increase coupled with the types of cars provides cause for concern. In many developing countries, the average annual percentage increase in car ownership has reached as high as 10% (Sharma et al., 2011). The rapid motorization is characterised by an older vehicle fleet as compared to developed economies (Carbajo and Faiz, 1994) and burgeoning import of second-hand vehicles from USA, Japan and Europe. Older vehicles pollute more as they have inferior emission reduction technology, poorer fuel economy and are mostly poorly maintained (Wright and Fulton, 2005, Harrington and McConnell, 2003). This assertion is echoed by Ghose (2002), who posits that vehicular emissions account for 40%-80% of air quality problems in cities in developing countries.

A distinguishing characteristic of motorization in developing countries is its concurrent growth with urbanization making the effect very severe (Button et al., 1993). According to Sperling and Salon (2002) and Gakenheimer (1999), the pace of motorization is important because systems, such as transportation facility capacity and urban structure adjustments cannot keep up, resulting in enormous congestion and worsening air pollution from vehicles. The World Bank emphasizes the looming problem of traffic congestion for cities in developing countries, and suggests that it is likely to worsen as motorization continues to increase in developing countries (Gwilliam, 2002). Although the rate of growth in car ownership is still relatively low compared to the developed economies, the challenge posed as indicated above by increasing motorisation requires prompt attention.

As a result of continuous increase in motorization various studies have been carried out over the years to understand vehicle ownership at various levels. However, as this thesis will show, understanding consumer's preferences with regards to car ownership in developing countries is confined to a few studies despite its potential importance to informing policy choices to tackle the congestion and pollution challenges faced.

## **1.2 Rationale for the Study**

The wide ranging implications of the reliance on private and household vehicle ownership and other related aspects like fleet size and usage has being a topic of concern to policy makers at various levels (Anowar et al., 2014, Zegras and Hannan, 2012). Models developed to investigate vehicle ownership have been under development since 1930's (Jong et al., 2004). Jong et al. (2004) provided a comprehensive classification of various models found in



literature after 1995. The earlier literature focused on understanding car ownership at the aggregated level (Clark, 2007). Aggregate models are seen to project the overall impact of car ownership by analysing at the national or zonal level (Anowar et al., 2014) and are also considered to be cost effective (Potoglou and Kanaroglou, 2008). There exist a lot of limitations with the aggregate models despite the advantages they possess. The major limitation of the aggregate model is the inability to capture underlying behavioural mechanisms which can reduce their accuracy and policy sensitivity (Anowar et al., 2014, Potoglou and Susilo, 2008, Wu et al., 1999). Also, aggregate models encounter biases due to correlation between the aggregate units. For example, when aggregating at the regional level, the if proxy measures which are used to estimate the vehicle growth are not actually representative of underlying factors it leads to bias in the results obtained. Disaggregate models are able to deal with most of the limitations identified with aggregate models. From the policy analysis and behavioural perspective, disaggregate models are able to develop structure to identify the relationship between number of vehicles in a household and a range of explanatory variables such as household size or household type (Potoglou and Susilo, 2008, Bunch and Chen, 2007). Whilst not focussing on total stock levels, the insights are more relevant for understanding how to intervene in the different aspects of the transport system that could influence the likelihood of owning a vehicle. Furthermore, disaggregate models have overcome deficiencies and limitations of aggregate models such as multicollinearity across explanatory variables, large standard errors of estimated parameters and aggregation of bias (Potoglou and Susilo, 2008). In Chapter 2, Section 2.3.3, the different disaggregate models are reviewed and the reasons for selecting this as an approach are set out.

Several disaggregate vehicle ownership models have been developed over the years relevant to the objectives set for research. However, much of the work has been done in the developed world as compared to the developing world. Though there exist similarities with various variables contributing to ownership, differences exist mostly because of the level of motorization and other sociological factors (Wu et al., 1999). Variables considered in literature in both developing and developed country research are centred around socio-demographic characteristics, built environment variables and other observed variables (Anowar et al., 2014, Dash et al., 2013, Gómez-Gélvez and Obando, 2013). A summary of

variables considered in various studies in both developed and developing country context and models adopted are shown in Appendix A.

Among the socio-demographic variables that have been researched, household income has been identified as a major determinant in the ownership of vehicles (Gómez-Gélvez and Obando, 2013). High income households irrespective of being in a developed or developing country have higher preference as compared to middle-and low-income households in owning cars. (Karlaftis and Golias, 2002, Wu et al., 1999, Soltani, 2017). Research has also been conducted on the impact of other household variables like household head characteristics and the number of children in the household. Whilst some research suggests an increase in children in the household results in the acquisition of cars as a result of increased mobility requirement (Kermanshah and Ghazi, 2001, Yamamoto et al., 1999), other studies suggest that increased children lead to reduced probability of owning of car as a result of increase in expenditure on other household items (Bhat and Koppelman, 1993). Matas et al. (2009) also in their studies in the changes in the structure of car ownership in Spain posits that car ownership in households increases where a male is the head of the household.

With respect to the contribution of built environment characteristics, different types of urban form measurements were often researched in the reviewed literature. They include land use variables, location effects and transit accessibility. Land use variables consist of residential population density, job-housing balance, employment density, and road density (Li et al., 2010). Studies which have examined the impact of increased residential density on car ownership indicates a negative relationship (Ryan and Han, 1999, Baldwin Hess and Ong, 2002, Li et al., 2010, Zegras, 2010). Research by Schimek (1996) and Bento (2003) in the United States of America indicates that households had fewer cars when close to the urban centre. Contrarily, Li et al. (2010) studies in Beijing and Chengdu in China indicates that households tends to have fewer cars when they live further away from the urban centre. The finding, though counterintuitive, indicates the differences in structure of society between the developed and developing countries. It is also suggested that this may vary very significantly between developing countries dependent on the historical development patterns of cities.

Transit accessibility as a variable to understanding car ownership has also been researched. In early works, researchers used transit-related attributes like cost instead of access to transit to predict car ownership (Huang et al., 2016). Many of the studies that have researched the

effect of transit access to car ownership have achieved mixed results. Most of the studies relating to transit accessibility has been carried out in the developed world. For instance, Research by Anastasopoulos et al. (2012) in Athens Greece, indicated that the availability of transit within 10 minutes' walk was negatively associated with car ownership. However, Bhat and Guo (2007) found the relationship between access time to transit stop and auto ownership to be insignificant. In addition, a study in Adelaide in Australia by Soltani (2005) did not find transit accessibility as a major determinant. The findings on transit accessibility impact on car ownership from developed countries especially Europe and North America where demand for cars and the supply of transportation infrastructure are stable may not be applicable to the developing world. Even within the existing literature there are substantial differences between studies in different countries, reflecting quite different public transport networks and connectivity.

Research into car ownership in developing countries is limited as compared to that of the developed world. Khan and Willumsen (1986) posits that the limitation of data and scarcity of technical resources makes transport modelling difficult. Another reason is that, car ownership is a recent phenomenon which has been increasing from the 1990's in most developing countries (Li et al., 2010). However, there have been studies in some emerging economies in recent times particularly in China, India and Chile. Wu et al. (1999) researched on the vehicle ownership in Xi'an, China based on a 1997 survey by developing a concept of symbolic utility or psychological gratification in the ownership of vehicles. The results support the role of symbolic utility in influencing vehicle ownership though income is considered as a dominant determinant with other variables like bus stop accessibility and parking availability also contributing. Srinivasan et al. (2007) research in Chennai in India indicates that income, presence of female workers and children of school going age increase probability of owning cars. With respect to transit accessibility's impact on car ownership few studies have been undertaken in some emerging economies. Zegras (2010), based on a study in Santiago Chile indicated that household living in areas with poor bus accessibility relative to car accessibility had more cars than others. Also Huang et al. (2016) in a study to determine the association between transit access and auto ownership in Guangzhou, China found that local transit access had a negative association with auto ownership.

As will be demonstrated further in Chapter 2, the existing literature has some important gaps with regards to understanding car ownership in the developing world. Firstly, the household structures and the other socio-demographic variables can sometimes be quite different. This may influence the propensity of different parts of society to want to own a car. Secondly, the spatial structure of cities is different with different patterns of living for rich and poor as a result of the rapid and often unplanned growth of edge of city areas. Thirdly, the context in which an ownership decision is being considered is very different. Few have the opportunity to buy a new car, with most being older imports and it may be that the issues such as the status a car affords someone is different. Developed country literature is often looking to understand what might be effective in undoing mass car ownership whereas developing countries are trying to understand growth. This may matter because the levels of public transport accessibility are radically different. Levels of access to public transport could be so high generally that they do not offer the same explanatory power in car ownership models.

This research presented in this thesis seeks to bridge those gaps by understanding the factors that influence car ownership in a low car owning economy by researching on potential variables which are identified to affect car ownership in Accra, Ghana. The particular novelty of the work, over and above being in a new context, centres on

- Understanding how the influence of the availability and quality of alternatives to the car might be understood in a context where the public transport services are informal not timetabled but ubiquitous.
- Exploring the role of the car as a status symbol and/or a utility purchase, where there is greater opportunity to understand the differences between owners and non-owners even amongst higher income groups.

### **1.3 Research Aim and Questions**

The research seeks to understand household car ownership in a context in which there is low but rapidly increasing car ownership but where there is also plentiful supply of informal public transport. The research seeks to understand how these different factors influence a car ownership and how this may differ from the main body of literature which refers to the developing world. To explore this, the following research questions are established:

- RQ1: Which household socio-economic factors explain car ownership decisions in developing world context where informal public transport is plentiful?
- RQ2: Which attitudes towards cars influence car ownership?
- RQ3: Which attitude towards public transport influence car ownership?

The research also aims at using the insights from RQ1 to RQ3 to make recommendations about what can be done with respect to the growth of car ownership in the context under study.

#### **1.4 Scope of Research**

The research is undertaken using a case study approach. This section provides introductory information about transport in Ghana and explain the choice of the case study which is Accra. Accra is the administrative and political capital of Ghana and covers more than 1000km<sup>2</sup> or about 45% of the Greater Accra Region (Abane, 2011). Aside being the national capital, Accra has been the centre stage in terms of motorization in the country. This is attributed to centralization of industrial, commercial and political activities within the country. According to DVLA (2015), out of a total of 1,376,053 registered vehicles in Ghana, 64.7% of them are located in Accra even though the city has only 7.4% of the total population. This indicates the concentration of vehicles in the capital city. This supports Wu et al. (1999) assertion that motorization in developing countries is particularly witnessed in the metropolitan areas. Although Accra has witnessed an increase in vehicle population over the years resulting in increased congestion, the majority of trips made by people are through the use of public transport. The public transport is operated largely by private transport operators with a mix of vehicles: mini-buses (trotro) and taxis. There also exists a publicly run bus transport service known as the Metro Mass Transit (MMT) and the Quality Bus Service (QBS). Although the MMT and QBS are considered to provide cheaper service and have better infrastructure, the private transport operators contribute 95% of the bulk of urban bus passenger transport in Accra (Birago et al., 2016).

In Accra, trotro accounts for the largest modal share of patronized mode of transport. Trotro carries 62.2% of passengers in Accra but occupies 18.3% of road space in a given day (Ministry of Transport, 2016a). Increased congestion in Accra has been attributed to the low carrying

capacity of public transport vehicles as well as the space occupied by private cars which also has a low passenger capacity. According to Ministry of Transport (2016a), private cars carry 21.2% of passengers on roads in Accra but use 60.6% of road space.

Household car ownership in Ghana is low as only 3% of households own cars (Armah et al., 2010, Quarshie, 2007, World Bank, 2015b). According to Ghana Statistical Service (2014a), high income earning households own more cars as compared to those with low and middle income groups. This confirms what has already been established in literature in relation to the dominant impact of income on car ownership especially in developing countries (Liu and Ingram, 1998). However, within the high income group there still remains a relatively low percentage of people that own cars with less than 30% owning cars (Ghana Statistical Service, 2014a). This research is aimed at understanding factors influencing car ownership in a relatively low car ownership environment.

The research will focus on groups that are capable of acquiring a car which is mostly within the high income group and will identify the factors that influence car ownership. The fairly dense nature of the coverage of the public transport network may render “accessibility gains” from private car ownership relatively less important than in some contexts but quality of service and safety considerations will also be considered. Chapter Three provides a detailed discussion of Accra and provides justification for selecting the city for this research.

### **1.5 Structure of the thesis**

*Chapter One* presents an introduction to the context within which this research is placed. It highlights the need for this research to advance the existing knowledge relating to car ownership studies especially within the global south with much emphasis on Sub Saharan African city. The research questions are then presented along with the scope of the thesis.

*Chapter Two* presents an examination of the literature relating to car ownership research. This chapter discusses the aggregate and disaggregate approaches that have been used in undertaking car ownership research over the years. The chapter underscores the relevance for the adoption of the disaggregate approach in this research by concentrating on households. Various socio-demographic factors as well as built environment variables which have been examined in the literature are discussed. Issues relating to the impact of accessibility to public transport in an informal setting on car ownership together with other

household socio-demographic variables are identified to be factors to be explored further in the research. In addition, attitudinal factors impact on car ownership were explored. This chapter also provides a review of empirical research on car ownership in both the developed and developing world and underscores the need for this research in providing insight especially on how factors like attitudes towards car and public transport affect car ownership in a Sub Saharan African city such as Accra.

*Chapter Three* examines Accra as case study in greater depth to provide an overview of the context being studied. This chapter discusses the demographic and economic characteristics of Accra. The chapter also explores the need for choosing Accra as a case study. Emphasis was placed on exploring the transport modes in the city of Accra. With various public transport modes available within the city, the chapter explores the reason for the dominance of one public transport mode within the city.

*Chapter Four* presents the methodology that was applied in this research. This chapter discusses the case study design adopted. It anchors the overall research to specific metropolitan context and proceeds to discuss important methodological issues including the focus group discussion, survey design, sampling techniques, data collection as well as statistical methods adopted to analyse the data. This chapter also explains the various univariate, bivariate and multivariate analysis methods that were adopted as part of this research. Particularly, the chapter provides an overview of principal component analysis and the considerations used to decide on the final factors for attitudinal variables. The chapter also discusses the two discrete choice models (i.e. Multinomial Logit and Nested Logit) that were used in identifying the role of various factors in understanding car ownership.

*Chapter Fives* provides an in-depth examination of the data that was collected through the household data collection. This chapter provides a descriptive account of the sample characteristics and an aggregated analysis of the travel characteristics of the sample. In this chapter the household socio-demographic variables were detailed and discussed together with the trip characteristics of the households. Another variable that was considered in this chapter was the household accessibility to public transport. This chapter also follows up with the discussion on various attitudinal factors that emerged after the principal component analysis for attitude towards car and public transport. The various attitudinal factors were

further subject to analysis to identify the role various household demographic variables play in the factors identified.

*Chapter Six* continues the work in chapter five by undertaking modelling exercise to examine the role of various factors in understanding car ownership. Multinomial Logit and Nest Logit models were used for this exercise. Comparisons were made with respect to the findings achieved in this research and that of the literature review in Chapter Two.

*Chapter Seven* finally brings together all the strands of evidence in order to finally address the research questions that were noted in Chapter One. In addition the limitation of the research and the contribution of the research are also discussed in this chapter.



## CHAPTER TWO: LITERATURE REVIEW

### 2.1 Introduction

This chapter primarily discusses the various factors that have been identified to explain car ownership. In achieving this, the studies have been categorized into aggregate and disaggregate levels. The aggregate level of analysis considers changes in macro factors over time (e.g. average incomes, population size, household locations) to estimate overall car ownership levels whilst disaggregate studies consider the factors affecting individual or household decisions to choose to own a car. The use of models in understanding car ownership has been adopted at different levels for different purposes. Car ownership models are known to have been developed and used by car manufacturers, oil companies, international organisations and national and local governments. For instance whilst international organisations like World Bank use car ownership by country to help investment decision-making, national and regional governments use car ownership models to forecast transport demand, emission levels and policy measures (Jong et al., 2004). Even though this research is restricted to car ownership at the household level, a review of aggregate models at the national and regional levels is included here in order to highlight the differences and explain the decision to use a disaggregate approach.

This chapter begins by providing review of research into car ownership models by assessing various studies undertaken by researchers in the field. This is followed by a thorough discussion of aggregate and disaggregate car ownership models. These are undertaken together with the empirical findings. The identified factors known to be influencing car ownership at both the aggregate and disaggregate levels are also discussed. The role of psychological factors in understanding car ownership is also discussed in this chapter. The chapter reviews various psychological theories and uses them in developing a set of statements that are used in eliciting information from respondents which are analysed in the subsequent chapters. The chapter ends with a summary of the findings in literature, identifying gaps in literature and relating them to the research questions of this research.

## **2.2 Modelling and Car Ownership Study**

### **2.2.1 The development of car ownership models over time**

The wide ranging implications of the reliance on private and household vehicle ownership and other related aspects like fleet size and usage has been a topic of concern to policy makers at various levels (Anowar et al., 2014, Zegras and Hannan, 2012). Models to investigate vehicle ownership have been under development since the 1930's when a rapid growth in western economies was anticipated (Whelan, 2007). There exist several reviews of car ownership modelling over the years. Among these reviews include works by (Tardiff, 1980, Bates et al., 1981, Allanson, 1982, Button et al., 1982, Mannering and Winston, 1985). More recent reviews include (Bunch and Chen, 2000, Jong et al., 2004, Potoglou and Kanaroglou, 2008a, Anowar et al., 2014). This section provides a description of various reviews undertaken in literature that are done with the aim of providing systematic overview and assessment of the methodological alternatives in the context of various potential representations of vehicle ownership decision process. The brief reviews undertaken below discusses the works of Jong et al. (2004), Potoglou and Kanaroglou (2008a) and Anowar et al. (2014). The researcher resorts to these recent works as they provide comprehensive review of car ownership models and are in tune with current advanced frameworks developed to model vehicle ownership as a result of advances in computing. These models are reviewed with the aim of documenting their application in the context of vehicle ownership under study.

Jong et al. (2004) restricts the review to car ownership models developed for the public sector planning. The review undertaken discusses both aggregate and disaggregate models developed since 1995 to 2002. Jong et al. (2004) compared the different models on the basis of sixteen criteria ranging from level of aggregation, data requirement, inclusion of attitudinal variables etc. Most of the models can be categorized into static or dynamic (based on data period); short or long term (based on forecast horizon) and aggregate or disaggregate (based on data type). Jong et al. (2004) note in their review that the application of aggregate time series models in developing countries has been attractive because they have low data requirements and income can generally be considered to be the main driving force behind car ownership growth.

Potoglou and Kanaroglou (2008a) also provides a critical review of car ownership modelling with the primary themes being the data collection methods, modelling approaches and the relevant explanatory factors. The distinguishing feature of this review over others is the classification of automobile demand models based on the type of data; either revealed preference (RP) or stated preference (SP). Revealed preference data correspond with actual choices made by households observed through a survey (Ben-Akiva et al., 1985). Stated preference correspond with choices made by households on hypothetical choice situations, developed using experimental design methods (Louviere et al., 2000). Whilst using both RP and SP data have their merits and demerits the review by Potoglou and Kanaroglou (2008a) provides a key point for consideration which is the data requirement needed to meet the objects of a particular research. Based on the research objectives of this study, the researcher uses revealed preference data as the research seeks to study actual choices that households within Accra make with respect to owning cars or not based on prevailing characteristics.

Anowar et al. (2014) also provides a comprehensive review of car ownership and categorizes modelling approaches into four types with the life span of the data as a major determinant. The four categories include; exogenous static, endogenous static, exogenous dynamic and endogenous dynamic models. Exogenous static models examine vehicle ownership in isolation of other choices at a particular instance ignoring the dynamics of vehicle evolution. The exogenous static models were sub categorized into standard discrete choice models, count models and advance discrete choice models. Based on the review, it was evident that the standard discrete choice models are by far the most commonly employed. The common models used under this type are the Multinomial Logit and the Ordered Logit. The endogenous static approach jointly models vehicle ownership with other household choice outcomes (such as residential location) and hence accommodating potential endogeneity issues (Anowar et al., 2014). Exogenous dynamic models examine evolution in vehicle ownership decisions. The exogenous dynamic models are estimated using panel data<sup>1</sup> sets that possess both cross-sectional and time-series dimensions (Woldeamanuel et al., 2009). Endogenous dynamic models consist of models in which endogeneity of household vehicle

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<sup>1</sup> Panel data sets are formed when sample of households are observed at multiple points in time and the observations are separated by a particular time GILBERT, C. C. 1992. A duration model of automobile ownership. *Transportation Research Part B: Methodological*, 26, 97-114.

It must be indicated that as a result of difficulty in obtaining panel data several researchers have adopted the use of pseudo-panel data (a dataset formed by stitching together multiple cross-sectional data)

ownership and dynamics associated with vehicle acquisition processes are considered (Anowar et al., 2014). The work by Anowar et al. (2014) as discussed also affirms the assertion of limited work being done in developing countries especially in Sub Saharan Africa on understanding car ownership. This is because out of the 85 studies (studies between 1990 and 2014) used for the review 50 were from United States of America and Canada, 22 were from Europe, 10 from Asia, 2 from Australia and 1 from South America. It can be deduced from this work that the choice of model for a research should be guided by the objectives to be accomplished, data availability and the nature of the dependent variables.

The review provided above indicates the importance of data type used, timespan of data, nature of the independent variables and the other factors which must be considered in choosing a car ownership model. The next part of this chapter reviews car ownership models by dividing them into aggregate level and disaggregate level.

### **2.2.2 Aggregate Car Ownership Modelling and Empirical findings**

Early research regarding car ownership was based on aggregate analysis employing area-wide data or regional based regression models predicting the number of cars per capita or per household (Train, 1986, Clark, 2007, Potoglou and Kanaroglou, 2008a). Aggregate models can be divided into two categories: cross sectional aggregate models and time series aggregate models. With the cross sectional models, data from a particular moment in time with a geographical distribution are developed by using linear regression model (Phang and Chin, 1990, Said, 1992, Shaygan et al., 2017). However as a result of non-linear structure of car ownership and local variation review, the cross sectional aggregate models raised a number of concerns. (Shaygan et al., 2017, Clark, 2007). Primary among these was that the local information or variability in the relationship was being ignored especially in the globally developed regression models (Clark, 2007). In respect of this the geographically weighted regression model developed was able to capture the spatially varying nature of the relationship as by Clark (2007) in the case of car ownership within various electoral wards in the United Kingdom. The Time Series aggregate models usually contain sigmoid-shape function for the development of car ownership over time as a function of income or gross domestic product (GDP) (Jong et al., 2004, Ogut, 2004). The GDP increases slowly in the beginning then rises steeply and ends approaching the saturation level. A prominent example is the work done by Tanner (1978) on car ownership in Great Britain. Tanner (1978) proposed

an equation for car ownership per person that consisted of GDP, population density, growth of population over ten years, income per person, the percentage of self-employed people and population proportions under 15 and over 64.

Button et al. (1993) undertook modelling of vehicle ownership and use in low income countries<sup>2</sup> mainly using the logistic function. Button et al. (1993) observes that while at the lowest income per capita vehicle ownership is static or falling, at higher income levels it appears to be following the classic sigmoid-shaped growth path which has been observed in developed economies. Button et al. (1993) observes that the main independent variable influencing per capita vehicle ownership at the national level is income and posits that additional variables which may influence vehicle ownership include the level of urbanisation, price of fuel and degree of industrialisation. The work highlights the fact that much of car ownership in developing countries occurs in urban areas confirming earlier works of Thomson (1983) and Spencer and Madhavan (1989) in the specific context of Asia and Barrett and Mundial (1988) in the specific context of Africa. Subsequent studies also indicate the similar assertion that in developing countries the centre of attraction of vehicular growth are the cities (Gwilliam, 1997, Gakenheimer, 1999, Gwilliam, 2013). This is in contrast with the situation in most developed economies where the availability of better public transport and imposition of traffic restraint policies have led to the rapid growth away from urban concentration (Button et al., 1993). Unlike Button who undertakes modelling of vehicle ownership in a number of low income countries, Sillaparcharn (2007) undertakes studies in Thailand and reports the influence of income and urbanization as seen the Button et al. (1993). Sillaparcharn (2007) proposed a vehicle ownership model for Thailand using limited aggregate data from both time series and cross sectional sources. Sillaparcharn (2007) used GDP per capita, population density and urbanization level in the model and find that those explanatory variables are significant.

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<sup>2</sup> Button (1993) defined low income countries as countries with per capita incomes of less than US \$3,000 in 1986. Current income classification of countries by the World Bank indicates that low income countries have per capita income of US\$ 1,025 or less, Lower-Middle Income Countries have a per capita income of \$1,026 to \$3,995 and Upper-Middle-Income Economies have a per capita income of \$3,996 to \$12,375 WORLD BANK. 2019. *World Bank Country and Lending Groups* [Online]. [Accessed]. Together these three income categories are recognised as developing countries.

Dargay and Gately (1999) used the more flexible Gompertz function to predict the motorization rate on the basis of GDP per capita for 26 countries made up of 20 developed countries and 6 developing countries (including China, India, Pakistan). This function gave the long-run equilibrium prediction. Their model treats car ownership as a function of per-capita income. The significant finding is that car ownership grows as per-capita income grows especially in the relatively low-income countries, where the most rapid growth of car ownership occur. Dargay et al. (2007) builds on the earlier work of Dargay and Gately (1999) by extending the number of countries considered to 45 and relaxing the 1999 paper's assumption of a common saturation for all countries. The use of different saturation levels is an indication of the difference in the trend and manner of vehicle ownership especially between developed countries who are seen to be nearing the saturation level and developing countries who are at a lower level. Whilst these two studies serve a guide in undertaking aggregate forecast of motorization rate, certain levels of uncertainties affect the adoption of the aggregate approach. For instance, there could be significant effects of non-income variables that were omitted from the model such as demographic changes (for example increase in the percentage of adults in the population and increased female labour-force participation) which can affect the results. Also, country specific characteristics which might distinguish trend of vehicle growth is not well represented in these models.

The use of aggregate models were mostly attractive for application to developing countries because they have the lowest data requirements and are cost effective, while income is generally considered to be the main explanatory factor for car ownership growth (Button et al., 1993, Jong et al., 2004, Potoglou and Kanaroglou, 2008a). However, there exist a lot of limitations with the aggregate models despite the advantages they possess. The major limitation of the aggregate model is the inability to capture underlying behavioural mechanisms which can reduce their accuracy and policy sensitivity (Anowar et al., 2014, Potoglou and Susilo, 2008, Wu et al., 1999). Also, aggregate models encounter biases due to correlation between the aggregate units. For example when aggregating at the regional level, individual behaviour may be hidden by unidentified characteristics associated with the regions which is known as aggregate bias (de Dios Ortuzar and Willumsen, 2011). Major findings from the review above is that motorization in developing countries are experienced mostly in urban areas and that the level of motorization in developing countries is lower than

that of developed countries. Even though aggregate models give an indication of level of motorization, it is difficult proposing sustainable transport policies solely on the findings as they are prone to exhibit spurious associations (Wu et al., 1999) especially in the case of developing countries. For instance, Gakenheimer (1999), found that cars per 1000 population correlates very well with the annual income of the top 20% of population of the low income countries<sup>3</sup> studies. Even though this gives an indication of the dominance of income as explanatory variable, such findings limit the understanding of car ownership with respect to other variables. This provides a good foundation for undertaking disaggregate modelling which will consider factors ignored whilst undertaking aggregate modelling.

### **2.2.3 Disaggregate Car Ownership Models**

Disaggregate models are able to deal with most of the limitations identified with aggregate models. From the policy analysis and behavioural perspective, disaggregate models are able to develop structure to identify the relationship between number of vehicles and a range of explanatory variables (Potoglou and Susilo, 2008, Bunch and Chen, 2007). Whilst the findings are more insightful than aggregate models for understanding how to intervene in the different aspects of the transport system that could influence the likelihood of owning a vehicle, they typically have smaller samples and so scaling up to total stock level implications requires representative samples. As the population of car owners in developing countries is highly concentrated in bigger cities it may be difficult to build up a picture for the whole country if that is the goal.

With respect to disaggregate car ownership models, the “unit of observation” can be an individual or a household. The unit of analysis refers to the primary entity that the research is being done on. Yin and Sun (2017) indicates that the unit of analysis is the ‘who’ or ‘what’ that is being researched on. With respect to “individuals” being used as unit of observation, various studies have used individuals of different demographic and economic backgrounds in order to achieve the objectives of a particular research. With reference to the objectives of this research, the unit of analysis is the household. Emphasis on households presents a better scope of issues to cover instead of dealing with individuals. In addition households also have

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<sup>3</sup> The low income countries used in the research include: Bangladesh, India, Pakistan, Ghana, Sri Lanka, Indonesia, Philippines Ivory Coast, Guatemala, Morocco, Peru and Columbia. GAKENHEIMER, R. 1999. Urban mobility in the developing world. *Transportation Research Part A: Policy and Practice*, 33, 671-689.

individuals in households. Grosvenor (2000) suggest that interview of households is capable of exploring issues such as the collective use of cars and knock-on effects of one individual's choice on the choice and behaviour of other household members.

Disaggregate car ownership models can be categorized into static and dynamic models. Static and dynamic models are based on rational choice theory and assumed that individuals make choices through a process of utility maximisation (Cirillo et al., 2015). Static models are estimated using cross-sectional data sets which contain observations about households in a population at point in time. Static models can consider the vehicle ownership decision process in isolation to other choices or in conjunction with other household choice outcomes (Anowar et al., 2014). A lot of empirical studies of household car ownership have been developed using static models. The major weakness of the static models is that, the models are not able to test the time dependent aspects of household car ownership decisions despite the recognition that such time dependent processes are important in the literature (Anowar et al., 2014, Huang, 2007). In addition, static models are known to have other limitations including; uncertainty and imperfect information regarding alternatives and pervasiveness of habits which cannot be well explained in a cross-sectional data-sets. (Goodwin et al., 1990, Dargay and Vythoukcas, 1999)

The static models discussed above are based on a snapshot of the vehicle ownership profiles. However, households pass through a vehicle fleet decision process over time. The changes in the vehicle ownership status of a household could be triggered by a plethora of factors including changes of marital status, birth of child among others affecting the vehicular requirements of a household. The development of dynamic models are therefore primarily aimed at providing better understanding inculcating the factor of time differential in addition to other variables. Dynamic models have developed methods aimed at examining the changing decisions of households over time using different approaches including vehicle disposal and replacement models and vehicle holding duration models among others (Yamamoto et al., 1999, Anowar et al., 2014). By undertaking this analysis, researchers are able to examine how life-cycle changes in households and existing fleet influence vehicle ownership decisions. Dynamic models are estimated using panel data sets that possess both cross-sectional and time-series dimensions (Woldeamanuel et al., 2009). Panel surveys collect data about the same households at repeated time ranges and hence are able to observe the



process of change over time. As a result of the expensive nature of panel data surveys, a number of surveys have been undertaken using pseudo-panel<sup>4</sup> data sets.

The reasons for the adoption of static models over the years has been as a result of the limitation of data availability and the expensive nature of surveys needed to be able to undertake dynamic modelling. There has been much development in the data availability and adoption of the pseudo-panel datasets which has enabled increased usage of dynamic models in the developed world. However, there continue to exist issues of limitation of data and the expensive nature of data collection which has hampered the popularisation of dynamic models in the developing world. In the case of this study the researcher has opted for the use of static models since the data to be used are cross-sectional that will be generated in the course of the research without prior access to any existing data sources.

Models of car ownership are classified on the basis of the underlying choice response mechanism. The model choice can be an ordered response mechanism or unordered response mechanism. Both the ordered and unordered choices have been used in varied research having their identified strength and weakness.

The most commonly used ordered response mechanism in car ownership modelling studies is the traditional ordered logit (see Kim and Kim (2004); Potoglou and Kanaroglou (2008), Potoglou and Susilo (2008); Matas et al. (2009)) and probit (see Kitamura and Bunch (1990); Pendyala et al. (1995); Dargay and Hanly (2007); Ma and Srinivasan (2010)). The ordered response mechanism assumes that there exists a unidimensional latent car ownership tendency index that impacts car ownership decisions (Bunch and Chen, 2007). The latent variable cannot be measured directly, but is mapped to the observed vehicle ownership levels. Specifically to household car ownership, ordered response assumes that the observed number of household cars (i.e. dependent variable) is a discrete, ordinal variable that is mutually exclusive and collectively exhaustive (Potoglou and Susilo, 2008).

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<sup>4</sup> Pseudo-panel data-sets are panels constructed from successive cross sectional data sets which do not pertain to precisely the same sample of households. The pseudo-panel approach estimate dynamic models that circumvents the need for panel data and their associated problems like attrition. Although pseudo-panel data provides a way to undertake dynamic modelling extra restriction needs to be taken before they are treated as actual panel data with the most important been that the cohorts should be based on the time-invariant characteristics of the households JONG, G. D., FOX, J., DALY, A., PIETERS, M. & SMIT, R. 2004. Comparison of car ownership models. *Transport Reviews*, 24, 379-408.

The unordered response mechanism models do not explicitly take into account the ordinal nature of the observed levels of car ownership. Instead, the mechanism is based on the random utility maximization (RUM) theory. The random utility maximization principle indicates that the decision making unit (e.g. Individual or household) associate a particular level of utility with each level of decision (e.g. car ownership level) that yields the maximum utility expected (Zegras, 2010, Wong, 2013). The most common RUM used in the literature is multinomial logit model (MNL). The MNL has the advantage of presenting a closed form solution and having computational simplicity (Anowar et al., 2014). Unlike the ordered response models the MNL has an added advantage of flexibility in model specification by not placing restrictions on the effect of household characteristics on car ownership levels (Savolainen et al., 2011, Anowar et al., 2014).

There exist different studies that support the use of either ordered random mechanism or unordered random mechanism. For example, Bhat and Pulugurta (1998), compared empirical results of MNL and (ordered logit model) ORL models using several data sets and found considerable differences in the elasticities of exogenous variables across the choice probabilities of car ownership levels and further identified misspecification problems associated with the ORL that could lead to incorrect and inaccurate forecasts. However, a review of literature indicates that some works prefer to use ordered logit or ordered probit (ORP) on the basis of the discrete and ordered nature of the dependent variable (Chu, 2002, Kim and Kim, 2004). Subsequently, Potoglou and Kanaroglou (2008) found that a MNL model performed significantly better over the ORL through a likelihood ratio test between the two models using data from the metropolitan area of Hamilton, Canada. Potoglou and Susilo (2008) offered a comprehensive comparison of car ownership models including MNL, ORL and ORP by using empirical analysis of household car ownership from three sources of data include National Household Travel Survey of Baltimore Metropolitan Area, 2005 Dutch National Travel Survey and Osaka Metropolitan Person Trip Data. The comparison included a behavioural, theoretical and technical evaluation of both ordered and unordered mechanism (Potoglou and Susilo, 2008). Potoglou and Susilo (2008) based on two key differences concluded that the unordered response is a preferable option as compared to the ordered response. Firstly, the unordered response models (specifically the MNL) are based on RUM are supported by a strong theoretical framework as compared to the ORL and ORP which

considers the probability of owning a number of cars as a linear function of explanatory variables. This makes the unordered response models a preferred option as findings are based on solid behavioural framework and not a single continuous propensity measure (Potoglou and Susilo, 2008). Secondly, whilst the ordered response were constrained to a unique coefficient per explanatory variable, the MNL model is more flexible giving room for alternative specific effects of explanatory variables across different ownership levels. Based on the comparison above the unordered response models are adopted in this research.

### **2.3 Empirical findings of Disaggregate Models**

A review of literature indicates most of the explanatory variables centres around individual or household demographic factors and built environment attributes. Some of the variables considered under the individual or household demographic factors include; household income, household size, number of people employed in household, household head attributes, educational level of household members, gender of household head, marital status of household head, age of household head, number of children, number of license holders and family type. Some of the built environment attributes considered include; land use variables and transit accessibility. A summary of the variables considered together with the models adopted and data type can be found in Appendix A for developed countries and developing countries. Significant empirical findings on these studies for the different variables are briefly summarized below.

#### **2.3.1 Individual and Household Socio-Demographic Characteristics**

Household Income is one of the most important variables in determining car ownership as it provides a household with the financial means to own and maintain a vehicle (Roorda et al., 2000). This confirmed when looking at the explanatory power of income in aggregate models. High income households irrespective of been in a developed or developing country have higher preference as compared to middle-income and low-income households in owning cars. (Karlaftis and Golias, 2002, Wu et al., 1999, Soltani, 2017). Studies in developing world including Joseph et al. (2017) in Akure, Nigeria, Salon and Aligula (2012) in Nairobi Kenya, Mokonyama and Venter (2007) in South Africa, Kumar and Krishna Rao (2006) in Mumbai India, Srinivasan et al. (2007) in Chennai India, Soltani (2017) in Tehran Iran, Li et al. (2010) in

China and Wu et al. (2016) support the observation that increased income is a determinant in household car ownership.

Research has also been conducted on the impact of other household variables like household head characteristics and the number of children in the household. Whilst some research suggests an increase in children in the household results in the acquisition of cars as a result of increased mobility requirement (Kermanshah and Ghazi, 2001, Yamamoto et al., 1999) other studies suggest that increased children lead to reduced probability of owning of car as a result of increase in expenditure on other household items (Bhat and Koppelman, 1993).

Matas et al. (2009) also in their studies in the changes in the structure of car ownership in Spain posits that car ownership in households increases where a male is the head of the household. However, Srinivasan et al. (2007) research in Chennai, India indicates that presence of female workers and children of school going age increases the probability of owning cars. This may reflect the different gendered cultures of travel in the different societies. Research conducted by Karlaftis and Golias (2002) conducted in Greece, Bhat and Guo (2007) conducted in San Francisco Bay, USA and Potoglou and Kanaroglou (2008) indicates that households with more employed people and increased license holders have higher probability of owning cars. Kim and Kim (2004) and Potoglou and Kanaroglou (2008) indicates that this happens as households with more employed people have greater mobility needs. There will also be a relationship between the number of employed people and household income.

### **2.3.2 Built Environment Attributes**

With respect to the contribution of built environment characteristics, different types of measurements have been often researched in the reviewed literature. Some of the measurements researched in literature include density, diversity, design, destination accessibility and transit accessibility (Cervero and Kockelman, 1997, Ewing and Cervero, 2001, Ewing et al., 2009, Ewing and Cervero, 2010). Density, a fundamental element of land use, not only impacts car ownership itself, but also serves as proxy for other land use elements that go along with density such as parking supply (Ding and Cao, 2019). Density measurement in literature with respect to its impact on car ownership have been undertaken in literature using variable descriptions such as residential density (Chen et al., 2008, Shen et al., 2016,

Ding et al., 2017) and employment density (Bhat and Guo, 2007, Chen et al., 2008). The results are similar, denser areas are associated with lower rates of car ownership. The explanation is clear as the mixture of jobs and households increases, the accessibility of the household increases and so the likelihood of owning cars decrease (Chen et al., 2008).

With respect to diversity, a number of variables have been considered in the literature to assess their impact on car ownership. Diversity deals with the degree of balance across various land use types (Jiang et al., 2017). Some of the variables include land use diversity, and job-housing balance. Evidence suggest that diversity of land use independently affects car ownership (Potoglou and Kanaroglou, 2008, Zegras, 2010). The majority of the results points to the fact that increased diversity of land use significantly reduce car ownership by making destinations available within a short distance of an individual's or household's home (Li and Zhao, 2017). Jiang et al. (2017) used a travel survey of 2540 households in 104 neighbourhoods in Jinan, China found that an improved job-house balance led to a decrease in car ownership and further decrease in car travel distance among those with cars.

Design, another measurement of built environment attribute indicates street network characteristics within an area. Design is generally measured by intersection design and average block size. The link between design of a neighbourhood and car ownership has received mixed results. Some results points to pedestrian-friendly design, including sidewalks and overhead street lights being associated with lower rates of car ownership (Zegras, 2010, Jiang et al., 2017). However, some studies also found insignificant relationship between pedestrian friendly design and car ownership (Soltani, 2005).

Destination accessibility is also one of the measures been researched under built environment attributes. The various destinations accessibilities been measured in the literature include job accessibility and distance to the Central Business District or Urban Centre. Research by Schimek (1996) and Bento (2003) in the United States of America indicates that households had fewer cars when close to the urban centre. Contrarily, Li et al. (2010) studies in Beijing and Chengdu in China indicates that households tends to have fewer cars when they live further away from the urban centre. This result in a Chinese city is supported by a study by Jiang et al. (2017) whose research undertaken in 104 neighbourhoods in Jinan, China found that household's relative location to city main and sub centres show no significant impact on

car ownership. The finding, though counterintuitive, indicates the differences in structure of society between the developed and developing countries. It is also suggested that this may vary very significantly between developing countries dependent on the historical development patterns of cities. In particular it is important to understand the extent to which better off citizens centralise or move to the peripheries of urban areas.

Whilst five measures of built environment attributes have been mentioned so far, they were initially generally grouped into dimensions of density, diversity and design, the so-called “three Ds” coined by Cervero and Kockelman (1997). Transit accessibility can be said to have been gradually added to the dimensions (Ewing and Cervero, 2001, Ewing et al., 2009) with limited number of studies undertaken with respect to the impact on car ownership within different geographic areas with different contextual issues. In early works, researchers used transit-related attributes like cost instead of access to transit to predict car ownership (Huang et al., 2016). Fairhurst (1975) used travel costs by transit and car to indicate the relative competitiveness and forecast auto ownership in London. Many of the studies that have researched the effect of transit access to car ownership have achieved mixed results. A number of studies relating to the impact of transit accessibility on car ownership have been carried out in the developed world. For instance, Holtzclaw et al. (2002), used an aggregate transit access data from Chicago, Los Angeles and San Francisco found that car ownership was determined by income, household size, residential density and transit availability. However, In addition, a study in Adelaide in Australia by Soltani (2005) did not find transit accessibility as a major determinant. Bhat and Guo (2007) using the 2000 San Francisco Bay Area Travel Survey found that households residing in zones with transit availability are less likely to own cars than those residing in zones without transit availability, and this effect is particularly pronounced for households with low income earnings. They also found that a longer transit access time at the residence end leads to higher car ownership propensity. Potoglou and Kanaroglou (2008) in undertaking car ownership modelling studies in Hamilton, Canada using micro-level data obtained through internet-survey found that the higher number of bus stops had negative effect on the probability of a household to own three or more vehicles. The studies concluded that whilst improved transit accessibility might reduce high levels of household car ownership, it would be less likely to eliminate it completely. Research by Anastasopoulos et al. (2012) studies in Athens Greece supports the findings by Potoglou and

Kanaroglou (2008), by indicating that the availability of public transit within 10 minutes' walking distance was found to reduce the likelihood of having two or more automobiles in the households. Also, Ding and Cao (2019) investigated the connections between car ownership and built environment at work locations as well as residential locations in Washington Metropolitan Area found that bus stop density has a significantly negative effect on car ownership, suggesting that people working in a place with more bus stops are likely to have fewer cars. It must be emphasized that the lessons from the developed countries, particularly in Europe and North America where the demand for cars and the supply of transportation infrastructure are relatively stable, may not be applicable to developing countries. For instance, in the above reviewed works from the developed countries, Potoglou and Kanaroglou (2008) and Anastasopoulos et al. (2012) indicates the impact of transit accessibility on the number of cars owned by cars but not necessarily the impact on a household owning or not owning which is the situation in most developing countries.

With respect to transit accessibility's impact on car ownership a number of studies have been undertaken in the developing countries and the results are also mixed. Zegras (2010), based on a study in Santiago Chile indicated that household living in areas with poor bus accessibility relative to car accessibility had more cars than others. On the other hand an analysis of the Bogota TransMilenio BRT by Combs and Rodríguez (2014) using quasi-longitudinal analysis indicated that there was no significant impact of access to TransMilenio route to car ownership except in transit and pedestrian friendly areas. Also Huang et al. (2016) in a study to determine the association between transit access and auto ownership in Guangzhou, China employed a random effect ordered probit model on data collected in 2011-2012. The study revealed that local transit access was negatively associated with auto ownership after controlling for demographics and other built environment attributes. The research concluded that although income is the dominant driver for car ownership in growing developing countries, public transport investment is a promising strategy to slow the growth of car ownership. Yin and Sun (2017) used a sample of 3480 individuals across China in 2012 to examine the impact of built environment on car ownership. The studies found that households living in cities with public transit systems are less likely to own a car. To be more specific, the studies found that respondents residing in cities with a high density of metro-stations have the lowest rate of car ownership. However the studies found that the

probability of car ownership is higher when respondents reside in neighbourhood with the long distance to transit (i.e. >1500metres). The results is consistent with studies by (Bhat and Guo, 2007, Chen et al., 2008).

Although research has been conducted in other developing countries with respect to impact of public transport access on car ownership they were conducted in areas where public transport services can be said to be regularised with no evidence from areas where public transport services operate in an informal environment known as informal public transport. Informal public transport services are prevalent in most developing countries especially in Asia and Sub Saharan Africa (SSA). The existing literature highlights the important role played by the informal public transport systems in meeting mobility needs by providing frequent, convenient, flexible and affordable services that either complement the existing public transport systems or fills the gaps left by existing systems (Cervero, 2000, Cervero and Golub, 2007, Kumar et al., 2016). The informal transport sector is generally made up of small-sized vehicles mostly mini-buses owned and operated by a single individual or two people. A major difference between the informal transport operations and the formal services operated in most developed countries is that they mostly have a partially fixed route and do not have a determined bus stops (Cervero, 2000, Booyesen et al., 2013). In Ghana, for example, the informal minibus services do not run to a timetable, stop along the routes where there is a need and have significant spatial coverage (Poku-Boansi and Adarkwa, 2013). This is quite different to the formalised services in the settings of Europe and North America. The characteristics and operationalisation of informal public transport services in such geographical locations therefore is distinct from those in the developed world. As a result of this, it is not clear how transit accessibility in such informal setting impacts on car ownership. The findings on transit accessibility impact on car ownership may not be applicable to the developing world especially in places where the operationalisation of informal transport services are dominant. This research seeks to fill the gap by identifying the impact of transit accessibility in such a context on car ownership. However, it may be necessary to rethink how accessibility to transit is conceptualised in order to do this. Measures which relate to distance to bus stops or service frequency hold no meaning in the Ghanaian context.



### **2.3.3 Other Attributes**

In addition to the traditional socio-demographic and built environment variables, some researchers have also explored the role of other attributes on car ownership. One of the variables that have been considered in the literature is the impact of motoring cost on car ownership. Some of the indicators considered in the motoring cost include the purchase price and the user cost (fuel, maintenance and tax). Whelan (2007) presents a model of car ownership for Great Britain. This model uses the national travel survey; a family expenditure survey and census data to examine what factors can contribute to the growth in car ownership. The results of this study show, as one might expect, that car ownership decisions are based on income, licence holding, employment, and purchase costs.

With respect to parking space, Weinberger et al. (2008) and (Weinberger et al., 2009) indicate that houses that are subject to minimum off-street parking requirements are populated with households with higher car ownership and car-use compared with residents within similar neighbourhoods but with less parking availability. Guo (2013a) and Guo (2013b) found that parking availability at home has a strong impact on car ownership. Christiansen et al. (2017) found in Norway something similar by indicating that access to private or reserved home parking triples the likelihood of car ownership. However, with respect to residential parking space impact on car ownership in developing countries, Sobhani et al. (2017) indicates that there exist little impact. Sobhani et al. (2017) posits that difference in car ownership in a city is more likely to result in difference in parking demand and therefore parking regulations.

### **2.3.4 Section Summary**

The review undertaken on car ownership modelling confirms that indeed models have been refined and become sophisticated over time. The process of development of the models has been observed to be driven first by the availability of data (i.e. cross sectional or time series data) and then by the advances of mathematical techniques (i.e. discrete choice models). This section also primarily classifies car ownership models into aggregate and disaggregate models. Whilst both models are applicable in various studies, disaggregate models are seen to be able to develop finer structure to identify the relationship between car ownership and a range of explanatory variables. In spite of the advances described in the advancement of

car ownership modelling, the literature is overwhelmingly based on understanding car ownership decisions in developed nation contexts where the levels of income are higher, ownership is more normalised and transport options are of higher quality but more sparsely distributed than in developing country contexts. Whilst a handful of developing country studies exist, there remains a gap in the literature to better understand ownership decisions and the underlying motivations which might explain future increases. Of particular note is the failure of existing studies to properly account for the impact of transit accessibility within an informal public transport setting. This research aims at identifying the impact of such variable in understanding household car ownership in a relatively low car ownership like Accra.

Whilst there exist a plethora of studies that have used both household socio-demographic factors and built environment variables alone in undertaking car ownership research, inclusion of attitudinal intentions in models makes them substantially more powerful (Choo and Mokhtarian, 2004, Johansson et al., 2006). The inclusion of attitudes in undertaking car ownership studies provides insight into behavioural relationships beyond what is possible with purely objective variables. To this extent the second section of this chapter undertakes review of psychological factors in car ownership studies and underscores the gap in literature that this work will aim at addressing.

## 2.4 Psychological Factors in Car Ownership

The literature review provided above provides better understanding of the factors influencing car ownership decisions but are silent on attitudes, perceptions and preferences. Handy (2004) has stressed that in the study of travel behaviour attitudinal theories have been of minor importance compared to economic factors. However, Anable (2005) posits that in order to understand the nature of influences on a particular mode choice of preference by respondents, methods adopted must use combination of large numbers of explanatory variables. This section therefore reviews the body of literature on socio-psychological literature describing how individual behaviours are formed in relation to transport.

### 2.4.1 Role of Behaviour in Choice Process

Research on travel behaviour has commonly used theories of behaviour emanating from the field of micro-economics as the starting point of explaining travel behaviour (Ben-Akiva et al., 1985). The use of rational choice theory in transport relies on some important simplifying assumptions of travel choice behaviour such as the ability to weigh up all choices and optimise decisions and having perfect information (Hensher and Dalvi, 1978). Lucas and Jones (2009 p.14) summarise the key assumptions underlying rational choice theory as follows:

- “individuals make choices by calculating the best outcome for themselves based on cost/benefit calculations of different available course of action”
- “self-interest is the main driver of these decisions”
- “the individual has all the relevant information with which to make a ration decision”
- “every decision is made on the basis of cognitive deliberation”
- “Decisions are made in a stable stare and preferences are fixed”
- “Individuals are fully able to process this information in order to reach optimal decision.”

A major reason why rational choice theory has been historically dominant in the travel behaviour field is the ease with which it can be mathematically operationalised through discrete choice theory (Jackson, 2005). The policy interventions that flow from this theory are relatively straightforward. The rational choice theory argues that policy should seek to ensure that consumers have access to sufficient information to make informed choices about the

available options (Jackson, 2005). Based on the assumptions espoused by the rational choice theory, car ownership can be located within the theoretical literature as simply another form of rational consumer choice (Lucas and Jones, 2009). In this respect, cars merely facilitate owners to improve their individual and collective well-being by connecting them to the goods and services necessary. The application of rational choice theory to travel behaviour and to a large extent car ownership research has been criticised as inadequate in aiding policy interventions which seek to modify travel behaviour (Wu et al., 1999, Jackson, 2005, Lucas and Jones, 2009, Gärling, 1998). Contrary to a basic assumption of the theory, people's preferences have been shown to be inconsistent (Gärling, 1998). Also, rational choice does not identify what utility is, what processes precede observed choices and how it is maximised by the decision maker (Gärling, 1998). Hence in order to understand car ownership, it is necessary to understand not only the socio-demographic and physical factors but also attitudes and behaviours (Stradling et al., 2004). Wu et al. (1999), based on the weaknesses of the rational choice theory posits that the notion of rationality must be extended to include such intangible factors of car ownership to appropriately account for car ownership behaviour.

Thus the satisfaction that car brings serves more than this simple utility function, feeding our social and psychological need as humans to belong and for our self-esteem and autonomy (Lucas and Jones, 2009). In this regard, car ownership behaviour matches other consumer behaviour, as identified by Jackson (2005) in his review *Motivating Sustainable Consumption*. Here Jackson (2005) identifies two key lessons flowing from the literature. Firstly that that material goods (in this regard car) are important to people, not only for their functional or instrumental uses, but also for the symbolic role they play in people's lives. The second lesson according to Jackson (2005) is that far from been able to exercise deliberative choices about what we consume, most people most of the time are 'locked in' to their existing consumption patterns. This lock-in occurs through habits, routines, social norms, expectations, cultural values, inequalities in access and restricted choice among others. As a result of the above, there has been the introduction of alternative behaviour theories and approaches arising from the field of social psychology to aid in explaining various travel behaviour phenomenon like car ownership.

## **2.5 Incorporating Psychological theory into Car Ownership Research**

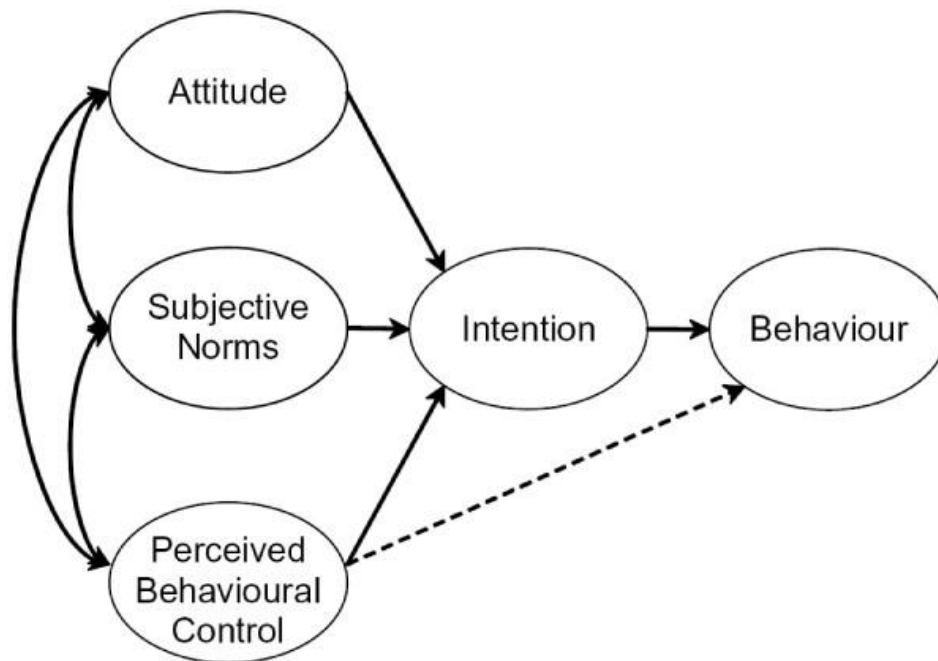
Travel behaviour research and specifically car ownership have in recent years drawn on and adapted a number of alternative behaviour theories arising from the field of social psychology. There exist a number of reviews on behaviour theories in literature including (Jackson, 2005, Anable et al., 2006, Parker et al., 2007, Lyons et al., 2008, Lucas and Jones, 2009, Gärling and Fujii, 2009). The existence of such theories as expounded by the authors listed above have helped to explore the link between attitudes and behaviour (Heinen et al., 2011, Zorrilla et al., 2019).

The various theories have been used to explain various travel behaviours with varied levels of complexity and predictive capability (Lanzini and Khan, 2017). This review covers the sub-set of research of relevance to car ownership decisions in this research. This section will consider Theory of Planned Behaviour (TPB) (Ajzen, 1991) which is centred upon the factors that influence the intention to perform behaviour. The Material Possession Model (MPM) (Dittmar, 1992) is discussed. A brief description of each theory and discussion of empirical testing of various theories in explaining car ownership is provided to identify gaps that this research seeks to address.

### **2.5.1 Theory of Planned Behaviour**

Theory of Planned Behaviour (Ajzen, 1991) was developed as an extension of the Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980). The extension was considered relevant because of the limitation of the TRA in examining behaviours where the person considered did not have complete volitional control (Ajzen, 1991). According to TPB as seen in Figure 2.1 Intentions are the closest antecedents of behaviour and have in turn three main predictors: attitudes, subjective norm and perceived behavioural control. Attitudes can be defined as psychological evaluation on particular objects or behaviour with certain degree of favour or disfavour (Eagly and Chaiken, 1993, Zhou et al., 2019). Subjective norm refer to an individual concerns about people expectation especially people important to the person. With respect to car ownership the subjective norm indicates the likelihood of a person experiencing social pressure to own (or not own). Perceived behavioural control is the individual's perception about their confidence and ability to perform the behaviour. Regardless, of how favourable a person's attitude or subjective norm are, they will also have beliefs about how feasible it to

own a car. Perceived behavioural control taps into a person's assessment of the control they feel they have over performing the behaviour.



Source: Ajzen (1991)

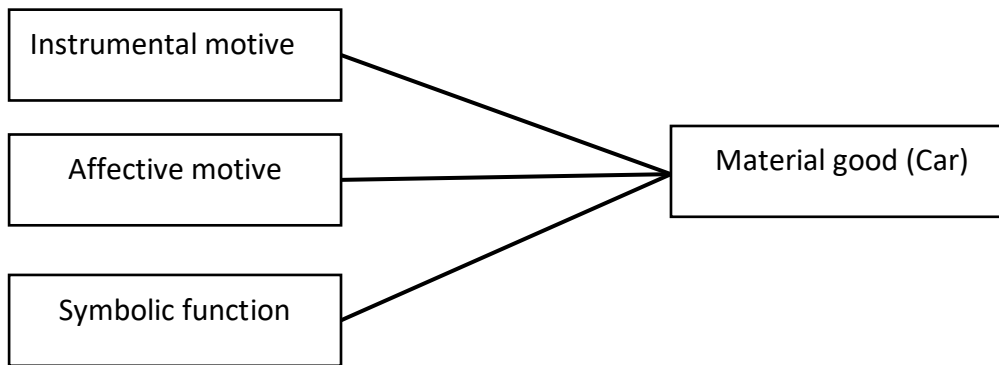
**Figure 2:1 Theory of Planned Behaviour**

The TPB is the most dominant psychological theory used in transport studies (Bamberg and Schmidt, 2003, Anable, 2005, Bamberg et al., 2011). Although TPB has been used widely in the literature there exist various studies in which authors have tailored or expanded the model to apply to a specific scenario. For instance, Eriksson and Forward (2011) examined travel mode choice (i.e. bus, bicycle and car) used an expanded version of TPB containing separate measures of social norms. This the authors argued provided support for the study of multiple modes of travel rather than just one. The need to expand TPB which occurs often in the literature emphasises the relative simplicity of the model as compared to other models but has however been acknowledged in the literature (Anable et al., 2006).

### **2.5.2 Material Possession Theory (MPT)**

The Material Possession Model (Dittmar, 1992) focuses on functions that possessing a specific good such as a car, can fulfil in one's life. MPT posits that possession of material goods fulfils three functions: instrumental, affective and symbolic. These types of functions can be seen as the different types of motives for owning a car. Instrumental motives of possessing a good

is captured by this theory by explaining traditional dimensions such as convenience, flexibility and speed. Symbolic motive captures the individual's reason to perform a behaviour which express self-identity or social position. Affective motive captures individual's reason to perform behaviour which express needs and desires linked to emotions. Figure 2.2 provides a pictorial description of the link between the various motives.



**Source: Dittmar (1992)**

**Figure 2: 2 Material Possession Theory**

### 2.5.3 Linkages between Models

Although the various theories have been used distinctively in explaining factors influencing travel behaviour there exist a lot of linkages among the various models. The two theories discussed above are drawn on as relevant concepts identified to be relevant are systematically explained and used in the research. The TPB asserts that people's behavioural intent depends on their attitudes, subjective norms and perceived behavioural control. It further posits that various motivational drivers influence an individual's perception of a particular behaviour and the intention to perform that behaviour (Le Loo et al., 2015). These motivational drivers may include instrumental, affective and symbolic motives as conceptualised by the Material Possession Model. For this research's purpose, to be able to explain a household's attitude or overall evaluation of a particular behaviour depends on the expectancy beliefs about the likelihood of a specific behavioural consequences occurring and the desirability of these consequences. The link that exist between these two theories provides the opportunity to use the underlying concepts which will inform the design the preparation of questionnaires for the household data collection.

## 2.6 Empirical Findings on Attitudes towards Car Ownership

Studies on attitudes towards private cars have gained considerable research attention (Steg, 2005, Gardner and Abraham, 2008). The review of literature indicates that research into attitudes towards car ownership have been undertaken using different approaches and targeting different groups. For instance with respect to the groupings studied there has been research targeting attitude of students (Bamberg and Schmidt, 2003, Zhu et al., 2012, Belgiawan et al., 2016b, Luke, 2018), young people (Verma et al., 2016, Pojani et al., 2018), generational differences (Zhou et al., 2019), comparison of countries and cities (Van and Fujii, 2011, Belgiawan et al., 2014) comparison of attitudes towards car and other modes of transport (Beirão and Cabral, 2007, Van and Fujii, 2011, Steg, 2003). In addition other studies tend to focus on car use behaviour rather than on car ownership behaviours per se, they have nonetheless yielded relevant insights as the results are reviewed. Whilst this study aims to understand car ownership, various empirical studies that have focused on car use will also be reviewed as there exist relevant lessons that can inform the current research.

One of the earlier works that considers attitude as a determinant factor of car ownership is by Wu et al. (1999). In this work, Wu et al. (1999) introduces the concept of 'symbolic utility' of vehicle ownership which refers to psychological satisfaction from owning and using a vehicle. The results suggest that attitude toward vehicle ownership have effects on vehicle ownership preference and that the accuracy of vehicle ownership models can be improved by taking into consideration symbolic utility. In similar fashion, Wright and Egan (2000) makes reference to Maslow's scale of human needs (Maslow, 1954) and suggest that the car satisfies needs on all these levels by providing shelter, security, warmth and serves as a means of expression for those that own. Additionally, Sheller (2004) indicates that car evokes "automotive emotions" that outweigh any reasoned arguments about the public good and goes beyond any economic calculation of cost and benefits.

Steg has deployed the Material Possession Theory (Dittmar, 1992) in undertaking research on car ownership and use (Steg et al., 2001, Steg, 2003, Steg, 2005). The study by Steg et al. (2001) aimed at examining the motivational dimensions underlying the attractiveness or unattractiveness of car use in order to distinguish a limited set of main motive categories. The study revealed that instrumental, symbolic-affective functions of motor cars are significant



dimensions underlying the attractiveness of car use. Subsequent to the previous research Steg (2005) investigated which categories of car use motives can be distinguished empirically and examined whether Dittmar's model could be validated by empirical results. Her study reports results of two questionnaires aimed at examining various motives for car use interviewing respondents from Groningen and Rotterdam in the Netherlands. Her study revealed that people distinguish between instrumental, symbolic and affective motives fulfilled by cars. The study further indicates that even highly functional commuter travel was influenced by symbolic and affective motives and not instrumental motives. The paper also revealed that symbolic and affective functions were most highly valued by male, younger respondents and low-income group.

Although the instrumental, affective and symbolic factors have been identified to play significant role in explaining the ownership or use of car other research has identified other motives. For instance Steg (2005) in her research identified independence as a motive that emerged as a separate factor in her explorative analysis. Gatersleben (2007) identified similar motives and referred to it as feelings of independence which was identified to be related to positive experiences of using a car. Aside the identification of different motives there has also been the pairing of psychological motives based on the findings of the researcher. For instance, Bergstad et al. (2011), using a large number of statements covering the motives for car use revealed two distinct correlated motives which were identified as affective-symbolic and instrumental-independence motives.

There has also been research that has sought to identify the link between car ownership or use and socio-demographic factors. For instance part of the objective of Bergstad et al. (2011) was to investigate whether the effect socio-demographic variables have on car use are mediated by symbolic, affective, instrumental and independence motives. The research provided evidence which indicated that psychological motives mediate and thus explain some of the difference in car use between different socio-demographic groups. For instance, an affective-symbolic motive was identified to partially mediate the relationship between the number of weekly car trips and sex and the instrumental-independence motive partially mediates the relationships between weekly car use and percent use as driver. The implication from this study indicates that psychological motives are proximal determinants of choice for

car use. The partial mediation as well as failure of mediation implies that there are also direct effects of socio-demographic variables on car use.

With most of the research on car ownership and use undertaken in Europe and North America, Van and Fujii (2011) sought to undertake studies on attitudes towards car and public transport in six Asian countries where there is diversity of culture, social life and disproportionate levels of development. The countries used in the research included; Japan, Thailand, Vietnam, Indonesia, China and Philippines. The first three factors (i.e. symbolic, affective and instrumental) underlying the attitudes toward car and public transport were consistent with previous studies (Steg et al., 2001, Steg, 2005) about car and generally agreed with Dittmar (1992) model. However there was identification of another factor known as “social orderliness” which captures environmental friendliness, safety, quietness and altruism of car or public transport. The comparison across countries in terms of the symbolic affective aspects appeared to affirm the notion that people in lower income societies perceive car as a higher symbolic status than other and vice versa. In terms of social orderliness of travel modes among countries, the scores for car in the Japanese sample seems to be different from those in the other countries which indicates that Japanese students evaluate car at low value because of social externalities such as air pollution, congestion etc.

Besides the above studies that have been identified to explain attitudes towards car, there also exist other studies that posits that the influence of others significantly impact decisions. The Theory of Normative Action by Cialdini et al. (1991) which provides two types of norms namely; the descriptive and injunctive norm is used in explaining the influence of others in affecting the ownership of cars by people. The descriptive norms refer to the common behaviour of others (e.g. the majority choices) whereas injunctive norms refer to one’s perceptions of the expectations of others regarding the behaviour in question. One significant finding of Weinberger and Goetzke (2010) and (Weinberger and Goetzke, 2011) in research undertaken in the United States is that social peers and neighbours influence the decision of to own a car.

Apart from the impact of attitudes towards car affecting car ownership there also exist another related research that looks at the impact of attitude towards other mode of transport on car ownership or the impact of car ownership on attitudes towards other modes of transport (Steg, 2003, Ibrahim, 2003, Beirão and Cabral, 2007, He and Thøgersen, 2017). For

instance Steg (2003), in the use of computerised questionnaire study among 1,803 Dutch respondents revealed that car outperformed public transport not only because of its instrumental function but also because the car represented cultural and psychological values. Cullinane and Cullinane (2003) undertook research in Hong Kong by interviewing 400 car owners to understand why people were reliant on their car even though the public transit system is highly efficient. In the survey, respondents were asked to rank the three main reasons for owning a car. The relevancy of public transit is shown to be relatively low: two reasons related to transit – “don't like public transport” and “public transport not available” – are ranked only 7 and 9 among the 11 reasons. They suggested that transit development might not always work for frequent car users. On the other hand, the main reasons for initial car purchase are “helpful for carrying things”, “saves time”, and “more comfortable”. This study indicates that the instrumental qualities of the car outweighs that of the public transport. Beirão and Cabral (2007) used qualitative approach in assessing people's attitude towards cars and perceptions of public transport service quality in Porto, Portugal. The study also revealed that attitudes are a key determinant of choice of mode to use and that participants using different modes evaluate car and public transport differently. The sample consisted of 24 regular and occasional users, including seven public transit users, ten car users, and seven who used both transit and cars. Regular bus users perceived the bus service more positively than the non-users. People who had not taken the bus in recent years had a very negative perception of the level of service.

Van et al. (2014) investigated the contribution of psychological factors in explaining the choice of transportation mode in six Asian countries (i.e. Japan, Thailand, China, Vietnam, Indonesia and Philippines). The research found that attitude variables about the car were all significant determinants for the entire sample from the six countries. Most importantly social orderliness (which represents environmental friendliness, safety, quietness etc.) aspect of public transport was common concern of respondents from developing countries. This particularly indicates the distinctive characteristics of such studies in developing countries as against those undertaken in the developed countries. Also, He and Thøgersen (2017) undertook research in Guangzhou, China to understand the motive to own a car and how car-ownership influence travel mode choice. The findings indicate that the respondents regardless of their car ownership status and use of travel modes perceived cars as superior to transit in most

cases. The study further revealed that attitudes towards cars compared to public transport have a strong influence on decision to own. Hence people who have more favourable attitudes towards cars compared to public transport are more likely to travel by car.

The review on the empirical research brings to bear a number of considerations that indicates the importance of the current research. Firstly, the context of study is seen to indicate the findings of new variables that hitherto may not be considered significant in the developed world; an example is the inclusion of “social orderliness” factors in car ownership research in developing world context. Secondly, whilst there exist the use of quantitative and qualitative methods in analysing psychological motives for car ownership in the review provided, the simultaneous use of the two methods is seen to yield significant results. As a result the current study will undertake focus group discussions in order to gather the relevant attitudinal statements regarding car and public transport use before undertaking household data collection. These steps are detailed in Chapter Four.

## **2.7 Chapter Summary**

The literature review in this chapter provides a detailed description of various aspects in understanding car ownership. From the discussion above, it has been indicated that using aggregate level in explaining car ownership has some advantages especially using the GDP as determinant variable (Button et al., 1993, Dargay and Gately, 1999, Dargay et al., 2007) but has also some important disadvantages. One of the major disadvantages identified with the use of aggregate level method is that, even though the method gives an indication of the dominance of income as explanatory variable, it limits the understanding of car ownership with respect to other variables. This is especially significant in a developing country context in which cars per 1000 population correlates very well with the annual income of top 20% of the of the population (Gakenheimer, 1999). To this extent, the disaggregate method is preferred in this research in order to capture variables which hitherto will be ignored in undertaking aggregate level analysis.

Another consideration that was brought to bear in this chapter, was the use of static models in this research rather than dynamic models. Primarily, using dynamic models require the use of continuous data that has been collected over a period of time. By using dynamic models, researchers are able to examine how life-cycle changes in households and existing fleet

influence vehicle ownership decisions. Dynamic models are estimated using panel data sets that possess both cross-sectional and time-series dimensions (Woldeamanuel et al., 2009). The reasons for the adoption of static models over the years has been as a result of the limitation of data availability and the expensive nature of surveys needed to be able to undertake dynamic modelling. With this research been limited by timescale and resources for the research, the researcher opted for the use of static models.

With regards to the various variables identified to be significant in undertaking the car ownership modelling in literature, the review indicates that the location of study with regards to the economic condition together with other contextual factors determines the variables that are significant. Household socio-demographic factors together with built environment attributes are identified to be significant in various studies. Specifically, household income (Mokonyama and Venter, 2007, Salon and Aligula, 2012, Soltani, 2017) is identified to be a major determinant of household car ownership. Therefore a key variable to inculcate in the questionnaire and further modelling analysis is the household income. Other variables such as number of children in a household (Bhat and Koppelman, 1993, Kermanshah and Ghazi, 2001), household head characteristics (Matas et al., 2009), household size and number of household members employed (Kim and Kim, 2004) are seen to have different impact depending on the context of study. To this extent, these variables will be texted as part of the determinants in identifying the impact on various household socio-demographic variables on car ownership.

With respect to the impact of public transport accessibility on household car ownership, the review indicates that there has been a plethora of studies mostly in the developed country context. Although research has been conducted in other developing countries with respect to impact of public transport access on car ownership they were conducted in areas where public transport services can be said to be regularised with no evidence from areas where public transport services operate in an informal environment known as informal public transport. In most cities in Sub Saharan Africa, for example, the informal minibus services which is the dominant means of transport do not run to a timetable, stop along the routes where there is a need and have significant spatial coverage (Poku-Boansi and Adarkwa, 2013). This is quite different to the formalised services in the settings of Europe, North America and some developing country where the impact of public transport on car has been accessed. This

research seeks to fill the gap by identifying the impact of transit accessibility in such a context on car ownership.

The review undertaken indicates that ownership decisions are much more than the economic considerations which have emerged in the aggregate and disaggregate modelling literature. The empirical findings in the literature indicates the dominance of symbolic, affective and instrumental factors as variables for explaining attitudes towards car and public transport. There has also been the introduction of context specific variables such as “social orderliness” (Van and Fujii, 2011) which is seen mostly in developing countries research. Other factors such as comfort and independence have been identified to influence car ownership decisions. The review has also indicated the existence of the influence of social norms attributes in car ownership decision. Whilst the literature from some developed countries generally tends to indicate a decline in car ownership, that from developing countries appears to reflect a growing desire to own cars. High car ownership intentions have been seen not only to relate to the lack of public transport services but also the quality of public service offering. The research seeks to understand household car ownership in a context in which most vehicles are imported second-hand vehicles, few households’ own cars and there is a plentiful supply of inform public transport. With such a context, presenting a different geographical, social and institutional setting in relation to car ownership, this research provides an opportunity for understanding of car ownership within such an environment.

## **CHAPTER THREE: ACCRA IN PERSPECTIVE (CASE STUDY SELECTION)**

### **3.1 Introduction**

Chapter three provides a justification for the selection of Accra as case study for the research. In this chapter, the city of Accra with its unique characteristics and perspectives are discussed into detail. The description of Accra thoroughly provides a good background to understand the various contextual and empirical issues that will be discussed in the subsequent chapters. The chapter discusses the political and administrative structure of Accra, demographic and economic characteristics. Another issue that is considered in this chapter is the description of the transport sector in Accra. This helps to appreciate the distinguishing features of transport in Accra as against those experienced even among the different Sub Saharan African countries. The operations and characteristics of various transport services are discussed thoroughly in this chapter.

### **3.2 Case Study Approach**

A 'case' indicates the unit of analysis that can represent an event, individual, organisation, city, country, or even the world as a whole (Gerring, 2004, Yin, 2014). Gerring (2006) understands case studies as extensive description and in-depth analyses of a phenomenon within a given physical, socio-cultural, economic and political context. In this research, the unit of analysis is the household car ownership in Accra. This makes up the spine of the study and provide suitable units for analysis, as the purpose is to generate in-depth understanding of car ownership in a city in Sub-Saharan Africa.

According to Bradshaw and Wallace (1991), case studies can be viewed to be useful in three conditions. The first condition that makes case studies useful is when the researchers do not have sufficient knowledge of the case under consideration to place it in a theoretical perspective or when the case does not fit any available theory. The second condition is when the case partially supports or deviates from available theories. The third condition is when the case represents a distinctive phenomenon and warrants an extensive research. The reason for adopting a case study approach here aligns with the third of these reasons that it represents a peculiar case within the car ownership studies within a developing country context specifically in the Sub-Saharan African city. It is an under researched area for car ownership studies and, as such, may provide a better understanding into ownership of cars

in this region. Blaxter et al. (2006) confirms this by arguing that case studies are appropriate for the needs and resources of small-scale researchers and are able to make important contributions in under-studied areas. It is important to stress that the case is not just interesting because it is under-researched per se, but that it also remains to be understood how best to research this topic in the wider context of Sub-Saharan Africa.

Although the case study approach has been identified to have a lot of advantages as enumerated above there also exist some criticisms against adopting this approach. For instance, according to Flick (2018), case study does not perfectly represent the population the research is undertaken on and cannot be generalised. Catherine (2000) also posits that with the use of case study, there exist researcher's propensity for selection bias and that findings can be shaped by the interest and perspectives of the researcher. However, it must be emphasised that case studies are more concerned about holistic and extensive studies of particular situation and do not aim to generalise findings but rather concentrate on a way a particular situation is dealt with or understood. Even though there exist weakness in the adoption of the case study research approach, the selection of the approach is befitting for this research because this work does not aim to make formal generalisations but to shed light on key differences between the case and the established car ownership literature. Whilst not being used to forecast ownership levels in Sub-Saharan African countries there will be important contextual parallels which the research can inform.

### **3.2.1 Case Study Selection Criteria and Justification**

The selection of an appropriate case study area is one of the important tasks involved in adopting the case study approach. The selection of the case study area was influenced by the research questions and other considerations. The other relevant considerations include the peculiarities of the context, data availability and familiarity with the context.

With respect to this research, the selection of the case study in which empirical questions are addressed hinged on the use of both objective and subjective considerations. As stated in the Section 2.3.3, car ownership studies over the years have concentrated mostly in developed countries. Although there has been an upsurge of studies of car ownership in the global south most of the identified studies have concentrated in Asia and South America (Belgiawan et al.,



2016b, Zhang et al., 2017, Zhu et al., 2012). Studies on car ownership particularly on Sub Saharan African cities remains limited (Luke, 2018).

Additionally, data availability and access are also an essential part in undertaking any research. The collection of data from primary source is most constrained by personnel, finance and time. In view of the limited resource and time, the researchers' familiarity and knowledge with the case study could be helpful to the research in general.

Finally, within a relatively low car ownership context it is imperative to select a city which comparatively increases the probability of identifying car owners in order to facilitate the data collection process. This happens to be the case of Ghana in which 7% of the population of Ghana own private vehicles (Ministry of Transport, 2016b). It is estimated that private vehicles to population ratio increased from 50 vehicles per 1000 population in 2010 to about 70 vehicles per 1000 population in 2015 (Ministry of Transport, 2016b, Acheampong and Siiba, 2019). Though there exist low levels of car ownership in the country, levels of car ownership in Accra represents the highest in the country. According to DVLA (2015), out of a total of 1,376,053 registered vehicles in Ghana, 64.7% of them are located in Accra despite having just 7.4% of the total population. As this thesis is seeking to understand car ownership in low car ownership context, it seems both appropriate and necessary to focus the data collection in Accra where it will be feasible to sample both owners and non-owners and where the role of the car in daily life is more visible in society.

### **3.3 Political and Administrative Structure of Accra**

Accra, the capital of Ghana is the economic and administrative hub of the country. Accra also serves as the anchor of the Greater Accra Metropolitan Area (GAMA) which is inhabited by four million people making it the thirteenth largest metropolitan area in Africa (Ghana Statistical Service, 2014a). The GAMA is made up of Accra Metropolis, Tema Metropolis and ten other municipalities (Oduro et al., 2015). Accra city is administered by the Accra Metropolitan Assembly (AMA) which is one of the existing 254 Metropolitan, Municipal and District Assemblies (MMDAs) in Ghana and among the twenty-six MMDAs in the Greater Accra Region. The AMA was established in 1898 but has gone through several changes in terms of name, size and number of Sub-Metropolitan Assemblies. When Ghana returned to constitutional rule in 1993, the AMA derived its legal basis from Local Government Act, 1993

(Act 462) which currently has been amended as the Local Governance Act, 2016 (Act 936) and under the Legislative Instrument (L.I.) 2034.

### 3.4 Location and Size

Accra Metropolitan Area shares boundaries with La-Dade Kotopon Municipal from the east and Ga West Municipal, Ga Central Municipal and Ga South Municipal Assemblies from the West. The Metropolitan Assembly also shares boundaries with the Gulf of Guinea to the South. Accra covers an area of 225.7 square Kilometres. Figure 3.1 indicates the location of Accra on the Ghana map and the map of Accra with various communities.

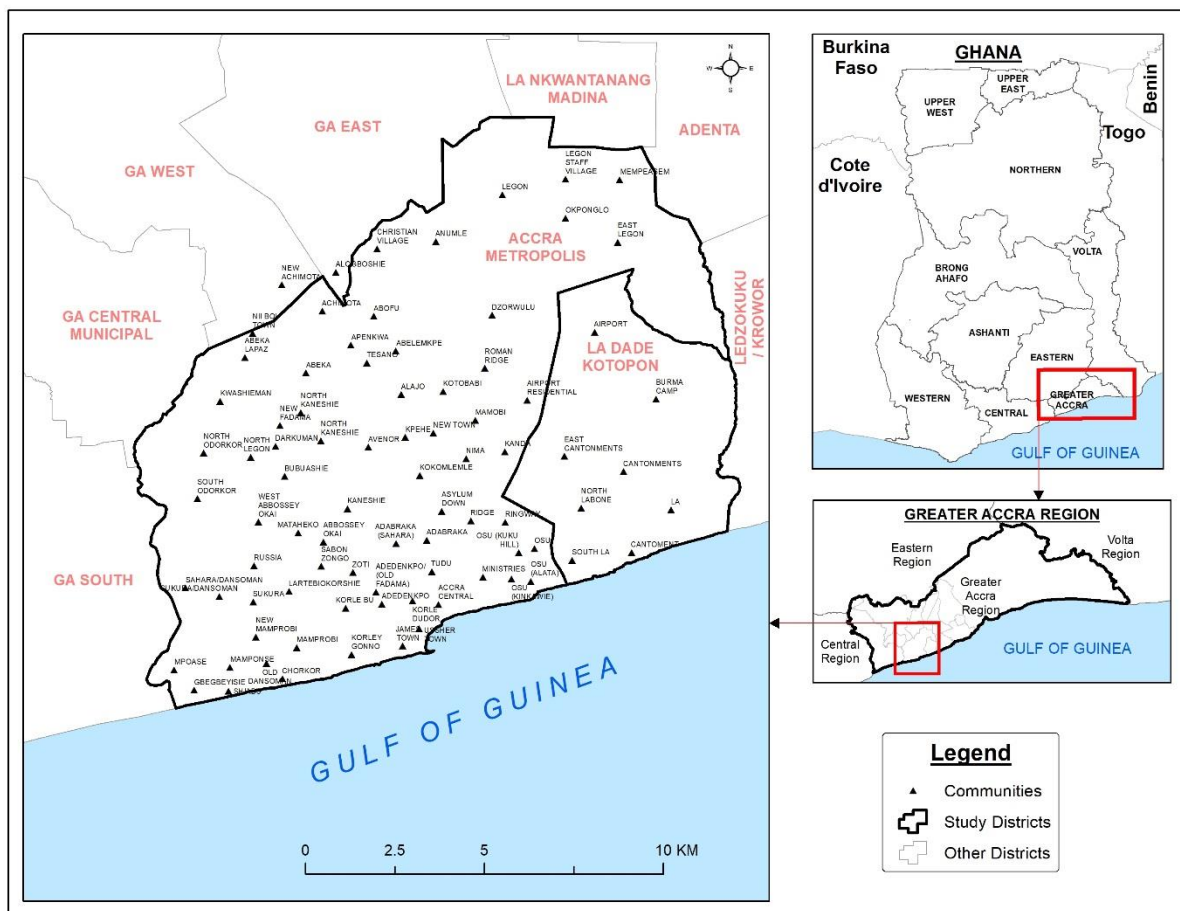


Figure 3. 1: Location of Accra on the Map of Ghana

### 3.5 Demographic Characteristics

#### 3.5.1 Population size, structure and composition

The population of Accra Metropolitan Assembly (AMA), according to the 2010 Population and Housing Census, is 1,665,086 representing 42 percent of the region’s total population. Males

constitute 48.1 percent and females represent 51.9 percent. The Metropolis is entirely urban (100%). It has a gender ratio of 93 and youthful population (children under 15 years) (42.6%) depicting a broad base population pyramid which tapers off with a small number of elderly persons (60+ years) constituting 5.9 percent. The total age dependency ratio is 48.5 percent, the child dependency ratio is higher (42.6%) than that of old age dependency ratio (5.9).

### **3.5.2 Household Size, composition and structure**

The Metropolis has a total number of 450,748 households. The average household size is 3.7 persons per household. Children constitute the largest proportion of the household composition of 35.5 percent while grandchildren consist of 6 percent of household population. Spouses form about 11.1 percent. Nuclear households (head, spouse(s) and children) constitute 26.9 percent of the total number of households.

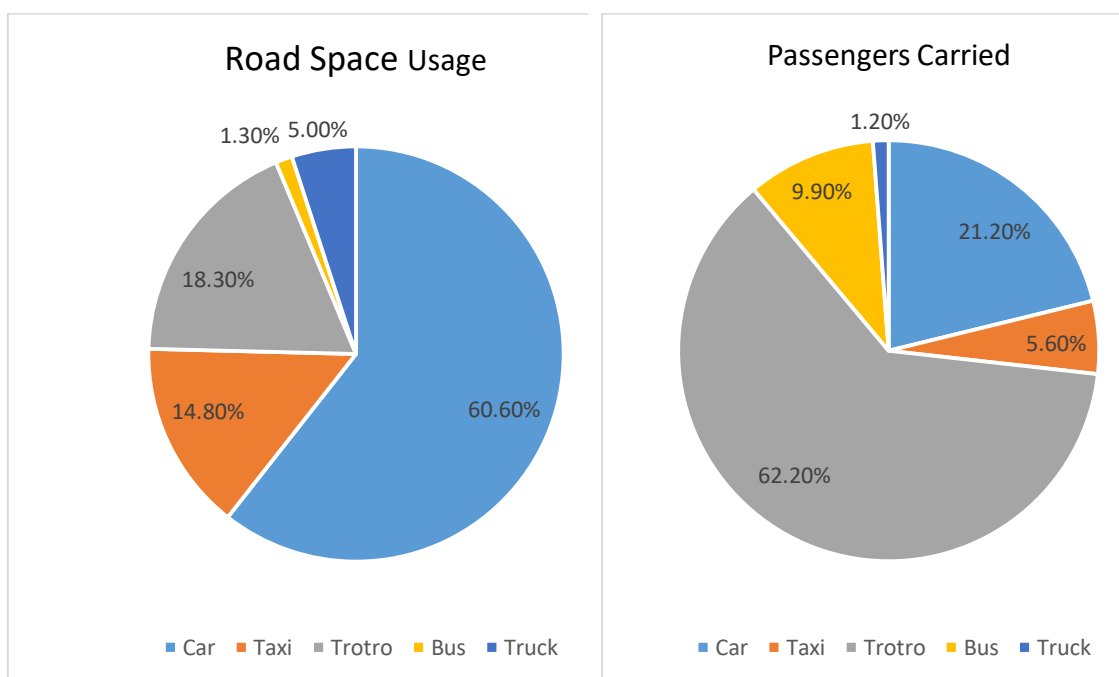
### **3.6 Economy of Accra**

The Accra Metropolitan Area is the economic hub of the Greater Accra Region and the rest of the country. It hosts a number of manufacturing industries, oil companies, financial institutions, telecommunication, education, and health providers (Chen et al., 2017). Accra represented close to 20% of the country's GDP in 2008, with the Greater Accra Region accounting for close to 51% of manufacturing activity in Ghana. Still, the manufacturing sector is small in Ghana, even compared to other SSA countries, accounting only for 5.8% of total GDP and close to 11% of total employment (Chen et al., 2017). Most urban jobs are concentrated in low value-added informal services (World Bank, 2015a).

According to the Census 2010, about 70% of the population aged 15 years and older is economically active (Ghana Statistical Service, 2012). The unemployment rate is quite low at an estimated 7%. Informality is predominant with private informal jobs accounting for 74% of all jobs (Ghana Statistical Service, 2014a). More than a third of the employed population works in the wholesale and retail trade industry. Manufacturing represents 14% of total employment, while accommodation and food services stand at 10%. The self-employed without any employee represent 48% of the employed population (Ghana Statistical Service, 2012). Employees on the other hand account for 35% of the employed.

### 3.7 Transport Modes in Accra

This section discusses the various modes that are used in Accra. The discussion of this of the various modes used in the Accra helps to understand the contextual issues relating to the options available to households aside the ownership of car. The various modes considered in this section include the minibuses, Metro Mass Transit, Aayalolo (Bus Rapid Transit service). Figure 3.1 shows the road space usage and the passengers carried by the various modes of Transport in Accra. Figure 3.1 indicates that whilst trotro had the majority in terms of the number of passengers carried, cars had the majority in terms of the road space used.



**Figure 3. 2: Modal Split of Vehicles on Arterial Roads in Accra**

Source: (Ministry of Transport, 2016a)

#### 3.7.1 Mini-buses (Trotro)

The boom in the service sector during the late 1980s and 1990s led to increase in the migration of people into Accra. Thus, the primacy of Accra as administrative, industrial and commercial hub continued to attract people from all over Ghana (Agyemang, 2015). However, the city's public transport had been erratic and had not responded to the urbanization trend. For instance, Kumar et al. (2004) and Addo (2005) note that until the late 1980s two state-owned bus companies – Omnibus Services Authority (OSA) AND City Express Service (CES) provided safe, frequent and comfortable intra-urban services in Accra. The difficulties in operating the government owned bus companies as a result of financial losses and

mismanagement led to the collapse of the two companies paving way for the private sector transport operations known as trotro (Kumar et al., 2004, Agyemang, 2015, MOT, 2016). In addition, Ofosu-Dorte (1992) and Fouracre et al. (1994) also noted that in 1989, in Accra the conversion of 10,800 minibuses to intra-urban transport gave impetus to the trotro transport system.

According to Abane (2011), trotro is a local expression meaning “three pence”, which is the fare charged for local trips in trucks in Accra in the late 1950s and 1960s. Currently, the term refers to all vehicles engaged in commercial transport including Toyota Hiace, Nissan Urvan among others. Trotro operators over the years have formed unions to advance their interest at various levels thereby becoming a very powerful force to reckon with. The largest union by far is the Ghana Road Transport Union (GPRTU). The trotro is readily available, accessible and affordable. Trotro enjoys the highest patronage as shown in the number of passengers carried having a modal share of 62.2% (Abane, 2011, Ministry of Transport, 2016a).

Although the trotro continues to enjoy the majority patronage as compared to other services it has been criticized on various fronts. The trotro operations has been criticized by the general public for the poor operations, safety standards and security issues especially during evening operations (Agyemang, 2015). For instance Addo (2002) found that the trotro transport unions had not been able to regulate effectively the behaviour of their members. As result, drivers and their assistants (known locally as ‘mate’) could be discourteous to passengers and other road users while knowing very well that sanctions were rarely applied, even when reports were made to the executive members of the unions. Agyemang (2009) also found that in Accra, trotro drivers and ‘mates’ were found to arbitrarily increase their fares especially after heavy downpours, during peak hours and shortly after an increase in price of fuel has been announced without their respective unions authorizing such fare increases.

### **Operations of Trotro**

The operations of trotro are mostly confined to terminals from their origins to destinations. However, as a result of the lack of strict regulation there exist ‘floating drivers’ who do not operate from terminals. In most situations, the trotro operate along a designated route in accordance with the route operating permit given to the association under which the trotro operate (Ministry of Transport, 2016a). However, the dynamism of the operations of trotro is

such that drivers can re-route through minor corridors mostly with the consent of passengers during peak hours to reduce travel time and passengers are allowed to embark or disembark at any location of their choice (Agyemang, 2015). Passengers pay their fare to the driver's assistant referred commonly as driver's 'mate'.

The trotros do not operate on any schedule or timetables as witnessed in the developed countries. Mostly, the services are on a "fill and go" pattern and operate mostly between 04:00 and 23:00. At the terminals or stations there are no timetables rather most station masters use board to track the departure turns of vehicles (Ministry of Transport, 2016a). At the bus stations the vehicles only leave when full. Due to the relatively low carrying capacity of 12-15 passengers a trotro may not queue for long especially during the peak periods but might be prolonged during the off peak if there are not a lot of passengers at the terminal. Figure 3.4 provides a pictorial evidence of a trotro in operation in Accra.



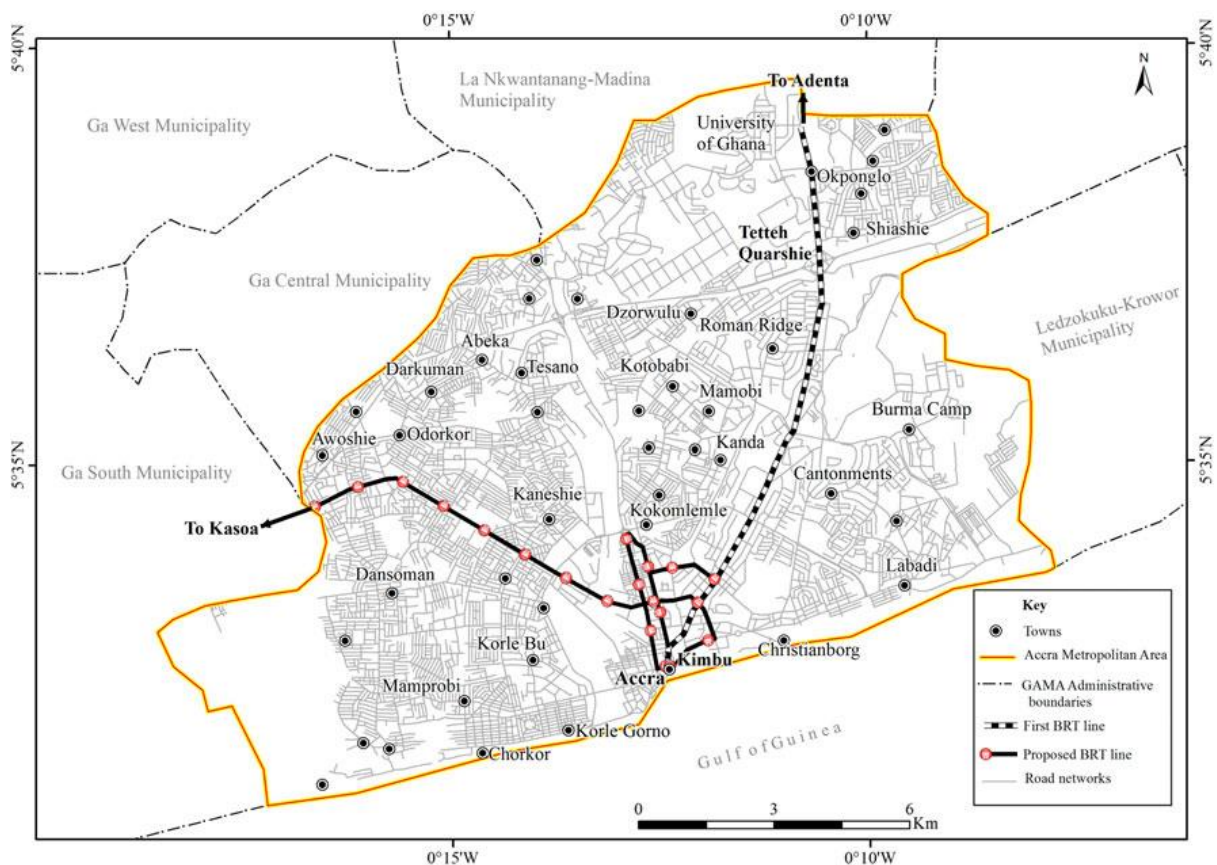
**Figure 3. 3: A blue 207-series Mercedes Benz trotro stopping for passengers in Accra**

### **3.7.2 Metro Mass Transit**

The MMT was created in 2003 to provide state operated public transport services (Birago et al., 2016). Government of Ghana is the major shareholder with 45% shares and the rest of 55% held by various private sector institutions (Birago et al., 2016, Ministry of Transport, 2016a). The MMT operates throughout the Ghana by offering three levels of services which

include intercity, intra-city and rural urban service. The buses used have a seating capacity of 47 with a maximum of 80 persons including standing capacity.

In September 2005, the Metro Mass Transit Limited (MMTL) piloted its version of the Bus Rapid Transit system on a 20 km 'Kimbu-Adenta' highway in Accra. Figure 3.5 shows the first BRT line. The MMTL BRT system was characterized by a fast, time bound trip connection between Kimbu terminal and Adenta town (Agyemang, 2015). The project started with twelve buses with the Department of Urban Roads delineating the outer lane of the existing Kimbu-Adenta corridor for the exclusive use of the buses (Agyemang, 2015). The pilot BRT system enjoyed initial success characterized by massive ridership however within two years of operation the BRT was replaced by the 'regular' service which meant that the buses were allowed to collect passengers en-route upon payment of fares in common with the trotros (Agyemang, 2015, Poku-Boansi and Marsden, 2018).



**Figure 3. 4 : The proposed BRT line within the Greater Accra Metropolitan Area**  
Source: Agyemang (2015)

A research conducted by Agyemang (2015) in Accra by interviewing passengers and operators of the service to identify the causes of the failure of the MMT BRT revealed some important findings. Firstly, because of the lack of the enforcement of the right-of-way provision for the BRT buses, travel time increased significantly as a result of the buses resorting to joining the congestion of the road. The regular allotted 45 minute drive from the CBD to Adenta could take as long as 87 or 86 minutes for morning or evening peak respectively. This findings is in tandem with earlier studies by Nuworsoo (2006) and Abane (2011) who indicated that high levels of delays and inability to maintain the semblance of regular schedule resulted in the lack of success of high occupancy buses in Accra. Also, the passengers' perception of comfort and safety on buses affected the patronage as some passengers were not comfortable with the lack of restriction on the number of people in the buses especially during times it was highly patronised. This resulted in the overcrowding in buses and making passengers highly susceptible to pick pockets especially those who were standing in the buses. Another major influencing factor was the inability of the BRT to overcome the trotro hail and ride and rerouting culture. Most residents of Accra are used to the culture of being able to stop anywhere whilst in the trotro and also the ability of the trotro to avoid traffic by rerouting. However, most passengers were not fully abreast with the operations of the BRT and its inability to engage in such activities. The research by Agyemang (2015) indicated that was mainly as result of the lack of collaboration with passengers who are a major stakeholders through various means like sensitization and advertisement. Other issues identified that affect the BRT was the resistance from the existing public transport operators and lack of enabling environment in the form of lack of any legislative instrument or bye-laws to ensure protection for exclusive use of busways by the BRT bus services.

Birago et al. (2016), also undertook research to identify factors that affected the operations of MMT buses in Accra without necessarily focusing on the failed BRT operations. Birago et al. (2016) focused on the perception of the level of service of MMT buses by interviewing frequent users, occasional users and non-users to identify why other modes were preferred than the MMT buses. The study revealed that though Metro Mass Transit was 20% cheaper in terms of price, commuters perceived its service delivery as poor. Over-crowding of buses, nonadherence to time schedule, long in-vehicle time, perception of not getting access to seats, non-availability of bus at respondents' origins and destinations, accessibility of



alternative modes and long waiting times for buses accounted for the major reasons for non-preference.

Presently, the operations of MMT nationally undertakes 30% of intra city services with the majority of services being intercity services. The research will also aim at identifying the percentage of respondents who identify the MMT transit as the major means of travelling in the city of Accra.



**Figure 3. 5: A Metro Mass Transit Bus**

### **3.7.3 Quality Bus System (QBS) (Aayalolo System)**

Accra Metropolitan Assembly together with eleven Metropolitan Municipal and District Assemblies which form the Greater Accra Metropolitan Area (GAMA) undertook a new transport program aimed at resolving the mobility challenges experienced as a result of the rapid population growth, urban sprawl and the use of private cars. The result was the establishment of a new QBS popularly referred to as Aayalolo which was launched on a pilot basis on September, 2016 (Poku-Boansi and Marsden, 2018). The service is managed by the Greater Accra Passenger Transport Executive (GAPTE) which is mandated for the management and execution of public transport reforms in GAMA. The QBS service if completed will have a total of 163.km which represent longest in network in Africa.

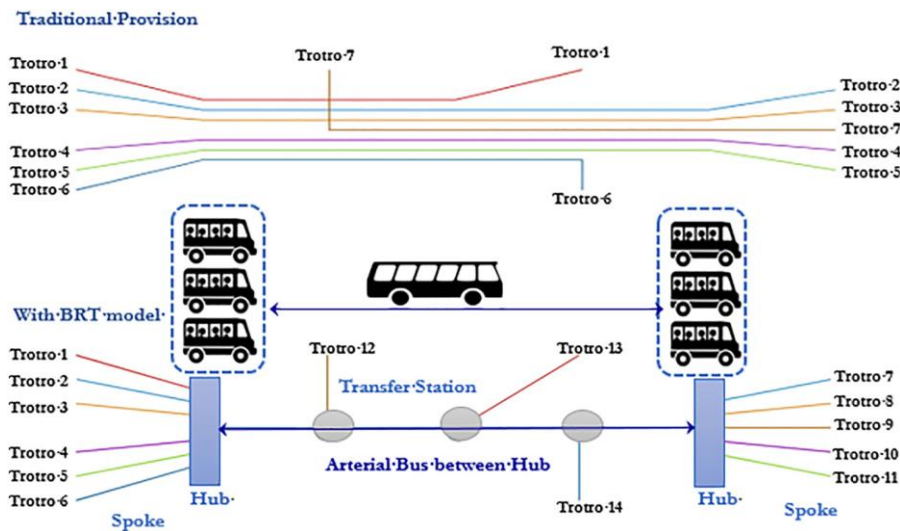
The pilot route which was started in September 2016 runs on Amasaman-Tudu corridor has been designed into three operational routes (i.e. Achimota to Tudu, Ofankor to Tudu and Amasaman to Tudu services). This is run by three different bus operators which were created

out of the existing informal bus and minibus operator unions operating along the route where the QBS operates (Poku-Boansi and Marsden, 2018).



**Figure 3. 6: An Ayalolo Bus**

Unlike the MMT which failed to inculcate existing services, the Ayalolo system is aimed at providing separate roles for the existing minibus and taxi operators within a universal system as shown in Figure 3.7. The universal network is fashioned around the hub and spoke strategy where the “spoke” refers to small sized terminals located along the local distributor roads within residential areas serving the medium capacity modes like the minibuses which will be feeding the Ayalolo buses on the major routes. The “hub” on the other hand refers to the existing informal minibus (trotro) terminals expected to become a major terminal. These hubs are supposed to be exchange point where passengers from the minibuses will be transferred on the Ayalolo buses for onward travelling on the major arterial routes and vice versa. The use of the universal network system is to make provision for already existing service providers like the trotros as well as the new bus services with the aim of avoiding agitations among stakeholders in the sector (McLachlan, 2010, Venter, 2013, Poku-Boansi and Marsden, 2018)



**Figure 3. 7: The proposed public transport system**

Source: (Poku-Boansi and Marsden, 2018)

Although there exist a seemingly good structure put in place to ensure the successful implementation of this system, the reality with respect to the implementation on the pilot route is different. Initial data suggest that the average monthly passengers carried on the pilot corridor increased from 42,491 as at December 2016 to 133,694 in July 2017 (Poku-Boansi and Marsden, 2018). Like the MMT the operation of new Ayalolo service has not been able to successfully replace the trotro services on the main trunk routes as explained above. This means that instead of trotro services feeding the Ayalolo buses so they can operate on the trunk roads, the Ayalolo buses are not being fed with by the trotro services and have had to compete with the trotro services on the same corridors. Another issue with the operation the QBS so far is the irregular operations as the services have been called off for various reasons. For instance on 25<sup>th</sup> October 2018 the QBS services were called off for what the officials described as technical challenges (Bokpe, 2018). According to Bokpe (2018), the major reasons for the suspension of service were the lack of routes to allow for the free movement of Ayalolo buses which affected the patronage of the services and also affected the financial gains needed in running the services. The QBS services were not operational until 18<sup>th</sup> April, 2019 but do not enjoy the patronage it begun to have (Bokpe, 2019). The QBS now have an average of 4000 passengers per day as against the 13,000 passengers experienced in the last quarter of 2017.

### **3.8 Chapter Summary**

The chapter provides a description of the city of Accra with respect to the demographics and economic activities. A major contribution of this chapter is the detailed description of the various modes of public transport that are available in the city of Accra. The analysis of the history and operations of the various modes as in trotro, MMT and QBS gives the reader a better understanding in the subsequent chapters and helps to appreciate the descriptive analysis that will be undertaken in Chapter Five. In addition, the description of the various public transport services provided in the city of Accra provides a unique context to which suitable recommendation can be made in an attempt to encourage people to use the public transport system as well as help policy makers understand the context for which to introduce any intervention. The chapter also provides justification of Accra as a case study area in terms of addressing the research questions and also other relevant considerations for data collection. Chapter Four presents the methodology that was used for the research. The methods adopted and discussed are informed by the case study selection and how the context informs approaches to use.

## **CHAPTER FOUR: RESEARCH METHODOLOGY**

### **4.1 Introduction**

In chapter two, an account of previous research relevant to this thesis was presented. In addition to providing an overview of the general direction of research, the literature review identified and discussed the research gaps that will be addressed in this thesis. Chapter three also provided a description of the context in which the research is being undertaken. Based on the current direction of research and the gaps identified, this chapter discusses the approaches that will be used in achieving the research objectives.

The focus of this chapter therefore is to set out the overall methodology used to address the empirical research questions. The methodological issues including the selection of the units of observation, research instrument design, sampling techniques, data collection, data analysis themes and statistical analysis methods are discussed.

### **4.2 Survey Design Methods**

Having set the geographical context for this study in the previous sections, this section provides the survey design approaches adopted for this research. This section discusses the unit of analysis of the research and discusses the sources of data that will be used in research.

#### **4.2.1 Unit of Analysis**

The unit of analysis refers to the primary entity that the research is being done on. Yin and Sun (2017) indicates that the unit of analysis is the 'who' or 'what' that is being researched on. The unit of analysis could represent an organization, individual or a household. With reference to the objectives of this research, the unit of analysis is the households. Emphasis on households presents a better scope of issues to cover instead of dealing with individuals. In addition households also have individuals as a subset as there exist individual in households. Grosvenor (2000) suggest that interview of households is capable of exploring issues such as the collective use of cars and knock-on effects of one individual's choice on the choice and behaviour of other household members.

The research adopted the official definition of the Ghana Statistical Service with respect to what a household should be. According to Ghana Statistical Service (2014b) a household is a

group of people sleeping in the same structure and having the same catering arrangements and who recognize one person as their head. By this definition a household, is not necessarily comprised of people who are blood relatives.

Although every member of the household could provide the necessary information to some extent, the approach is consistent with other car ownership studies in approaching the head of the household as the member of the household with most influence on car ownership.

#### **4.2.2 Secondary Data from Institution**

Although the unit of analysis for the research is at the household level, there was the need to obtain secondary data from various institutions in Ghana and specifically Accra to inform the research. It must be emphasized that most of the documents needed could be obtained via the internet whilst some had to be obtained by establishing contact with the relevant institution. As outlined in Table 4.1 information obtained from the institutional sources covered, socio-demographic factors, physical conditions of Accra. In addition aggregate population data and characteristics at the national, regional and metropolitan level were obtained from the Ghana statistical service.

Notwithstanding the data obtained from the various institutions which provided important data on contextual issues there existed a number of limitations. For instance the socio-demographic data were aggregated mainly at the national, regional and metropolitan level and did not contain the relevant variables at the level of the household required for meeting the objectives of the research. Also, the data of the trip characteristics primarily concentrated on the national and regional level with no emphasis at disaggregate level. However these data provide avenues for comparison and also allows the researcher to make selections about where to survey and to understand the nature of the sample relative to the population.

As a result of the limitation that the various secondary data sets pose, there was a need to undertake a survey to obtain primary data from households in order to understand car ownership at a disaggregate level in a relatively low car owning city.

**Table 4. 1: Summary of data obtained from Institutional Sources**

<b>Datasets</b>	<b>Source (Institution)</b>	<b>Format</b>	<b>Spatial Scales</b>
Historical Population and housing data	Ghana Statistical Services	Reports: Ghana Population and Housing Census (1986, 2000, 2010)	Aggregated at national, metropolitan, sub-metropolitan and settlement scales.
Travel Surveys	Ghana Statistical Services	Report: Second National Household Transport Survey Report 2012	Aggregated at national, and regional levels
Vehicle Ownership Data	Driver and Vehicle Licensing Authority	Report	Aggregate
Administrative boundaries data	Town and Country Planning Department, Accra	GIS shape file format	National, regional, sub-regional, metropolitan and sub-metropolitan scales
Zoning of Communities in Accra data	Town and Country Planning Department, Accra	GIS shape file format	Metropolitan level

Source: Author's Construct

#### **4.2.3 Primary Data Collection**

As indicated above, the basic unit of analysis for the research are households hence in order to obtain data the households must be targeted. Teddlie and Tashakkori (2009) suggests six key strategies for data collection which include questionnaire, interviews, focus groups, tests, observation and unobtrusive measures. Teddlie and Tashakkori (2009) further indicate that whilst the different forms of data collection can be used independently to collect data on different aspect of a research work, they can also be used to complement the work of each other. In order to achieve the goal of the research the primary data collection approached adopted for the research is the use of questionnaires. However, as the research wanted to understand the underlying motivations around car ownership as well as actual ownership

decisions, a battery of attitudinal statements were going to be required. The extent to which attitudinal questions that have previously been used in developed western car ownership studies might apply in the Ghanaian context was unclear and so it was also deemed important to inform the design of the questionnaire through focus group discussions. To this extent, the researcher adopts the questionnaire as the main means for primary data collection and uses the focus group discussion to aid in designing the questionnaire. A detailed discussion of the various approaches are now provided below.

### **4.3 Focus Group Discussion**

According to Powell and Single (1996) a focus group can be defined as a group of individuals selected and assembled by a researcher to discuss and comment on the topic that is the subject of the research, based on their own personal experience. Kitzinger (1995) supporting Powell and Single, posits that the discussion within the focus group is a good feature because it brings to bear the views of the participants about an issue and their values and beliefs about a situation. Hence focus groups are able to bring out the contextual issues that might not be explicitly captured in the literature but which are worth of notice. A review of literature indicates that focus group discussion are performed for varied reasons. For instance focus group discussion can be used as a stand-alone research methodology or on its own rights (Morgan, 1996). According to Powell and Single (1996) focus group discussion can also be used to generate hypotheses and also test the results of other research methods. Also according to Lankshear (1993) focus group discussion can also be used to develop questionnaires and also be used at the preliminary stages of a research.

The reasons for undertaking the focus group discussion as part of the research process include the following:

- To gain insight into the study area by understanding contextual and attitudinal issues to help in the development of questionnaires which will be administered at the household level. Particularly to improve upon the measures of attitudes on the questionnaire by identifying specific salient beliefs
- To pay attention to the language used to inform how the household questionnaire is to be worded.



#### **4.3.2 Selection of Focus group members**

There exist different recommendations in literature as to the number of people that can form a focus group. For instance, Kitzinger (1995) recommends that at least four members within a focus group is acceptable. MacIntosh (1993) recommends that a focus group can be made of members from six to ten whilst Goss and Leinbach (1996) used a focus group members of up to fifteen. Morgan (1996) posits that for a focus group discussion to be effective the members must be from six to ten and must have a total of at least three to five groups for the research with a relatively structured interview with good moderator involvement.

Based on the aforementioned considerations, the researcher conducted three focus group discussions. As a result of financial constraint the first two focus group discussion were done in Leeds but involving members from Ghana who stay in the communities selected for the research but are on a visit to Leeds or are studying in Leeds. The one other focus group discussion was done with members who are currently staying in the communities selected for the study but was held via skype. The attendance for the three focus group discussions varied from five members to eight members.

Focus group discussions provides an avenue for people to openly express their views on issues especially if they find themselves among peers who share similar interest. While focus groups purpose is to tap into a wide range of views, they do not claim to represent public opinion in any conclusive sense. However, in the case of this research, opinions obtained through focus group discussions served as a guide in the preparations of statements that will be tested in the final survey.

Based on the aforementioned considerations the choice and selection of focus group participants for the discussion depended on two decisions. Firstly, a decision was made concerning the car ownership status of the individual which was whether the person belonged to a household that owned or did not own a car. This was done based on the national statistics of car ownership in order to reflect the current happenings in the city. Lastly consideration was given to the community in which the participant lives when in Accra because the researcher had already selected the ten communities in which the survey will take place hence the need to focus on them. The researcher served as a moderator for all the three focus group discussions. No incentives were offered to the participants. A topic guide

steered the discussion and the sessions were recorded. Each focus group discussion lasted between 45 minutes and 1 hour 10 minutes.

#### 4.3.3 Topic guide

The discussions followed a topic guide (Appendix A) which proceeded from the general to the specifics:

- The first part of the discussion had to do with understanding participants understanding of car ownership and public transport in Accra
- Understanding of participant's perceptions of car and public transport in general especially with respect to advantages and disadvantages.

#### 4.3.3 Results from Focus Groups

##### 4.3.3.1 Descriptives

Descriptive statistics are presented in Table 4.2. The focus group selection was done to reflect the various socio-demographic characteristics that exist in the city of Accra. To that extent, majority of the individuals involved in the discussions did not own cars representing 65 percent of the respondents. With the communities for the data collection already decided, the participants of the focus group discussion were residents of these ten communities.

**Table 4. 2: Socio-demographic Characteristics of Focus Group**

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>
<b><i>Focus Group Discussions</i></b>		
Discussion 1	8	40%
Discussion 2	7	35%
Discussion 3	5	25%
<b><i>Gender of Participant</i></b>		
Male	13	65%
Female	7	35%
<b><i>Age of Participant</i></b>		
18-30	6	30%
31-45	7	35%
46-60	6	30%
61 and older	1	5%
<b><i>Type of Household</i></b>		
Single Person	7	35%
Single with Children	3	15%

Couple only	4	20%
Couple with Children	6	30%
<b><i>Educational level of Head of Household</i></b>		
Basic	2	10%
Secondary	10	50%
Tertiary	8	40%
<b><i>Sector of Employment of Household Heads</i></b>		
Public Sector	3	15%
Private Formal	6	30%
Private Informal	11	55%
<b><i>Participant with Driving License</i></b>		
With Driving License	8	40%
Without Driving License	12	60%
<b><i>Number of Cars owned by Households</i></b>		
0	13	65%
1	5	25%
2 and more	2	10%

#### **4.3.3.2 Content Analysis**

The purpose of the focus group was to inform the household survey that was to take place afterwards and as result of that many of the salient observations went on to be measured in the questionnaire. The results are presented here in the methods chapter because of the impact on the questionnaire design that follows in Section 4.5. The focus group discussions revealed various themes. The discussion in this section captures the advantages and disadvantages of car and public transport. Also the social influence on car ownership and aspirations and reasons for owning were discussed in this section. Recordings were made of the focus group discussions and was then transcribed. A summary of the various attributes captured during the focus group discussion are a presented in Figure 4.1.

#### **Aspirations/Reasons for Car Ownership**

As part of the focus group discussion, participants were asked the reasons for owning car or the reasons for wanting to own cars. It became apparent during the discussion that most of the reasons given by those who own and those who do not own are similar. The statement that was prevalent by all most all the participants irrespective of their car ownership status had to do with the ease with which the car can help them in the movement of their family and carrying out other activities. The emotional attachment to the car was mostly expressed

by those who did not own car. Some of the statements captured during the discussions include the following:

*“Owning a car will reduce the struggle I have to go through every morning in sending my children to school and going to work as well. I have to hire a taxi for my children so as to ensure that they are safe for school. For myself I use the trotro. If I have a car all these struggles will be over. I want to own a car not for the prestige of it alone but mainly because of movement of my family”*

Miss P(Achimota, 39years)—Non car owner

*“With my car, I worry less about travelling around the city. My family and I can do a lot without the hassle that not having a car brings in this city.”*

Mr KA (East Legon, 37years)—car owner

### **Advantages and Disadvantages of Car and Public transport Use**

Asking about the advantages and disadvantages of car and public transport generated a lot of discussion as a result of various participants sharing their experience and perception with the two modes of transport. Interestingly, when asked about the negative aspects of cars, it was usually greeted with the negative aspects of public transport instead, thereby serving as a justification for accommodating the disadvantages of cars. Also, the advantages of the public transport was not emphasized by the participants and the moderator had to keep asking for that to be discussed.

When asked about the advantages of the public transport system, almost all the participants made mention of the fact that public transport buses are universally accessible. Most of the participants indicated that as a result of this attribute one can easily get a bus from ones house. Another mention was made of the affordability of the service as compared to using a car. Another advantage that was mentioned by participants is that, although there exist no time table for the bus services, one can get a bus to board easily as they operate in a competitive environment with numerous drivers using a single route. The following were typical comments made about the frequency of the public transport service.

*“One do not have to wait long whilst standing by the road side to get a bus”*

Mr A. (East Legon, 38years)

*“I am also confident there will be bus once I get to the road side”*

Miss T (Adabraka, 28years)

With respect to the disadvantages of the public transport system a plethora of points were made. Majority of the discussion about the disadvantages of the public transport service had to do with the experience people have whilst using the service. In addition to that, the conduct of operators of buses and the nature of buses used were also mentioned by most of the participants. Generally, most of the comments were very negative. Some of the statements made include the following:

*“Using trotro can be very crowded especially during the peak hours and some of the trotros have uncomfortable seats”*

Mr T(Kaneshie, 42years)

*“I always think about my safety when are use the trotro. Most of the vehicles used are very old and I know might even have faults which can easily cause accidents. I am forced to use them because I don’t have the resource to own my own car”*

Mr O (Adabraka, 31years)

*“Even though I use my own car, I do not fancy using the trotro because they make so much noise and waste a lot of time as the drivers stop so many times”*

Mrs O (Cantoments, 50years)

With respect to the advantages of the car, it invoked a lot of discussion among the participants. Some of the advantages of the car mentioned ranged from convenience, privacy, comfort and independence in travel. During the discourse, it seemed clear based on the contribution of various participants that, the car was seen as a necessity in order to live in Accra. Some of the statements made include the following:

*“Living in Accra without a car is not easy. There is already so much congestion so having a car can help you choose your own routes and avoid some delay.”*

Mr P (Abelemkpe, 35years)

*“I have to take my children to school after which I will go to work. Owning a car makes me carry out these activities daily without much struggle”*

Mrs AA (Cantonments, 44years)

### **Social Influence**

Discussions were held over the influence of the society on a household owning car. It became apparent that there existed a strong attachment of the society to car ownership. Based on the discussion, there existed a societal rating of various modes of transport in Accra. The car was seen to be superior to all other modes with the public transport rated very low. Hence these could be seen as an unseen force which can influence the ownership of a household. Some of the statements captured during the survey include the following:

*“Our society view car owners to be rich people. One is not expected to be using public transport if you are seen to doing a good job. Obviously, no one who can afford a car should use the public transport since you will be seen as miser”*

Mr MB (Dzorwulu, 29years)

*“I currently use the public transport and I know that is not the best. In order for me to attain certain level of respect in the society I must own my car. Public transport is mostly looked down upon by the society”*

Miss B(Adabraka, 38years)

Figure 4.1 captures the various salient statements that were identified during the focus group discussion.

**Figure 4.1 Summary of Focus Group Discussion**

Attributes of car ownership	Attributes of Public Transport
<ul style="list-style-type: none"> <li>• Convenience</li> <li>• Faster</li> <li>• Society respects car owners</li> <li>• Privacy</li> <li>• Success symbol</li> <li>• Comfort</li> <li>• Independence</li> <li>• Relaxing way to travel</li> <li>• Flexibility in movement</li> <li>• Social pressure to own</li> <li>• Expensive to own and maintain</li> <li>• Enhance movement of family</li> </ul>	<ul style="list-style-type: none"> <li>• Accessible in most places</li> <li>• Cheaper</li> <li>• Poor conduct of operators</li> <li>• Time wasting</li> <li>• Old and rickety cars</li> <li>• Makes noise</li> <li>• Less valued by society</li> <li>• For those who cannot afford cars</li> <li>• Not environmentally friendly</li> <li>• A lot of stops</li> <li>• Congestions</li> <li>• Stressful</li> <li>• Poor safety standards for goods and people</li> </ul>

#### **4.3.4 Contribution of Focus group to Questionnaire Design**

The utility of the focus group discussion can be grouped in to two main categories:

- “Confirmatory” findings
- “Challenging” or “different” findings

##### **Confirmatory findings**

The focus group undertaken indicated a number of attributes towards car and public transport that has been in the literature as espoused in Section 2.6. Generally, there existed the positive outlook towards car by both car owners and non-car owners in a developing country city like Accra which is reflective of various studies undertaken in other developing countries (Belgiawan et al., 2016a, Salon and Gulyani, 2010, Luke, 2018). The positive attitudes towards car were seen to reflect various studies both in developing and developed world context in relation to the independence, control and comfort that the car provides far and above that of the public transport. Thus statements capturing the attitudinal factors such

as instrumental, affective and symbolic factors which have well been espoused in literature were also identified.

Another observation that was witnessed as part of the focus group discussion was the strong emphasis of the negative attitude towards public transport in by both car owners and non-car owners. However, in the midst of the generally negative view the regular public transport users were seen to have more considerate outlook about the public transport service than the car users which is consistent with the findings from previous studies (Anderson and Stradling, 2004, Ibrahim, 2003, Beirão and Cabral, 2007). Another aspect of the focus group discussion which was seen to be in tandem with other studies, especially in the developing countries, had to do with the rickety nature of vehicles used for public transport service and the negative on board experience by passengers. This was titled “Social orderliness” by Van and Fujii (2011). With Accra been a developing country city, with the dominance of informal public transport service the attributes expressed during the focus group discussion was seen to reflect those seen in other developing countries. Although these, findings were seen to be reflected in other studies they helped shape the questionnaire that were used in the household data collection process.

### **Challenging or Different Findings**

Although most of the findings from the focus group discussion were seen to reflect the review literature, there existed aspects of the discussion which presented opportunities for further exploration in this study. One of such findings was the attribute of universal accessibility of the public transport service in Accra reported by the respondents. Review of literature in Section 2.4.2 of Chapter Two indicates the existence of structured routes with bus stop for most developed countries (Soltani, 2005, Bhat and Guo, 2007). With a ubiquitous transport system in Accra, the focus group discussion has pointed to almost universal accessibility to public transport by respondents, despite no formal bus route system. Hence there is the need to identify how to measure the accessibility of public transport within such context and also identify the impact accessibility to public transport plays in car ownership decisions. It may, for example, be more the quality of the service or the journey times rather than the frequency of departure or proximity of stop which determines whether people see the service as usable.



Another finding from the focus group discussion was the strong attachment to the instrumental role of the car in the life of households in Accra over and above the considerations for the symbolic and affective attributes. Although, the emotional attachment to the car was discussed by participants especially by non-car owners during the focus group discussion, there existed strong emphasis on the instrumental role the car plays. Within a developing country context with low car ownership, the reviewed literature has indicated the dominance of symbolic and affective factors over and above the instrumental factors (Van and Fujii, 2011, Van et al., 2014, Belgiawan et al., 2016b). Although the discussions from the focus group was taken with the motive to guide questionnaire design, such observations are important. This finding although preliminary will be compared to that obtained during the household data collection process.

#### **4.3.5 Concluding Remarks on Focus Group Discussion**

The focus group discussion provides a good background to undertake the household data collection exercise. The focus group has accomplished a whole range of analytical task. One of the objectives of the focus group discussion was to aid in the development of the household questionnaire. The findings obtained during the exercise provides a better foundation for the household survey as well as the formulation of questions. In addition, the focus group discussion have provided an indication of some distinctive characteristics of the study area which is different from the reviewed literature.

#### **4.4 Sampling of Households**

Rubin and Rubin (2011) asserts that in order to sufficiently capture the complexities of reality, the researcher has to ensure that differing views and variables are accounted for. One of the ways of achieving this is by adopting a good sampling strategy. Sampling is the selection of units to represent an entire population (Grinnell Jr and Unrau, 2010). According to Neuman (2002), the main purpose of sampling is to collect data about specific events or cases that can deepen understanding.

There are two types of sampling techniques: probability and non-probability sampling (Doherty, 1994). With probability sampling, each member of the population has a known non-zero probability of being selected. Some of types of probability sampling include cluster sampling, stratified sampling, systematic sampling and multi-stage sampling techniques

(Richardson et al., 1995). In non-probability sampling, members are selected from the population in a non-random manner (Grinnell Jr and Unrau, 2010). Examples of non-probability sampling include snowball sampling, quota sampling and purposive sampling (Patton, 2005, Flick, 2014). The major difference between the two types is that unlike the probability sampling where the sampling error can be calculated, the sampling error remains unknown with the non-probability sampling. However, both types can be used depending on the objectives of a research study.

This study adopted a probability sampling technique so that certain types of statistics can be used and provide a more robust assessment of the wider implications of the findings of the research. In order to be able to sample households that reflect the research under consideration, there is the need to first select communities within the city. The process used in selecting the communities are discussed below.

#### **4.4.1 Selection of Communities in Accra**

The aim of the community selection process was to identify communities that best represents the objective of the research which is to identify car owning households and non-car owning households. Whilst there exist a plethora of variables that serves as determinant for the ownership of cars by households (Anowar et al., 2014), income is typically a critical determinant. In order to meet the objectives for this research income is used as a basis in the selection of communities.

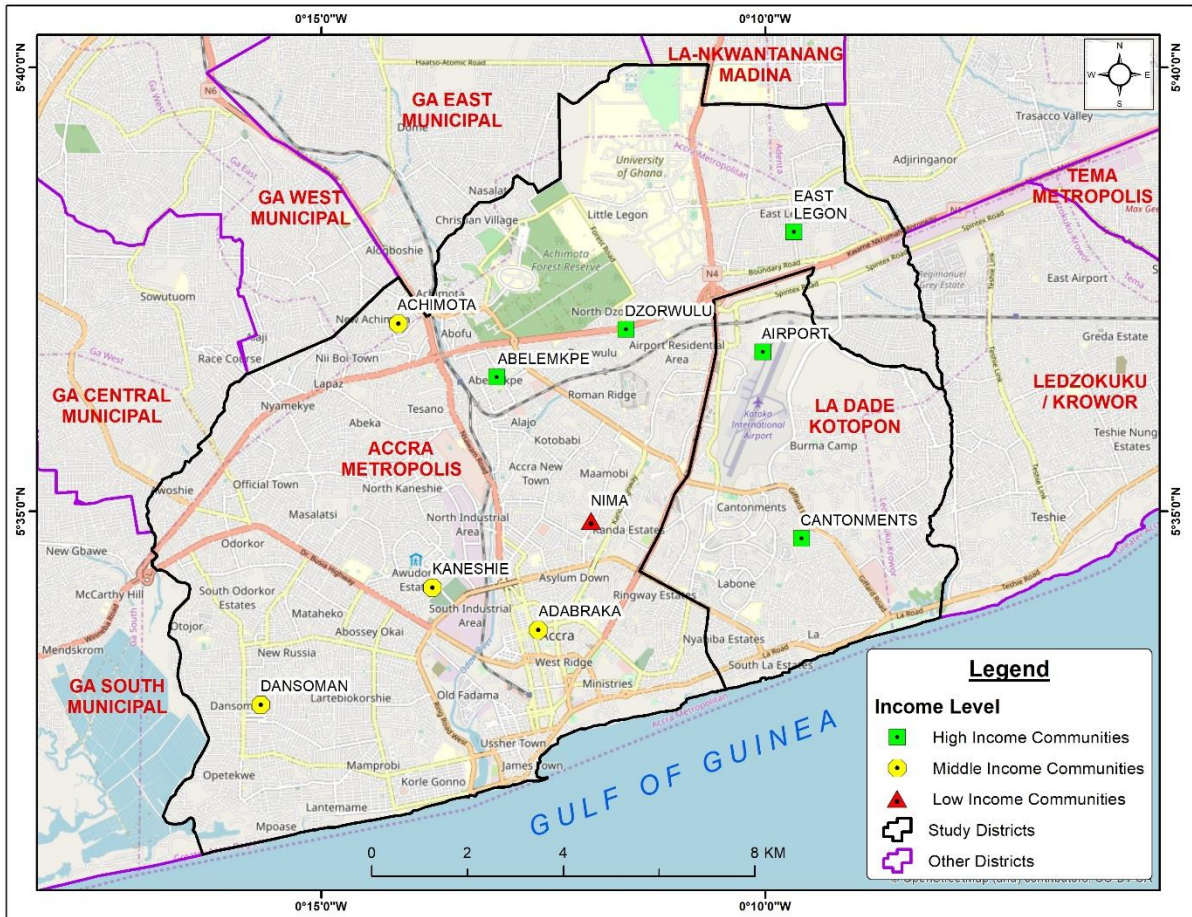
##### **4.4.1.1 Selection of Communities based on Income**

Among the socio-demographic variables, household income has been identified as a major determinant in the ownership of vehicles especially in economies with low car owning households (Gómez-Gélvez and Obando, 2013). Based on the established importance of income on household car ownership decisions elsewhere, this research uses income as a major determinant in selecting households and communities for data collection. This is also necessary as a result of lack of data on household car ownership in Accra and so the basis for sampling areas on car ownership would be unclear.

CHF International (2010), conducted research into the poverty zones of Accra. The various indicators used to undertake the classification included the demographic indicators,

economic indicators, housing indicators and urban services provision. Based on the indicators, the communities in Accra were divided into poverty pockets. The aggregate poverty pockets included low poverty pockets, moderate poverty pockets, high poverty pockets and very high poverty pockets. Though the research conducted used poverty pockets in the analysis it gives an indication of the various income groupings within Accra. The researcher decided to use the various groupings identified in by CHF International by giving them different names which are high, middle and low income groups. Therefore high income grouping represents the low poverty pocket, middle income grouping represents the moderate poverty pockets and low income grouping is represented by high and very high poverty pockets.

The 79 communities in Accra can therefore be categorized into high, medium and low-income groups, within which seven communities were identified to be in the low poverty zones. As a result of the comparatively low levels of car ownership across Accra emphasis is placed on the high income communities and middle income communities in order to increase the probability of identifying households with cars. In addition, aside high income households in a relatively low car owning city being most likely to own a car they will also be most likely to consider ownership which presents a better picture in understanding aspirations to car ownership in such an environment. This assertion was reinforced during the pilot survey in which most car owners were identified to be resident in high income communities followed by middle income communities (The pilot survey discussion in Section 4.6.3 would provide much description of this). In all 10 communities were selected with five belonging to high income, four belonging to middle income and one belonging to low income. The selection of 10 communities represents more than 10% of the available communities in Accra. However the findings of the research can be said to reflect more of the moderate and high income communities but would under-represent low income. Also the selection of more communities within the high income communities, apart from increasing the probability of identifying car owning households, is also based on the fact that there are fewer households in high income areas than other places. Table 4.3 provides list of communities with their respective household population to support this assertion. Hence increasing the number of communities also helps to increase the number of households interviewed within these areas. Figure 4.1 shows the 10 communities selected with the corresponding income groupings.



**Figure 4. 1:** Map indicating the ten selected communities

#### 4.4.2 Household Sample Size Determination

Household sample size for the ten communities was determined by using the mathematical formula given as  $n = \frac{N}{1 + N(\alpha)^2}$ , where  $n$  is the sample size,  $N$  is the sample frame,  $\alpha$  is the confidence interval (which is 95%). The total households of the various suburbs were projected from the 2010 population and housing census for a more updated figures for 2017 as shown in Appendix B. The inter censal growth rate for Accra which is 4.2% was used to calculate the 2017 projected household population of suburbs using the formula  $P_t = P_o(1+r)^t$ .

Where ;

$P$  = projected population,

$P_o$  = base population,

$r$  = growth rate

t = time.

Based on the calculations made, the sample size needed for the survey was 398 households. Because there would be a need to sub-divide the sample into different groups for comparison, the researcher increased the sample size to increase the statistical likelihood of finding differences between groups. Also as a result of the expected unwillingness of some respondents not participating fully or partly filled questionnaire the researcher was guided by previous response rates of households' surveys in Ghana. With reference to other household surveys conducted in Ghana such as (Ghana Statistical Service, 2015, Ghana Statistical Service, 2008, Abane, 2011, Birago et al., 2016) the average response rate identified was between 55% and 80%. Based on the above considerations the researcher opted to use a sample of 900 in order to capture all the factors explained.

**Table 4. 3: Sample Size Determination**

Suburbs	Total Household (2010)	Total Household (2017-- Projected)	Percent of total households	Sample size
Airport	6745	8,996	7.1	64
Dzorwulu	6609	8814	6.9	63
Abelemkpe	5904	7874	6.3	57
Cantoments	7216	9624	7.6	68
East Legon	5885	7849	6.2	57
Adabraka	9736	12811	10.4	94
Kaneshie	9269	12362	9.8	88
Dansoman	8069	10762	8.5	76
Achimota	17077	22776	18.0	162
Nima	18196	24268	19.2	171
<b>Total</b>	<b>94706</b>	<b>126136</b>	<b>100</b>	<b>900</b>

Source: Author's Construct based on Ghana Statistical Service (2014a)

#### 4.4.3 Sampling Technique

This study adopted the systematic sampling technique. Systematic sampling is a technique of selecting units from a list through the use of a selection interval "l" such that every lth unit

on the list, following a random start, is included in the sample (Richardson et al., 1995). The systematic sampling technique is adopted for this study because it produces a highly representative sample of the population under study.

This is given by the formula:  $K=N/n$ , where,  $N$  is the sampling frame and “ $n$ ” is the sample size and  $K$  refers to the  $K^{\text{th}}$  respondent to be interviewed after the first sample unit has been selected randomly. In adopting this sampling approach, a house was used a surrogate for household. To this extent, the total sampling frame for each community is made up of the total houses within the community.

This was made possible especially as a result of the low residential density of the selected suburbs as compared to other high residential density areas in the city. For instance the household in the 20<sup>th</sup> house after the first one was randomly selected will be interviewed in Airport Residential. In the similar manner, in Abelemkpe after the initially randomly selected household, the 17<sup>th</sup> will be interviewed. The sampling strategy for the remainder of the suburbs is shown in Appendix C. In cases where a particular residence has more than one household, only one household in that residence will be selected for interview.

#### **4.5 Designing of Questionnaire**

The questionnaire was carefully designed to address the various objectives of the research. This section discusses the questionnaire design considerations, structure and content of the questionnaires.

##### **4.5.1 Questionnaire Design Considerations**

In order to get the best out of questionnaires a lot of factors must be put in place and adhered to (Bickman and Rog, 2008, Dillman et al., 2014). According to Bickman and Rog (2008) two factors in particular summarize the key elements of survey question design: the first relates to what constitutes a good question in surveys; and the second is a general checklist for designing survey instruments. In view of the above there was the need to ensure that certain indicators are observed in order to design questionnaires that can help in obtaining the needed information to be able to address the research objectives. Bickman and Rog (2008) have additionally prescribed characteristics that questions in a questionnaire should possess

in order for them to meet a required standard. Some of the points to consider as prescribed by Bickman and Rog (2008) include the following:

- Questions need to be consistently understood
- Questions need to be consistently communicated to respondents
- Respondents should have access to all information needed to answer questions correctly.
- What constitutes an adequate answer must be clearly communicated to the respondents

In addition to the above Oppenheim (2000) stipulates that the principal motive of the data collection process using questionnaires were to get accurate and honest answers, therefore adequate measures must be put in place to ensure that this is achieved. In order to meet the requirements espoused above the following were considered in the designing of the questionnaires:

- The questionnaires underwent a series of reviews. First the questionnaires were set with the help of data from the focus group discussion especially with the attitudinal statements. In addition there were a series of reviews with research supervisors, peers and literature relating to the subject matter
- Questions were phrased in such a way as to facilitate easy translation into the local language without losing their meaning.
- The use of loaded and leading questions were avoided
- The questions were written in English and administered by the survey assistants in English or local dialect according to the preference of the respondents
- The use of jargons in the questions were avoided to prevent ambiguity

#### **4.5.2 Structure of the Questionnaire**

The questionnaire had seven sections named Section A,B,C,D,E,F and G. A copy of the final questionnaire is included as an Appendix D. Table 4.4 shows the summary of the data collected from each section of the questionnaire.

**Table 4. 4: Data Collected in the Questionnaire**

Structure	Data Category	Data Collected
Section A	Socio-Demographic Information	Q1: Household type Q2: Age, Relationship to household head, Employment status, Sector of Employment, Educational Level, Driving License Availability Q3-Q6: Cars owned , access to other travel modes of transport, ownership of other modes
Section B	Car Owners Only Information	Q7: Information on car(s) owned Q8: Reasons for owning a car
Section C	Non Car Owners Only Information	Q9-11: Ownership of Driving License and reasons for owning a license or not Q12-13: Desire to own a car and reason
Section D	Trip Characteristics	Q14: Frequency of Trip purposes Q15: Frequency of use of various modes Q16-19: Trip to work and other activities
Section E	Attitudinal Questions	Q20: Attitudes towards car in general Q21: Attitudes towards Public Transport
Section F	Public Transport Accessibility	Q22-30: Journey time to public transport route, journey time to work, cost of travel
Section G	Concluding Questions	Q31-32 House tenure type and house type Q33: Household Income

Apart from Section B and Section C which had to be answered by car owners only and non car owners only respectively, the rest of the sections were to be answered by all respondents. Section E captures the respondents attitude towards car and public transport. The various attitudinal statements were asked on a seven-point Likert scale. The Likert-scale is the most



common approach to scale response in questionnaire surveys. In most cases the 5 or 7 points Likert scale is used (Hartley, 2014). Whilst 5-points Likert are desirable for respondents with low motivation to complete the questionnaire as it is easy to understand (Smith Jr et al., 2003) the 7-point scale has the advantage of increasing the measurement precision (Nemoto and Beglar, 2014) to that extent, the 7-point scale was used.

### **4.5.3 Questionnaire Content**

#### **4.5.3.1 Section A and G: Demographic Questions**

The set of standard demographic questions about the household were asked. These were designed to be compatible where possible with national data sets such as the National Population and Housing Census, National Travel Survey and the Ghana Living Standard Surveys to enable comparisons to be drawn between the sample population and the national population during the analysis phase. Section G also contains demographic data but was put at end in order to reduce the chance of a participants losing interest in the survey as a result of variables like income which is considered relatively sensitive topic in the context in which the research takes place.

More importantly, variables present in typical car ownership models were included in the questionnaire so that the relationships revealed by such models could be explored using the survey data. The list of relevant variables compiled and included in the questionnaire were obtained by reviewing a number of sources particularly Jong et al. (2004) and Anowar et al. (2014). Chapter two provides an extensive discussion on various variables that have been included in household car ownership models.

An attempt to capture variables that are contextually relevant and also used in car ownership models provided the opportunity for the researcher to test various results which have shown to have varied influence on car ownership in the literature. For instance the inclusion of the number of children in a household was included in the questionnaire to ascertain how it influence car ownership in Accra since this variable has been identified to have mixed result in the literature. Whilst some studies indicate an increase in children in the household results in the acquisition of cars as a result of increased mobility requirement (Kermanshah and Ghazi, 2001, Yamamoto et al., 1999) other studies suggest that increased children lead to reduced probability of owning of car as a result of increase in expenditure on other household

items (Bhat and Koppelman, 1993). Also the adoption of contextually relevant issues also helps to present distinct findings which might not be relevant in other developed countries but can be seen to be relevant especially in the Sub-Saharan African context. An example is the composition of household which is not seen to be made of only the nuclear family but other members who might not be related by blood. According to Ghana Statistical Service (2014b) a household is a group of people sleeping in the same structure and having the same catering arrangements and who recognize one person as their head. By this definition a household, is not necessarily people who are bounded by blood relations alone as there exist a number of households within the study area with members not related by blood. To this extent the questionnaire makes provision for not only the number of people in the household but the composition of people in the household

The following variables were used as part of demographic questions:

- The household structure including age, gender, educational level and occupation of all household members and number of employed adults
- The number of driving license holders
- Car ownership status ( number of cars owned)
- Access to other cars not owned e.g. Company car, Government car etc.
- Ownership of other modes of transport e.g. motorcycle, bicycle

The data generated in the demographic section will serve as the basis to differentiate households into various groupings and also to determine how these attributes shape car ownership of households within the context under study.

#### **4.5.3.2 Section B: Questions for Car Owners Only**

Section B is dedicated only to car owners. As stated in the introduction car ownership is very low in Ghana and by extension many Sub Saharan African countries. In order to broaden our understanding of why people own car under such circumstances, respondents were given a list of statements to select from. This section is different from Section E where respondents answer questions on attitude towards car whether they own or not. By asking respondents about the main reason for owning a car an attempt is made to understand the ‘front of mind’ reasons that affect such decisions. The statements used in this section was guided by the focus group discussion which was discussed in Section 4.3. For instance statements such as

“to help in movement of the family” and “ease journey to work” which were used in this section was from the focus group discussion.

#### **4.5.3.3 Section C: Questions for Non Car Owners Only**

With the car ownership in Ghana, identified to be low, there is the need to understand factors influencing why various households do not own cars. In order to achieve that, questions are asked of ownership of driving license of these households and the reasons informing their decision to own the license. Furthermore, questions are asked of these households’ desires to own car. These questions also helps to understand respondents’ willingness of households to own cars. These statements were also guided by the focus group discussion and the literature as well. For instance statements like “I cannot afford to buy a car” and “It is not necessary as there are other ways of getting around” were used based on the results from the focused group discussion.

#### **4.5.3.4 Section D: Trip Characteristics**

Mobility characteristics of respondents constituted a section in the questionnaire. Under this section questions were asked about the transport mode use and travel frequency. The transport mode considered include car, taxi, motorcycle, public transport (i.e. trotro, metro mass and ayalolo) and bicycle. Whilst there exist works especially in Accra which indicates that trotro is the most patronised means of transport among the populace (Abane, 2011) this research goes a step further by providing details with respect to frequency of mode use among respondents and how the use of these modes affect their attitude towards car and public transport. Also this section helps to understand the frequency of car use among owners and their use of other modes of transport apart from their car.

In addition, this section considered the frequency of various journey types like commute, shop (market), leisure and social activities and the associated modes of transport used for these activities. Specific questions focused on commute trips in relation to the mode used for this trip, travel time and distance to work. Studies by Abane (1993) and Abane (2011) indicates that the most important trip among residents in Accra is the commute. As there is the potential for the commute trip to be important in the decision to own a car, the additional questions on the commute were included.

#### **4.5.3.5 Section E: Attitudinal Questions**

The respondents were divided into two groups according to whether they owned cars or not. Both car owners and non-car owners were asked 19 questions about their attitudes toward cars and 17 questions about their attitude towards public transport. It was emphasized that they should answer considering “cars in general.” And public transport considering the most popular (trotro). The respondents were given a statement and asked to indicate their level of agreement by assigning the responding Likert scale score for the statement. Some statements were reverse-worded to encourage introspection and break up any patterned responses. The various statements used in the questionnaire were derived from various literature sources and were shaped to reflect the contextual issues using the focus group discussion as a guide. Further details are discussed below.

#### **Attitudes towards Car**

With respect to the attitudinal statements towards car various works in the literature influenced the use of some statements. For instance, studies by Van and Fujii (2011), Zhu et al. (2012), Belgiawan et al. (2016a) influenced statements used based on their research into car ownership in developing countries. It must also be highlighted that works by Steg (2005) and others also influenced the formation of the statements as well as most of the elements highlighted in the literature review.

For instance, attitudinal statements like “A car allows a person to distinguish themselves from others”, “Car gives a person prestige” were taken from Steg (2005) and was subsequently used by Belgiawan et al. (2016a). Whilst Steg (2005) finds that these statements load high in the symbolic/affective construct, Belgiawan et al. (2016a) using similar statements finds them loading on a construct named as arrogant prestige. Other statements that were found to be similar in Steg (2005), Belgiawan et al. (2016a), Van and Fujii (2011) include: “driving a car is relaxing way to travel”, “one can feel free and independent in his/her car”, “using a car provides privacy”, “A symbol of success in life”, “a car allows you to choose your own route” and “Car allows you to travel anytime” were used.

Van and Fujii (2011) propose that there is an additional attitudinal factor referred to as social orderliness. To verify its importance especially since it was used in a developing country

context, statements on whether respondents consider that “cars are environmentally friendly” and “cars are not disturbing to one’s neighbourhood” were included.

Apart from the various statements listed above that are seen to be used in the literature there are also additional statements that were used based on the focus group discussion. Statements like “there is societal pressure to have a car” and “transport modes other car are looked down upon” were used. Such statements emerged in the focus groups and so were tested in the questionnaire. Whilst these statements have not been used in the literature, these statements are seen to be relevant especially since societal influence and considerations are seen to be relevant in car ownership decisions.

### **Attitude towards Public Transport**

The literature review revealed that the quantity and quality of alternative modes of transport especially public transport was important in affecting decisions on car ownership (McGoldrick and Caulfield, 2015). Previous works by Steg (2003) asked respondents perception towards public transport on instrumental, affective and symbolic scales using for example convenience, freedom, stress, control etc as the statements to be considered. Van and Fujii (2011) and Van et al. (2014) undertaking studies in six Asian countries uses similar statements as Steg in identifying the various constructs for assessing the perception of respondents towards public transport. Also Abane (2011) in undertaking work in four cities in Ghana including Accra, Kumasi, Takoradi and Tamale on the reason for mode preference also adopts generic statements such as comfort, convenience and availability. Whilst these approaches are seen to be accepted, based on the focus group discussion and the literature review undertaken, this study used of specific statements which were intended to reflect the context in which the work is undertaken. Hence although the statements may capture the sentiment used by the authors above, this contextualisation enable the respondents to understand the statements well in order to provide informed answers. Such statements used include: “there are comfortable seats for passengers”, “public transport vehicles are seen as rickety”, “people who are successful do not travel public transport” and “public transport vehicles are environmentally friendly”. It must be emphasized that respondents who do not or only seldom use public transport might answer the questions relating to perception towards public transport questions based on what they have heard rather than what they experience. This

difference though is not important relative to this research as respondents attitudes are seen to be formed with both direct and indirect experiences (Eagly and Chaiken, 1993).

#### **4.5.3.6 Section F: Public Transport Accessibility**

Section 2.3.2 discusses the impact of public transport accessibility on car ownership. Based on the review provided it was established that few studies have been undertaken in the developing world. More so, public accessibility in these areas were based mostly on services which were regularised. The study area presents a context in which public transport is generally not regularised as discussed in Chapter three. To this end, data relating to public transport stops are not mostly available in this context so that access to public transport from one's home cannot be calculated from a particular reference point. This is because the public transport buses that are used in the city are able to stop at any place and fill passengers which is mostly known as the "fill and go" pattern of operation. Hence, whilst it might be difficult to get respondents to provide answers with respect to distance and time to public transport stops, in most cases access to a major road can be used as pseudo access to public transport stop since passengers can stop the public transport buses whilst along the road.

To this end, the researcher asked questions relating to time and distance to the nearest public transport route from the perspective of the respondents whilst also using Google Map to get estimates of distance from the house of the respondents. This was done to be able to compare the subjective answer given by the respondents as against the objective results obtained from the Google Map.

#### **4.6 Conducting of Survey**

Having identified the research unit of analysis, the key variables, designed questionnaire and data sources the next step of the research process was to conduct household survey. Conducting the survey involves very critical considerations like the data collection method to use, recruitment and training of field assistants, pilot and main survey. Details of various steps taken and used in conducting the survey are discussed in this section.

#### 4.6.1 Questionnaire Collection Methods

The data collection method adopted is the use of household questionnaires. De Vaus and de Vaus (2001) state that questionnaires can be administered in a number of ways. Some of them include; by phone, through the internet and supervised face to face or person to person. The advantages and the disadvantages of the various methods are provided in Table 4.5.

**Table 4. 5: Advantages and Disadvantages of Survey Methods**

Survey type	Advantages	Disadvantages
Internet	<ul style="list-style-type: none"> <li>• Less time needed</li> <li>• Low cost involved</li> <li>• Flexibility</li> <li>• Ensures anonymity</li> <li>• Automation and real time access</li> <li>• Respondents may be more willing to share information</li> </ul>	<ul style="list-style-type: none"> <li>• Sampling bias</li> <li>• Low response rate</li> <li>• Difficulty to adopt in regions with limited internet usage</li> <li>• Respondents cannot be probed</li> </ul>
Phone	<ul style="list-style-type: none"> <li>• Moderate cost</li> <li>• Less time needed</li> <li>• Flexible</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of visual materials</li> <li>• Difficulty in sustaining conversation for long time</li> <li>• Difficulty with sensitive topics</li> <li>• Difficulty to adopt in regions with limited data availability resulting in sampling errors</li> </ul>
Mail	<ul style="list-style-type: none"> <li>• High degree of anonymity</li> <li>• Respondents can take time for their answers</li> <li>• Relatively low cost</li> </ul>	<ul style="list-style-type: none"> <li>• Low response rates</li> <li>• Respondents cannot be probed</li> <li>• No guarantee for obtaining fully completed surveys</li> </ul>
Person to Person or Face to Face	<ul style="list-style-type: none"> <li>• High response rate</li> <li>• Allow probing and clarification</li> <li>• Ability to collect supplementary information</li> <li>• Flexibility in questioning process</li> </ul>	<ul style="list-style-type: none"> <li>• Time consuming</li> <li>• High cost involved</li> <li>• Trained interviewers required</li> <li>•</li> </ul>
Drop and Collect Method	<ul style="list-style-type: none"> <li>• Respondents can take time for their answers</li> <li>• High degree of anonymity</li> <li>• Respondents may be more willing to share information</li> </ul>	<ul style="list-style-type: none"> <li>• Low response rate</li> <li>• Time consuming as number of visits are needed to get the questionnaire</li> <li>• High cost involved</li> <li>• No guarantee for obtaining fully completed surveys</li> <li>• Respondents cannot be probed</li> </ul>

Source: Adapted from Frankfort-Nachmias and Nachmias (2007) and (Mangione, 2014)

In this study supervised face-to-face administration of questionnaires by trained interviewers was adopted. The majority of the questionnaires were administered through the supervised face-to-face interviews. The use of drop and collect option became apparent and important as a result of some observations during the pilot survey. During the pilot survey some respondents indicated their willingness to partake in the data collection process only if they were allowed to answer it within some days so that the collection can be done later. To this extent, the drop and collect method was adopted as part of the data collection process. Although face to face and drop and collect approaches tend to be time consuming and involves the use of monetary resources it ensures high response rate, better response for questions and offers the interviewers opportunity to explain the motive of research to respondents. Another critical reason for adopting these approaches are that they fit the geographical context in which the survey is taking place. This is because methods like the use of the internet, mail and telephone will be difficult to implement as internet access is restricted for certain group of people and the culture of administering questionnaires through such mediums are not well known. To this extent, the approaches adopted provide the best opportunity to gather credible data as well as helps to overcome many inefficiencies that are involved in collecting data through other means.

#### **4.6.2 Selection and Training of Field Assistants**

The researcher undertook the survey with the help of selected field assistants. The researcher discussed the need for field enumerators with the Ghana Statistical Services who helped the researcher in selecting field enumerators for the research. The Ghana Statistical Service was chosen because of the department's continuous use of enumerators to collect household data for varied purposes. The criteria for the selection of the enumerators include:

- Experience in administering household questionnaires
- Minimum educational qualification of diploma
- Conversant with the selected suburbs
- Can speak and understand both English and the local dialect

In total ten field assistants were selected for the survey. The selected enumerators were adequately trained for a period of two days before undertaking the research. The areas to be covered in the training included the following:



- The purpose of the research
- Ethical issues
- Data collection approaches to adopt
- Dealing with uncooperative respondents
- Remunerations

The field assistants were given allowances for the two days of training provided. In addition, the enumerators were paid per each questionnaire administered.

#### **4.6.3 Pilot Survey**

A pilot survey was undertaken with the aim of testing the questionnaires and to provide the field assistants the opportunity to gain practical understanding and familiarity before the main surveys. A total sample of 50 randomly selected households from five of the ten selected communities were undertaken as a means of piloting the process of survey administration as well as the questionnaire itself. Even though the questionnaires had been subjected to scrutiny through the answering by some research colleagues recruited from within the university and non-researchers recruited among friends who appreciate the case study context, the process did not include the use of research assistants and the actual participants. It was therefore important to pilot together with the research assistants and the selected communities in order to be well prepared for the main survey. Administering the questionnaire in person provided an unanticipated and valuable opportunity to quickly validate the questionnaire with the respondent and also access the performance of the research assistants in undertaking the task.

In order to provide on the job training for the ten research assistants, they were paired in twos and the researcher made an attempt to administer at least one questionnaire with each team. A very important aspect of the piloting exercise was to teach the field assistants on record keeping in order to come up with accurate data. In this regard, any respondents who was approached but refused to answer was recorded, those that started but refused to complete the process were also recorded and any other information that was important but not provided in the questionnaire was also to be recorded. The results of the pilot survey influenced the final questionnaire and data collection process in a number of ways.

Firstly, through the pilot there was the identification of the misunderstanding of skip instructions relating the answering of some questions. Skip instructions were an important and unavoidable feature of the questionnaire design as quite complex branching was required in order to accommodate car ownership trajectories. This mainly had to do with the differentiation of specific questions for car owners only and those for non-car owners only. The skip instructions were significantly improved through the use of visually striking and bolden words to direct respondents to the next relevant question. Field assistants were also notified to be very conscious that they put forward the right questions for the various categories correctly especially when using the face to face method of administration.

In addition, though the research anticipated the use of face to face interview, based on the experience from the survey, there was the need to introduce drop and collect option as well. This became very necessary as some of the respondents were not ready to undergo the process of answering questions at one moment. With the introduction of drop and collect method of administering the questionnaire certain measures had to be introduced in order to increase the response rate for such an option. In this regard, further information had to be gathered from households that opted for the drop and collect option. Since there was not the option for the questionnaire to be posted back to the researcher, the address of the household and if possible the telephone number of the respondent had to be collected in order to aid the recollection on an agreed date. The modified questionnaire designed was emailed to my supervisor for approval. The approved questionnaire was the one used for the actual survey.

#### **4.6.4 Main Survey**

Based on the lessons learnt during the pilot survey it provided a very good background for undertaking the main survey. In all 900 questionnaires were to be administered in ten communities in Accra. The allocated sample size for each community was then distributed. The survey exercise was first undertaken in middle income communities and subsequently in high income communities before one low income community. Also even though ten research assistants were selected to be part of the survey from beginning to the end, the researcher on some days had to work with eight research assistants as a result of situations beyond the control of the researcher. This however did not affect the data collection process as this had

been factored in when choosing the number of research assistants. The data collection process took place from January 2018 to March 2018.

In the selection of households within each community, the systematic sampling process discussed in the sampling technique section (Section 4.4.3). This method helped to provide an adequate coverage of households within each community. Prior agreement was sought from respondents who either used the face to face method or the drop and collect method that their responses were for only academic purposes and that they would be anonymized as this was part of the research ethics consideration discussed in Section 4.8.

A major factor to consider was the reliability of the responses that were provided. An important factor that can affect the reliability of the responses is the positionality of the research. In this case, the researcher is a doctoral researcher schooling abroad and has also lived in the context under study for a decade. In order to prevent these factors affecting the responses, the researcher encouraged the field assistants to take time in explaining the purpose of the research, how the data will be used and who is conducting the survey to the respondents. In addition, the field assistants were to encourage the respondents not to overestimate or underestimate their responses.

In addition, triangulation methods were adopted by the researcher to check the reliability of the responses by the respondents and also the quality of work by the field assistants. One of the ways in achieving this was the design of the questionnaire itself. For instance given the employment type, educational level and other factors the income level of the household could be predicted. Such checks also helped to ensure that research assistants do not make up responses. Also, one community was visited at a time so as to afford the researcher the opportunity to undertake a quality monitoring role during the exercise.

#### **4.6.5 Lessons and Challenges on Data Collection in Accra**

Benevenuto and Caulfield (2019) discuss the existence of issues relating to data availability and collection in developing countries. Some of the identified issues included: lack of timely data; poor data quality and unavailability of disaggregate data. In respect to this research, whilst there existed data sources such as National Travel Survey, there was some identified issues that limited the use of such data. The major issues with this existing data had to do

with the unavailability of disaggregate data. For instance the socio-demographic data were aggregated mainly at the national and regional level and did not contain the relevant variables at the level of the household required for meeting the objectives of the research. Also, the data of the trip characteristics primarily concentrated on the national and regional level with no emphasis at disaggregate level. However these data provide avenues for comparison and also allows the researcher to make selections about where to survey and to understand the nature of the sample relative to the population. As a result of the issues relating to existing data, the researcher had to result to collecting primary data which was also limited by time constrains and the availability of funds. Dimitriou (2013) suggests scenarios of data deprivation especially in developing world context leads to a trade-off with model sophistication which usually leads to the creation of transport models which benefit the available data. With respect to this research, the adoption of models used were based on the data available. Hence the lack of existing data in the context of Accra affected the model selected.

With respect to the data collection process a number of challenges were identified and addressed. One of the most important factors to consider in any social research is the positionality of the researcher—the background and position of the researcher in relation to the survey participants and the research setting. The need to consider the researcher's positionality and the extent of influence it could have on the research was important for two main issues. Firstly, being a doctoral researcher and coming from a university abroad put me in the outsider position and could potentially influence the respondents' perception of me and the responses they provide. Secondly, having previously lived in the case study area for over two decades put me in the insider position where my knowledge of the local context could also be a source of bias especially in looking for predetermined responses to the survey questions. In order to account for the potential effect of my positionality on the reliability of the survey responses, the field assistants were trained to spend a reasonable amount of time at the beginning of the interviews to explain to the participants the purpose of the research, who is conducting the survey and how the data obtained will be used. In addition, the interviewees were encouraged not to understate or overstate their responses to the survey questions since their responses would be anonymized but instead, to provide answers that

reflect their circumstance as close as possible with respect to the content of the questionnaire.

Another challenge that was addressed in the data collection process was the adoption of triangulation methods which were employed to check the reliability of the responses to the questionnaire administered by the field assistants. In order to achieve this a number of measures were adopted. Firstly, reliability was achieved through the design of the questionnaire itself. Inbuilt triangulation included conditioning responses to some of the questions based on previous responses supplied by the interviewee. Secondly, actual fieldworks were scheduled so that each selected community was visited the same day by the researcher and field assistants. At the end of each interview by a field assistant, a debriefing meeting was held to audit the completed questionnaire. Answers to the survey questions were then audited and interrogated. These measures helped to reduce challenges associated with data collection in developing world city like Accra.

#### **4.7 Survey Response Rate**

As discussed above the questionnaire was administered in two ways which were face to face and drop and collect methods. The overall response rate of the survey was 60.7% which mirrors that achieved during the pilot survey. The two methods adopted for the survey had different response rates. The response rate for the face to face method was 78.6% whilst the response rate for the drop and collect method is 23.4%. The breakdown for the survey is provided in Table 4.6.

Comparing the response rate for the two methods, it is apparent that the face to face method was more successful than the drop and collect method. This reaffirms Frankfort-Nachmias and Nachmias (2007) assertion that the use of the face to face method has high response rates as compared to other methods including the drop and collect method used in this research. It appears that the inability of the researcher to partake directly in the answering of questions by respondents using the drop and collect method affected the response rate for that approach. Also, the response rate for the drop and collect method was low because some of the questionnaires were not received back from the respondents as some indicated they had misplaced it whilst others could not be reached during the survey period for their response.

**Table 4. 6: Response Rate for Survey**

<b>Breakdown of Responses</b>	<b>Numbers/Percentages</b>
Number of Households Sampled	900
Questionnaires administered through face to face	610
Completed through face to face	480
Refusals through face to face	40
Uncompleted through face to face and cannot be used	90
<b>Response rate for face to face</b>	<b>78.6%</b>
Questionnaires administered through Drop and Collect	290
Completed Questionnaires received through drop off and collect	67
Uncompleted Questionnaires received through drop off and collect and cannot be used	102
Unable to collect questionnaires given through drop off and collect (Did not receive after follow ups)	121
<b>Response rate for drop and collect method</b>	<b>23.4%</b>
<b>Overall Response rate</b>	<b>60.7%</b>

Source: Field Survey, 2017

With the various questionnaires obtained from the data collection process some were not adopted for the data entry process. The non-adoption of some questionnaires was based on a variety of reasons. For instance with the face to face interview some of the respondents who initially showed interest in the survey later decided not to continue on the data collection process and asked for their questionnaires to be scrapped from the process. Others also answered less than 70% of the questionnaires and were not ready to complete the whole process hence those questionnaires were redrawn. The questionnaires that were administered through drop and collect method also followed similar trend. Some returned the questionnaires to us unanswered whilst some answered less than 70% of the questions.

#### **4.8 Research Ethics**

An important part of the research process is the ethical considerations (Homan, 1991) as it helps in addressing issues of confidentiality, anonymity, psychological concerns and

conflicting issues (Punch, 2013, Neuman, 2013). The research involved the use of human participants hence there was the need to consider ethical issues as part of the research process. In order to undertake the data collection, the University of Leeds approved the ethical review form submitted by the researcher. The ethical reference number given was AREA 17-026. The various issues addressed with regards to research ethics include the following:

- Consent of Participants and Participant Information Sheet
- Data protection and Storage

#### **4.8.1 Consent of Participants and Participant Information Sheet**

An essential ethical requirement for any research with human actors is gaining the informed consent of the participants, as this respects the autonomy of participants by enabling them to make an informed decision about their participation given all the needed information about the research and how it may impact upon them (Cohen et al., 2002). In order not to take advantage of people, enough information was made available to the participants in order for them to make informed decision. The Participant Information Sheet provided the details of the study and other answers to other anticipated questions. In order to take part in the data collection exercise, formal consent form must be filled. The participants had the liberty to withdraw from the process at any point. In such situations, that particular questionnaire will not be used as part of the process. The consent form also stated the right of the participant to withdraw.

#### **4.8.2 Data Protection and Storage**

The original filled questionnaires of respondents are treated confidential by identifying respondents with codes instead of their names. The hard copies of the questionnaires are stored in the locked cabinet provided to the researcher at the university accessible only to the researcher. The anonymised and transcripts of questionnaires are saved on the university N drive accessible only to the researcher. Various analysis and modelling and backup are done on the N drive of the university.

#### 4.9 Analysing the Survey

The analysis is intended to answer the various objectives of the research. As a result of the objectives of the research, it is an intention to generate highly structured quantitative data for use in a modelling framework. The questionnaire survey data was entered into and managed using SPSS 23. The majority of the preliminary quantitative analyses took the form of univariate and bivariate of association between variables. The univariate test yielded descriptive statistics for various forms of data. The bivariate analyses were used to examine the relationships between pairs of data items. The various statistical approaches adopted were informed by Bryman and Cramer (2004) who recommends a rule of thumb statistical approach to apply for different data types like ordinal-nominal data or ordinal-ordinal data among others. The statistical methods adopted are discussed below. Table 4.7 shows the various statistical methods used for different analysis.

**Table 4. 7: Statistical Methods Adopted**

<b>Analysis Undertaken</b>	<b>Nature of Variables</b>	<b>Statistical Method Used</b>
Descriptive statistics of socio-demographic factors	Categorical data	Frequency, percentage, mean, standard deviation
Extracting factors from attitudes towards car and public transport	Ordinal data	Principal Component Analysis
Difference in attitude towards car by car owners and non-car owners	Ordinal data	Mann-Whitney U Test



Identifying differences in attitude towards cars and public transport across socio-demographic cohorts	Ordinal data	Kruskal-Wallis Test
Relationship between various household demographic factors (for instance Relationship between availability of children and car ownership)	Categorical data	Chi-Square

Source: Author's Construct

#### 4.9.1 Descriptive Statistics

The univariate analyses was undertaken using mainly descriptive statistics. The descriptive statistics used included frequency tables, bar chart (including grouped bar chart and stacked bar chart), mean, standard deviation and percentages. These were adopted to showcase the data graphically for easy interpretation and inspection.

#### 4.9.2 Chi-Square test

Chi-square tests of association are used to explore the relationship between two categorical variables; for instance, the relationship between car ownership status and sector of employment of household head. The variables for the test are normal or ordinal scales. The results are the levels of significance associate with the Pearson chi-square. This value, that is the probability that the results were produced by random chance, can vary from 0.0000 to 1.0000. The lower the significance value, the less likely that the results were produced by random chance (Field, 2013). The degree of freedom in chi-square is calculated as  $(r-1) \times (c-1)$ , where  $r$  is the number of rows and  $c$ , the number of columns in the cross tabulation (Denscombe, 2014). According to Denscombe (2014), chi-square is calculated by summing up all the cells and squared residuals divided by the expected frequencies. The chi-square which has been calculated is then compared to the critical points on the chi-square distribution to produce estimate which indicates a probability of whether variables under consideration are independent or not. Such probability is known as the observed level of significance. If the probability is smaller (for instance 0.05 or 0.01) then the variables are independent. The chi-square was adopted in this research to assess the relationship that exist between various household socio-demographic factors.

#### 4.9.3 Mann-Whitney U test

The Mann-Whitney U test is a non-parametric test to assess if there is a difference between the medians of two independent samples. The Mann-Whitney U test is the alternative to the independent sample t-test in the parametric test (Field, 2013). In the field of the behavioural sciences, this test is one of the most commonly used non-parametric statistical test (Kasuya, 2001). The significance of the test depends on the size of the two samples. In this research Mann-Whitney U test the difference in attitude towards car and public transport by both car owners and non-car owners.

#### 4.9.4 Kruskal-Wallis Test

The Kruskal-Wallis Test has its equivalent as ANOVA in the parametric test. This test is a non-parametric test that aims at comparing the medians of two or more independent groups of samples and the test variable assesses in individual cases on at least an ordinal level (Field, 2013). This test is in the research to identify difference in attitude towards car among more than two socio-demographic cohorts.

#### 4.9.4 Principal Component Analysis (PCA)

Principal Component Analysis is one of the major inferential analysis methods considered to be suitable for the analysis of survey data involving attitudinal variables. PCA is a multivariate statistical technique used to compute factors from original variables by deriving linear correlations from combinations of the original variables: the new variables are called principal components (Abdi and Williams, 2010, Jolliffe and Cadima, 2016). A major reason for using PCA is to reduce the number of statements presented in the questionnaire into factors. To this end PCA is used to screen and consolidate the number of original questions in order to define the most effective factors.

The variables included in the PCA comprised of 36 attitudinal statements. These statements were divided into two separate groups as indicated in Table 4.8

**Table 4. 8: Groupings of attitudinal statements to which factor analysis was applied**

Categories	Original Number of Statements
Attitudes towards car ownership	19
Attitudes towards public transport	17

<b>Total</b>	<b>36</b>
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Generally, PCA requires large samples to make the results reliable and meaningful. Tabachnick and Fidell (2007) posits that a sample size of over 300 is recommended in general and Comrey and Lee (2013) indicates that a sample size of 100 is poor, 300 as good size and 1000 as excellent. This research is well within the recommended sample size stated above as the sample used for conducting the PCA is 547.

In designing the questionnaire some statements were negatively worded whilst others were positively worded. This was to break the monotony of respondents so as to increase the reliability of data. An example of a statement which was reverse scored was “people are at risk in their car”. In undertaking the PCA there was the need to reverse some scores in order to make interpretation and reliability analysis easier. This was to ensure uniformity in scores so that a low score of a statement indicates that statement is of low priority.

Aside meeting the recommended sample size there is also the need to check the suitability of the data for PCA. Three approaches were adopted including: correlation matrix, Barlett’s Test of Sphericity (BTS) and Kaiser Meyer Olkin (KMO) test of sampling adequacy. A correlation matrix is created to examine the magnitude of the individual correlation coefficients. In each case all the matrices had a considerable number of correlation coefficient above 0.3 (which is generally recommended level) (Field, 2013). Kaiser-meyer-Olkin Measure of Sampling Adequacy (KMO) (Kaiser, 1970) is a technique used to check for sample adequacy for conducting PCA. The resulting statistic varies between 0 and 1. A value closer to 1 indicates that patterns of correlations are relatively compact and that PCA is appropriate. As a rule of thumb, KMO values greater than 0.5 indicate sampling adequacy for PCA. Hutcheson and Sofroniou (1999) provides appropriate description of each value from 0 to 1 indicating the strength of the value. Barlett’s Test of Sphericity test for the presence of correlation among the variables and the null hypothesis that all the correlations in the analysis are independent (Field, 2013). The result of the BTS should be significant at ( $p < 0.05$ ) (Tabachnick and Fidell, 2007).

A further step for factor analysis is to check whether a variable might relate to more than one factor using rotation. Rotation produces a more interpretable solution by minimising low item

loadings and maximising high item loadings. There are several options for this step; for example Orthogonal Varimax is the most common technique with uncorrelated factors, while Oblique is the most common technique with correlated factors (Field, 2013). In this research varimax rotation was used. Varimax rotation maximises the variance of loadings within factors across variables so that original items relate to one factor alone.

Another step in the PCA process is the determination of choice of number of factors to extract from the set of data. In this research two methods were adopted. The methods adopted were Kaiser's criteria (Eigenvalue) and the Scree test which graphs the eigenvalues to visually depict their relative importance. Both methods are available in SPSS. Kaiser's criterion is based on the idea that the eigenvalues represent the amount of variation explained by a component. Using this criterion, components/factors with eigenvalues greater than 1 are retained.

After the determination of factors comes the checking of the nature of each factors which is inferred from the variables that load mostly on it. To be sure, the research made sure all items loaded on only one factor. The threshold for the factor loading was set at 0.4.

#### **4.9.4.1 Reliability Analysis of PCA results**

After undertaking the PCA, the research resorts to performing reliability analysis of the results in order to arrive at the final results. The reliability analysis was done using Cronbach's Alpha (Cronbach, 1951). The reliability analysis is also a form of undertaking elimination of variables. The Cronbach's Alpha helps to identify the internal consistency of various factors obtained during the PCA. The Alpha coefficient range from 0 to 1 and the closer it is to 1 the greater the consistency with the statements within the factor. In this research any factor with an Alpha of less than 0.4 was dropped.

#### **4.10 Car Ownership Modelling**

Section 2.3.3 set out the two competing approaches for modelling car ownership decisions. Whilst dynamic car ownership modelling is preferable to understand ownership decisions in transitions, the practical limitations of the PhD mean that it was only possible to deliver a one-shot cross sectional survey. The approach adopted to building a car ownership model will therefore be a static model.

This section considers the models that were used in identifying the role of various sociodemographic, built environment and attitudinal factors in understanding car ownership in Accra. The car ownership decision is modelled at the household level. Car ownership has mostly been modelled using unordered response mechanism based on the principles of utility maximisation (See Section 2.3.3). The Multinomial Logit (MNL) and the Nested Logit (NL) models are two of such model structures that are adopted in this study. These two models have been widely used because of their ease of analysis and computation using software that is easily accessed (Vovsha, 1997).

#### 4.10.1 Multinomial Logit Model (MNL)

The data collected during the study was analysed using MNL model to identify the relationship between car ownership and factors like household sociodemographic factors, built environment attributes and attitudes towards car and public transport. MNL assumes that each individual will choose the alternative within the choice set with the highest utility value. For the household car ownership, let  $U_{nj}$  be the utility of the household  $n$  choosing alternative  $j$ , where  $j=0$  for having no license, license and no car, owing one car and owning 2 or more cars. A linear form of the utility function is assumed with a deterministic component a random component,

$$U_{nj} = V_{nj} + \varepsilon_{nj} \quad \dots\dots\dots \text{(Equation 4.1)}$$

and  $V_{nj} = a_j + \beta x_{nj} \dots\dots\dots \text{(Equation 4.2)}$

Where  $x_{nj}$  is the vector of explanatory variables of household  $n$ ,  $a_j$  and  $\beta_{nj}$  are the parameter vectors to be estimated, and  $\varepsilon_{nj}$  is the random variable in the utility which is not observable. The probability that the household  $n$  chooses alternative  $i$  is given by

$$P_{ni} = P_r (U_{ni} > U_{nj}, \forall j \neq i) \dots\dots\dots \text{(Equation 4.3)}$$

The MNL assumes that the random variable  $\varepsilon_{nj}$  are independently and identically distributed and follows a Gumbel distribution such that

$$P_{ni} = \frac{\exp(V_{ni})}{\sum_j \exp(V_{nj})} \dots\dots\dots \text{(Equation 4.4)}$$

The discrete-choice model is estimated by the maximum –likelihood approach and the software R (CMC, 2017) is used for the estimation purpose

#### 4.10.2 Nested Logit

A nested logit model is appropriate when the set of alternatives faced by a decision maker (in this research to own or not to own a car) can be portioned into subsets called nests (Train, 2009). The MNL is criticised for its property of Independence of Irrelevant Alternative (IIA) which restricts the ratio of the choice probabilities for any alternatives to be independent of the existence and characteristics of other alternatives in the choice set. The NL on the other hand assumes that some of the alternatives been considered to share common components in their random error terms (Koppelman and Bhat, 2006). The conditions of independence from IIA which state that the probability of selecting of two alternatives is independent of the choice set, hold within a nest and not from one nest to another (Koppelman and Bhat, 2006). The NL therefore has become an attractive since it relaxes the strong assumption of the MNL and can also be said to be computationally straightforward and fast as compared to the other models like the mixed logit (Heiss, 2002). With respect to the nested logit model, the researcher specifies a structure that partitions the alternatives into groups (nest).

With respect to the derivation of the nested logit model equation, assume that the utility of household  $n$  obtains from alternative  $j$  in nest  $B_k$  is denoted as

$$U_{nj} = V_{nj} + \varepsilon_{nj} \quad \dots\dots\dots \text{(Equation 4.5)}$$

Where  $V_{nj}$  is observed by the researcher and  $\varepsilon_{nj}$  is a random variable whose value is not observed by the researcher. Based on the principle of the utility maximisation, the nested logit model is obtained by assuming that the random term of the utility expression (i.e  $\varepsilon_n = (\varepsilon_{n1}, \dots, \varepsilon_{nj})$ ) is cumulatively distributed as indicated in equation 4.6

$$\exp\left(\sum_{k=1}^K \left(\sum_{j \in B_k} e^{-\varepsilon_{nj} / \lambda_k}\right) \lambda_k\right) \dots\dots\dots \text{(Equation 4.6)}$$

The distribution is a type of the Generalized Extreme Value (GEV) distribution. It is the generalization of the distribution that gives rise to the logit model (Train, 2009). With respect to the nested logit, the marginal distribution of each  $\varepsilon_{nj}$  is univariate extreme value. For

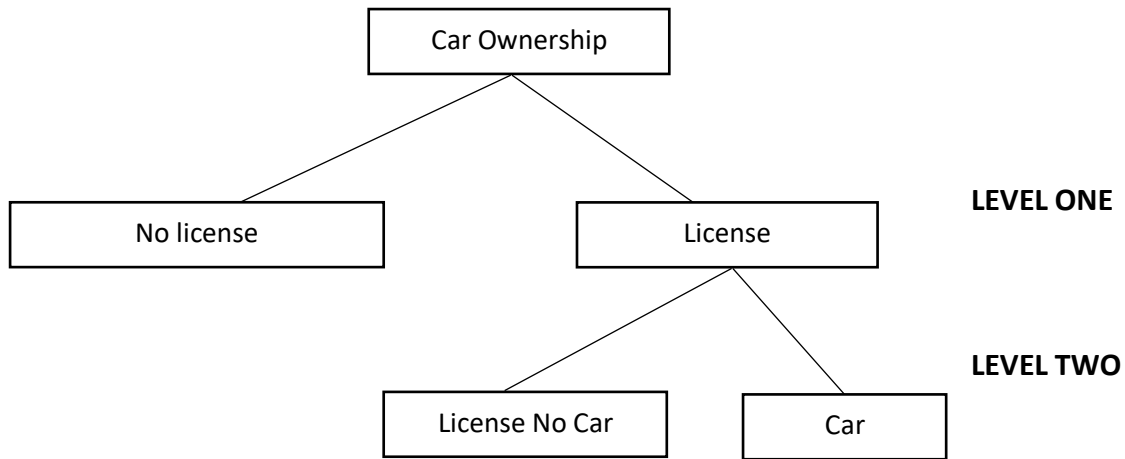
instance for any two options of  $j$  and  $m$  in nest  $B_k$ ,  $\varepsilon_{nj}$  is correlated with  $\varepsilon_{nm}$ . The parameter  $\lambda_k$  is a measure of the degree of independence in the unobserved utility among the alternatives in nest  $k$ . The higher the value of  $\lambda_k$  means less correlation and greater independence. A value of  $\lambda_k = 1$  shows complete independence within nest  $k$  indicating that there is no correlation, in this case the nested logit model reduces to the standard logit model.

The distribution for the unobserved components of the utility gives rise to the choice probability for alternative  $i \in B_k$  :

$$P_{ni} = \frac{e^{V_{ni}/\lambda_k} \left( \sum_{j \in B_k} e^{V_{nj}/\lambda_k} \right)^{\lambda_k - 1}}{\sum_{\phi=1}^K \left( \sum_{j \in B_\phi} e^{V_{nj}/\lambda_\phi} \right)^{\lambda_\phi}} \dots \dots \dots \text{(Equation 4.7)}$$

Equation 4.7 shows that IIA holds within each subset of alternatives but not across subsets. For the nested model to be consistent with utility-maximising behaviour the value of  $\lambda_k$  must be within a particular range (Train, 2009). If  $\lambda_k$  is between zero and one, the model is consistent with utility maximisation for all possible explanatory variables (Koppelman and Bhat, 2006, Train, 2009). If  $\lambda_k$  has a negative value, the model is inconsistent with utility maximisation therefore the nested logit model is rejected. If  $\lambda_k$  is equal to one it implies there exist zero correlation among alternatives pairs in the nest so the nested logit model collapses to the MNL model. If  $\lambda_k$  is equal to 0 it implies there exist a perfect correlation between pairs of alternatives in the nest. If  $\lambda_k$  is greater than one it implies the model is not consistent with the theoretical derivation and hence the nested logit model is rejected. The nest structures considered in this research are illustrated in Figure 4.1.

The NL model provides an opportunity to formulate household car ownership decision as a choice process among different alternatives using nested logit structure. A large number of nested logit structures can be proposed for any context in which the number of alternatives is not very small. In the case of the three dependent alternatives used in this work, two nest structures were explored. The appropriate nested logit structure was chosen using the nesting parameter estimates which were expected to be between 0 and 1. Figure 4.2 demonstrates such a structure. The objective of the level 1 model is predicting the relative probability of a household owing a license as compared to not owning a license. The level two provides information regarding the relative probability of owning a car with a license or not owning a car with license.



**Figure 4. 2: Nesting Structure for Nested Logit Model**

**4.10.3 Parameter Estimation Method**

The model is estimated using Maximum Likelihood Estimation (MLE). MLE technique is the most common method used for developing car ownership models. This method selects coefficients that make the observed values most likely to have occurred (Kleinbaum and Klein, 2010). The procedure for MLE involves two important steps which are developing a joint probability density function of the observed sample called the likelihood function and estimating parameter values which maximise the likelihood function (Koppelman and Bhat, 2006). The function is expressed as in the equation below (Koppelman and Bhat, 2006)

$$L(\beta) = \prod_{i \in I} \prod_{j \in J} (P_{ij}(\beta))^{\delta_{ij}} \dots\dots\dots \text{(Equation 4.8)}$$

Where  $L(\beta)$  is the likelihood,  $\beta$  is a vector function of the model parameters,  $P_{ij}$  is the probability of alternative  $j$  being chosen by individual  $i$ .  $\delta_{ij} = 1$  if individual  $i$  picks alternative  $j$  and 0 for any other alternative.  $I$  and  $J$  are the total number of individuals and alternatives respectively.

The parameter estimates for which the likelihood function is maximised are found by differentiating the expression and equating the first derivative to zero. Since the log of a function yields the same maximum as the function and is more convenient to differentiate, we maximize the log-likelihood function instead of the likelihood function itself. The expressions for the log-likelihood function are shown in the equation below



$$LL(\beta) = \sum_{\forall i \in I} \sum_{\forall j \in J} \delta_{ij} \times \ln(P_{ij}(\beta)) \dots \dots \dots \text{(Equation 4.9)}$$

Where  $LL(\beta)$  is the log likelihood.

#### 4.11 Chapter Summary

This chapter has set out the overall approach and methodology to empirically examine the household demographic factors, household attitudes towards cars and household attitude towards public transport. This chapter also outlines the rationale for and the methods adopted in undertaking a survey.

The case study design, which allows for comprehensive investigation of a phenomenon within a specific context was chosen as the most appropriate approach to examine car ownership within households in a developing city. Following from this and applying a set of case study selection criteria, the city of Accra in Ghana was presented as the case study area for this research.

A coherent approach to obtain the needed data from the case study was advanced. This involved the identification of the specific study variables from the research questions. The variables were then harnessed through the focus group discussion and then translated into research questionnaire that was used to gather data regarding household demographic attributes, travel characteristics, attitude to car and public transport. The various analytical methods that will be adopted based on the structure and detail of data collected were also elaborated. The methodological practicalities have dictated the choice of a static cross-sectional understanding of car ownership.

The next two chapters following this chapter (i.e. chapter five and six) will present the analysis of the survey data. Chapter five will discuss the survey sample characteristics and travel behaviour. Chapter six based on the discussions in Chapter five will then advance the analysis by undertaking a modelling exercise to identify various variables that are considered to influence car ownership decisions within the context under study.

## **CHAPTER FIVE: SAMPLE CHARACTERISTICS AND TRAVEL BEHAVIOUR**

### **5.1 Introduction**

The use of socio-demographic indicators to systematically explain variations in car ownership is well established in the literature as discussed in Section 2.4 of Chapter Two. Household socio-demographic factors like income, household size and household type among others are seen to have an impact on car ownership status with varying influences based on the context of study. Attitudes have also been seen to be significant in relation to car ownership in various studies reviewed in Section 2.7. To that extent, attitudinal statements gathered based on the literature review and focus group discussion were used as part of the questionnaire. Consequently, this chapter is dedicated to profiling the sample characteristics and travel behaviour. This chapter begins the analysis of the questionnaire data.

The focus of this chapter is to set out the household characteristics and travel behaviour characteristics of the respondents used in this research. Another aspect of the empirical research objective that begins in this chapter is to understand how households view car and public transport through the use of attitudinal statements used in the questionnaire and extend this to establishing meaningful clusters of attitudes which may inform the car ownership models which will be developed in Chapter 6. Comparison is made between the characteristics of the population of Accra and that of the sampled population in order to get better understanding of the social stratum that the vehicle owning population studied belongs to. In addition, the empirical analysis is also compared with what is identified in literature.

### **5.2 Chapter Organization**

Results of the data analysis follow in five interrelated sections. In the first section the household and household head characteristics are discussed. This is followed with the discussion on travel resources of various households which provides information on households' ownership of car, driving license and reasons for owning cars. In the third section, the trip characteristics of households are discussed. This section provides analysis on the frequency of use various modes of transport together with the frequency of various household trips. Accessibility indicators of the households are discussed in section four. With this self-reported travel time to bus routes are discussed and compared to the actual distance

covered by such routes. Finally, attitudes towards car and public transport are discussed. This section discusses differences that exist between households with varied characteristics and the corresponding responses to attitudes towards car and public transport. Chapter four discussed the two main data collection methods which were face to face and drop and collect methods. In undertaking the analysis in this chapter, attempts will be made to identify the distinguishing features with respect to the data gathered by comparing the responses between the two methods. The face to face data collection contributed 87.8% of the total data collected with the drop and collect method contributing 12.2%. Also since the data was collected in ten communities but can primarily be categorised into three residential zones based on income namely: high income, middle income and low income communities, some attempts are made to identify the distinguishing features in these categories of communities in the analysis.

### **5.3 Preliminary Statistics of Household Socio-demographic Factors**

This section provides summary statistics of some of the various household characteristics that are discussed subsequently in this chapter. The aim of the summary statistics is to provide the reader an overview of the various characteristics of the respondents interviewed during the data collection process. Detailed discussion of the various household socio-demographic factors are discussed after this section. The sampling method adopted during the data collection stage resulted in some differences between the sample and that of the population of Accra. In order to improve the number of households with car especially in a low car owning city like Accra, the high income households were oversampled and as a result there exist some difference between the sample and the total population. This was successful as the sampled data reports 27.1% of households owning cars compared to 11.5% of households in Greater Accra Region of which Accra is the capital according to the Second National Household Travel Survey (MOT and GSS, 2013). Households with one car dominate in terms of households with cars which reflect the case in most countries with low car ownership rates (Kermanshah and Ghazi, 2001, Zegras and Hannan, 2012, Gopisetty and Srinivasan, 2013).

Some of the socio-demographic characteristics that indicates difference as result of the sample approach adopted includes the housing characteristics of households, household size,

sector of employment of household head, household car ownership and household income etc. For instance 41.9 percent of households live in a compound house. Although this forms the majority in the sample it is less than that of the city of Accra which indicates that 67.7 percent of households live in a compound house (Ghana Statistical Service, 2014a). The sampled data records 60.3 percent belonging to the informal sector whilst the census data reveals that 74 percent belongs to the informal sector (Ghana Statistical Service, 2014a). In terms of the household monthly income, the surveyed data presents a relatively high figures in terms of groupings as compared to that presented in the Ghana Living Standards Survey 6 by the (Ghana Statistical Service, 2014b) and the (World Bank, 2010) in the City of Accra, Ghana Consultative Citizens' Report Card. Table 5.1 provides a summary statistics of the household socio-demographic factors which are discussed in detail in this chapter.

**Table 5. 1 Summary Statistics of Household Socio-demographic Factors**

Variable	Frequency	Percent
<b><i>Gender of Household Heads</i></b>		
Male	393	71.8
Female	154	28.2
<b><i>Age of Household Heads</i></b>		
18-30	119	21.8
31-45	293	53.6
46-60	123	22.5
61 and older	12	2.2
<b><i>Household Size</i></b>		
1	62	11.3
2	92	16.8
3	118	21.6
4	149	27.2
5 or more	126	23.0
<b><i>Type of Household</i></b>		
Single Person	62	11.3
Single with Children	117	21.4
Couple only	52	9.5
Couple with Children	261	47.7
Others	55	10.1
<b><i>Educational level of Head of Household</i></b>		
Basic	170	31.1
Secondary	188	34.4

Tertiary	189	34.6
<b><i>Sector of Employment of Household Heads</i></b>		
Public Sector	81	14.8
Private Formal	136	24.9
Private Informal	330	60.3
<b><i>Household Heads with Driving License</i></b>		
With Driving License	222	40.6
Without Driving License	325	59.4
<b><i>Car Ownership Status of Households</i></b>		
Non-owning	399	72.9
Owning	148	27.1
<b><i>Number of Cars owned by Households</i></b>		
0	399	72.9
1	92	16.8
2 or more	56	10.2
<b><i>Monthly Household Income</i></b>		
less than 1000cedis	228	41.7
1000-2000cedis	136	24.9
2001-3000cedis	50	9.1
3001-4000cedis	39	7.1
4001-5000cedis	37	6.8
5001-6000	45	8.2
Don't want to disclose	12	2.2
<b><i>Dwelling Type</i></b>		
Detached	120	21.9
Semi-detached	52	9.5
Apartment/flat	146	26.7
Compound house	229	41.9

Source: Field Survey, 2017

## 5.4 Household and Household Head Characteristics

### 5.4.1 Gender and Age Profile of Household Head

The sample indicates a male dominance as household heads of 71.8% this is similar to the 63.7% of households in Accra being household heads (Ghana Statistical Service, 2014a). This

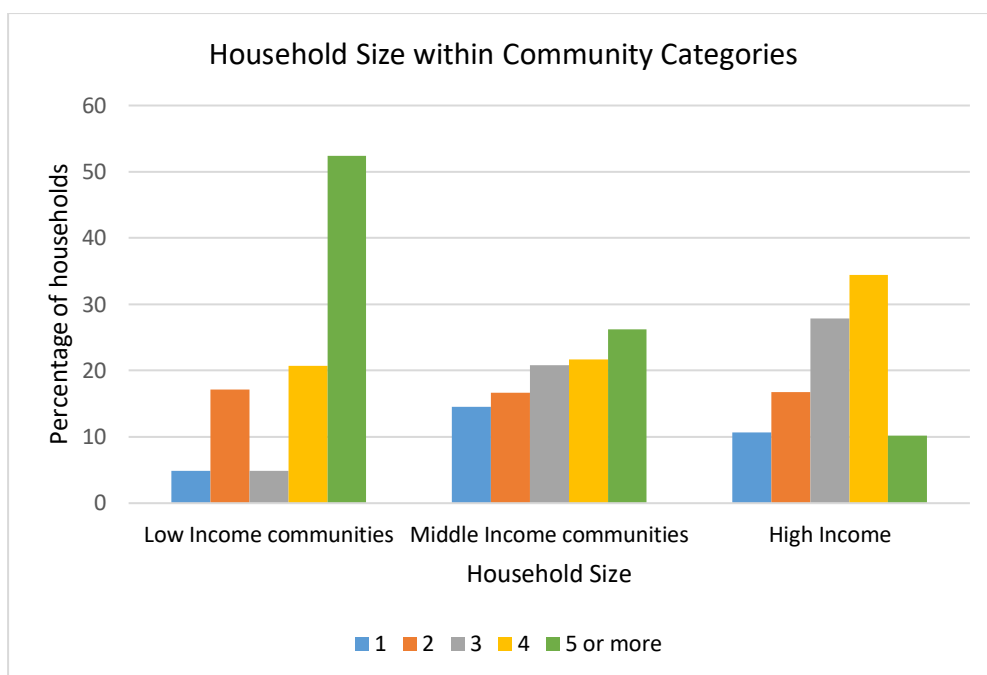
is expected because within the Ghanaian cultural settings, males are heads of households not females. A female may become a head of household under the following circumstances: when she is not married or when she is widowed, divorced or separated or where her husband has migrated (Tanle, 2010). The respondents were predominantly middle age with 57.2% between the ages of 35 and 54. In comparison with the 2010 population and housing census conducted in Accra the older age group (55+) may be slightly under-represented in this sample (7.5% vs 12.6%) although they appear in sufficient numbers for this analysis. However the dominance of middle age (35-54 years) household head is in consonance with the national population.

#### **5.4.2 Household Size and Household Structure**

The average household size of the sampled population is 3.4 which is lower than that of Accra which is 3.7. This is attributed to the over sampling of the high income household where the average household size is mostly low as compared to other households of different income bracket in Ghanaian homes. This is indicated in Figure 5.1 which shows the number of household members within the three residential categories used for the data collection. Figure 5.1 shows that the higher the household size the lower income of the household.

With respect to the household type, the dominant type was couples with children comprising 47.7% of the respondents. There are 73.3% of households with children from different household types. Of these, the majority of the households had two children (27.8%) with the minority of households (6.6%) having four or more children.

With respect to the various communities, 60.9% of households in low income communities have three or more children, 33.1% of households in middle income communities have three or more children and 16.0% of households in high income communities have three or more children.



**Figure 5. 1: Household Size within Residential Categories**

#### 5.4.3 Sector of Employment and Education Level of Household Head

With respect to the sectors of employment the sampled data records 56.9 percent belonging to the informal sector<sup>5</sup> whilst the census data reveals that 74 percent belongs to the informal sector (Ghana Statistical Service, 2014a). The informal sector in both cases (i.e. sampled data and Accra) are followed by the private formal and the public sector. The reduction in percentage recorded for the sampled population as compared to the figure for Accra is because the majority of households earning more than 3000 cedis monthly work in the private formal sector with some working in the public sector. Baah (2007) and Tanle and Awusabo-Asare (2007) also find that there exists a relationship between income generated and the sector of economy that one is employed in Ghana. Households employed in the private informal sector have a high tendency of getting lower incomes as compared to those in the private formal sector and it would therefore be expected they would be under-represented giving the sampling approach adopted

<sup>5</sup> Informal sector is any economic activity unrecorded in the official statistics such as the gross domestic product. In case of Accra informal activities include mainly trading, retailing among others. See FARRELL, G., ROMAN, J. & FLEMING, M. H. 2000. The Shadow Economy. *Journal of International Affairs*, 53, 387.

In terms of the levels of educational attainment of household heads, the analysis found that 31.1% of households had basic education with 34.4% having secondary education whilst 34.6% had tertiary education. Using qualification as a proxy of skill levels, it can be inferred that most of the household heads had low to intermediate levels of skill. This can be seen in Table 5.2 in which most of the household heads with basic education are identified to be working in the informal sector.

**Table 5. 2: Comparison of Educational level and Sector of Employment of Household head**

Educational level	Sector of Employment			Total (%)
	Public Sector (%)	Private Formal (%)	Private informal (%)	
Basic	0	1.8	98.2	100
Secondary	3.2	28.2	68.6	100
Tertiary	34.9	57.1	8	100

#### 5.4.4 Housing Characteristics of Household

Four types of dwellings were identified in the Accra metropolis from the survey data. 44.4% of the households live in a compound house<sup>6</sup>. Compound house also is the majority in the city of Accra according to the 2010 census report but with a higher percent of 67.7% (Ghana Statistical Service, 2014a).

The compound house remains the dominant form among the low and middle income communities as indicated in Table 5.3. However, the proportion of detached houses forms the majority in the high income communities. Again, the difference between the sample and Accra as a whole is in line with expectations from the sampling strategy.

Besides the type of dwelling type, the survey also asked households to indicate their tenure arrangement for their dwelling. Figure 5.6A indicates that 77.3% of households rent their dwelling place. Whereas 18.5% were owner occupied, 4.2% were rent free. Figure 5.6A and 5.6B indicates that renting is the main house tenure type patronised by the respondents in the survey.

<sup>6</sup> A compound house is mostly a one storey structure, consisting of a series of single rooms surrounding a square courtyard SINAI, I. 2001. Moving or improving: housing adjustment choice in Kumasi, Ghana. *Housing Studies*, 16, 97-114.



**Table 5. 3: House tenure Characteristics**

Type of Community	Dwelling Type				Total (%)
	Detached (%)	Semi-detached (%)	Apartment/flat (%)	Compound house	
Low income	4.8	7.3	15.8	71.9	100
Middle income	9.9	9.9	28.9	51.3	100
High Income	52.4	9.8	28.2	23.3	100

#### 5.4.5 Income of households

The households interviewed were also differentiated on income levels. Out of 547 households, income data was obtained for 535 of them representing 97.8% of all households surveyed. On average the households interviewed had 2 adult working members. Total household income was taken as the sum of reported monthly earnings of all working members within the household aged 18 years and above.

Households were categorized into different groups based on their earnings. Pre-existing data on income categories to which the survey data could be cross-checked does not exist in Ghana. Instead, there exist a national absolute poverty line of GH¢1,314.00 per annum or GH¢ 109 per month (Ghana Statistical Service, 2014b). Based on the information provided above and coupled with the survey sample being concentrated in middle to high income communities, the research provided monthly income groupings for respondents in the thousands (i.e. less than GH¢ 1000, 1000-2000, 2000-3000 etc.). The seven categories nominal scale used in the study is shown in Figure 5.7. Though this approach imposes the assumption of linearity between the categories, this scale is preferred because of household difficulty in being very accurate about income. Gough et al. (2003) in undertaking studies in Accra and Pretoria indicates that reporting of household income is marred with a number of complexities like unwillingness to give exact income figures. Hence banding is an easier response option for respondents since it affords respondents the opportunity not to state exact income of households but indicate the category of income. Table 5.1 shows the frequency of the various income groupings and shows the dominance of monthly household income of less than GH¢1000 for 41.7% of the respondents.

## 5.5 Travel Resources

### 5.5.1 Driving license

The sample indicates a high incidence of driving license ownership among households as compared to car ownership. For instance whilst 40.6% of households interviewed had at least one person having a driving license, only 27.1 % of household owned a car. As would be expected, there is a positive relationship between car ownership and driving license holding (See also Bhat and Pulugurta (1998), Ryan and Han (1999), Potoglou and Kanaroglou (2008) ). With respect to the relationship between the gender of household head and holding a driving license, the survey indicates that men are more likely to hold a license (44%) than women (31.8%). This could be due to a multiplicity of factors with socio-cultural circumstance being also a factor.

The survey data indicates that 81.5% of households without car do not have license. The researcher sought to identify the reason for not owning license among those who do not own cars. At the same time the researcher sought to identify the reason for not owning a car among households with a license. This is presented in Table 5.4 and Table 5.5.

**Table 5. 4: Reason for not holding a driver's license**

Statements	Frequency	Percentage
I cannot afford to buy a car	178	52.1%
I don't like driving	13	3.8%
I prefer PT	33	9.7%
Because of environmental reasons	14	4.1%
I cannot afford a driving school	95	27.7%
Owning a car is too much hassle	9	2.6%
Total	342	100

**Table 5. 5 Reason for not owning a car but have license**

Q12	Frequency	Percentage
I cannot afford to buy a car	57	47.1%
I cannot afford to run a car	15	12.3%
I prefer PT	11	9.0%
Have access to other car	30	24.7%
Because of environmental reasons	5	4.4%
Owning a car is too much hassle	3	2.5%
Total	121	100

Table 5.4 indicates that the dominant stated reason for households not having driving license are financial reasons which is presented by households not been able to buy and run and car. The tables indicate that whilst some people express a preference for public transport among those who do not have a car it does not contribute a major reason for not having a license with less than 10% indicating their preference for it. These findings could be potentially important for understanding car ownership decisions, as there appears to be a group who have a license but do not have the means to own a vehicle. Of particular mention is that 24.7% of participants indicated that they have license as a result of access to other cars which are not their own. Understanding the different attitudes and behaviours of this group to both those who own cars and have a license and those who do not own cars and do not have a license may shed some insights on the transition from non-ownership to ownership.

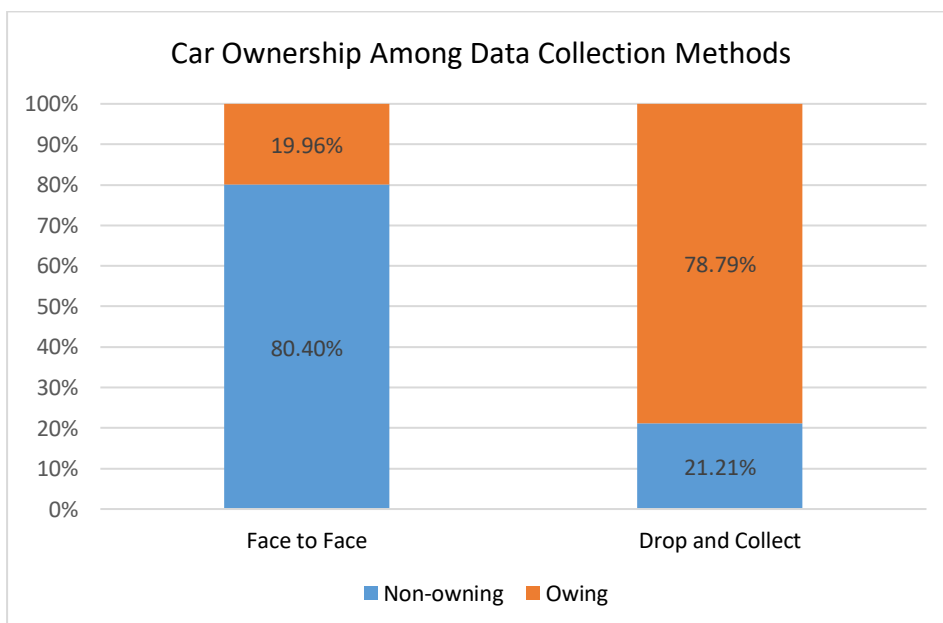
### 5.5.2 Car Ownership

With respect to the car ownership in Accra, the sampled data reports 27.1 percent of households owning cars. Households with one car dominate (62.1%) in terms of households with cars which reflect the case in most countries with low car ownership rates (Kermanshah and Ghazi, 2001, Zegras and Hannan, 2012, Gopisetty and Srinivasan, 2013). Table 5.6 indicates the number of cars owned by a household. In addition to this Table 5.6 indicates additional categorisation of car ownership and license holding within the households. This provides a platform to differentiate households without a car who have license and those who do not. Because the number of households with more than two cars is relatively small, for modelling purposes the decision was taken to model 0,1 or 2+ as the options as otherwise the samples would be too small to distinguish differences between.

**Table 5. 6: Number of cars and license in a household**

Number of License holders per household	Car ownership status		
	No car (%)	One car (%)	Two or more cars (%)
0	324 (81.2%)	0 (0%)	0 (0%)
1	74 (18.5%)	63 (68.4%)	4 (7.1%)
2 or more	1 (0.3%)	29 (31.6%)	52 (92.9%)
Total	399 (100%)	92 (100%)	56 (100%)

Another aspect of car ownership that is of interest in this research is the number of households that own car based on the survey return method. As discussed in Section 4.6.1, two main methods of data collection was adopted in this research that is the face to face and the drop and collect method. Figure 5.2 indicates the contribution of each data collection method to the car ownership of the households sampled. It can be observed that majority of car owning households were obtained using the drop and collect method as compared to the face to face method. Most of the households (87.8%) that answered question based on drop and collect methods are also identified to be located in high income communities. This method was opted for by most households in the high income communities for number of reasons including: lack of time by these households to engage in time of visitation and greater literacy to understand and answer.

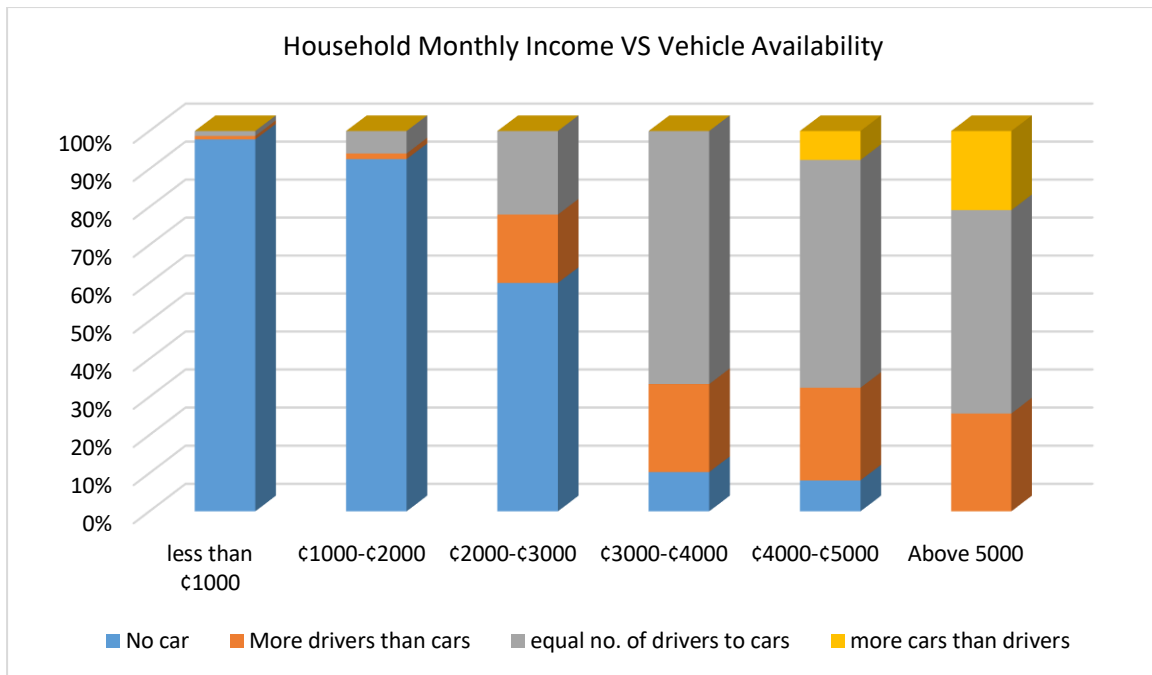
**Figure 5. 2: Car Ownership among Data Collection Methods**

With differing availability of cars in households as against the number of drivers (i.e. the number of license holders), the researcher sought to identify the degree of availability of car per car driver. An Index of Vehicle Availability (VAI) (Stradling et al., 1999) was constructed by dividing the number of cars per household by drivers per household for each respondent. VAI provides an indication for the access each driver in the household has to a car. For majority of the car-owning households there was one vehicle per driver (64.9%) with 29.1% of car owning households having less than one car per driver and 6% having more than one car per driver. The lowest ratio obtained was 0.3 indicating 1 car between 3 people within a household.

The number of cars owned by a household is significantly related to a number of socio-demographic factors. The various socio-demographic factors assessed to identify the car availability include household type, residential location, sector of employment of household head, household size and monthly income of household. Table 5.7 show the relationship between household socio-demographic variables and car availability. It can be realised that the lowest VAI is seen in low income communities with the index being 0.14 indicating that high come communities are more likely to own a car than other communities. In addition, couples without children and single persons are more likely to own a car than couple with children and single person with children based on the VAI indicated in Table 5.7.

**Table 5. 7: Relationship between household socio-demographic variables and car availability**

Household Variable	Mean VAI	% Households without a car	Chi-Square $\chi^2$ (df) p-value
<b>Household Type</b>			$\chi^2 = 26.74$ p= 0.00
Single Person	0.77	82.3%	
Single with Children	0.53	87.2%	
Couple Only	0.84	59.6%	
Couple with Children	0.67	65.9%	
Others	0.66	78.2%	
<b>Residential Location</b>			$\chi^2 = 103.51$ , p=0.00
Low income communities	0.14	96.3%	
Middle income communities	0.39	87.8%	
High income communities	0.81	51.6%	
<b>Sector of Employment of Household head</b>			$\chi^2 = 93.23$ p= 0.00
Public Sector	0.70	58.3%	
Private Formal	0.82	49.4%	
Private Informal	0.43	88.7%	



**Figure 5. 3: Household Monthly Income VS Vehicle Availability**

As shown in Section 2.4.1, many studies indicate that there exist a positive relationship between car ownership and income (Karlaftis and Golias, 2002, Soltani, 2005, Li et al., 2010). The surveyed data supports such assertion. From Figure 5.3 it can be realized that there exist a direct relationship between number of cars available to a household and the household income. With respect to the residential location of a household, Table 5.7 indicates that households living in high income communities have the highest VAI mean (0.9). With respect to the household type, the availability of children does not increase the availability of cars in the house.

### 5.5.3 Desire to Own

With respect to the non-car owning households, 97.7 percent indicated the desire to own a car in the next ten years. According to Table 5.8 instrumental factors like helping in the movement of family and ease journey to work dominates the reason given by non-car owning households, relative to the symbolic and affective factors. Table 5.8 represents multiple responses for desire to own a car capturing all reasons stated by respondents. Using a multiple response set form of questioning households were asked to tick the number of options that apply to them.

**Table 5. 8: Desire to Own a Car**

Reason	Number of response	Percent
To help in the movement of the family	190	22.7%
To ease journey to work	220	26.3%
I would love to drive	98	11.7%
it is safer to get around by car than by PT	65	7.7%
Owning a car is something to aspire to	167	20.0%
I believe I would be happier with a car	95	11.3%
Total	835	100%

Source: Field Survey, 2017 N=383 (Non Car owners only)

#### 5.5.4 Reason for owning a car

With 27.1 percent (N= 148) of the surveyed households having a car, the reason for owning a car was asked in order to broaden our understanding of why people will own cars. Using a multiple response set form of questioning households were asked to tick the number of options that apply to them. Based on Table 5.9 it can be observed that the major reasons for owning cars are to ease the journey to work and to help in the movement of families. One similarity between desire to own and reason for owning is the dominance of the instrumental use of the car in the city of Accra. This suggest that living in the city without a good means of travelling is difficult to cope with.

**Table 5. 9: Reason for Owning a Car**

Reason	Number of response	Percent
Can afford it	74	18.4%
To help in movement of the family	85	21.1%
Ease Journey to work	96	23.8%
It is safer to get around by car than by public transport	31	7.7%
I believe I am happier with a car	18	4.4%
Owning a car is something people aspire to	63	15.6%
I love driving	35	8.7%
Total	402	100%

Source: Field Survey, 2017 N=148 (Car owners only)

### 5.5.5 Car Age

Respondents were asked to state the condition of their cars when purchased (whether new or second hand). Out of the 148 households that owned cars, 93.2% indicated that their cars were purchased in a used state or second hand. In addition, the research sought to identify the age of the respondents' cars when purchased that are being used as indicated in Table 5.10. This may be an important source of difference between car ownership decisions in Accra and more developed economies. Even the more affluent in society are likely to be buying second hand vehicles, some very old indeed. Whilst cars may still confer some status on owners it will be within a quite a different purchase context.

**Table 5. 10: Age of Cars when purchased**

Age of Car	Sample	Percentage
Less than 3 years	20	13.7%
Between 3-10 years	47	31.9%
Above 10years	80	54.4%

### 5.5.6 Access to other cars

Respondents were asked whether they had access to other cars that were not their own. 7.9% of respondents indicated that they had access to other cars that were not their own. 60.4% of those who had access to other cars were non car owners. The access to other cars consisted of access to drive that particular car. Table 5.11 indicates the sources of cars that households have that do not belong to them.

**Table 5. 11: Access to other cars**

Source of Car	Sample	Percentage
Government Agency	24	55.8%
Private company	14	32.6%
Relatives	5	11.6%
Total	43	100%



## 5.6 Trip Characteristics

### 5.6.1 Frequency of Mode Use by Household Heads

The estimated frequency of mode use for all journeys combined in an average year gives an indication of the mode use by the surveyed household heads. The modes used include Car as driver, Car as passenger, Trotro, Metro Mass, Ayalolo, Taxi, Bicycle, Motorcycle and Walking. In order to provide a clearer picture of the modes adopted there is a separation between car owners and non-car owners. Figure 5.4 indicates the frequency of modes adopted by non-car owning households whilst Figure 5.5 indicates the frequency of modes adopted by car owning households. Figure 5.5 indicates the heavy reliance of household heads with cars for all journey purposes with 90.5% of households using cars for 5 or more times in a week. With respect to non-car owning households, the majority of the trips are made with trotro having 64.7% of households using it for 5 or more times in a week. The other public transport modes which include Metro Mass and Ayalolo are not used frequently by both car and non-car owning households. This finding confirms the report by the World Bank which indicates that operationalisation of high-capacity mass transport in Accra has not made the required impact resulting in less than 0.3% using public buses (World Bank, 2015a).

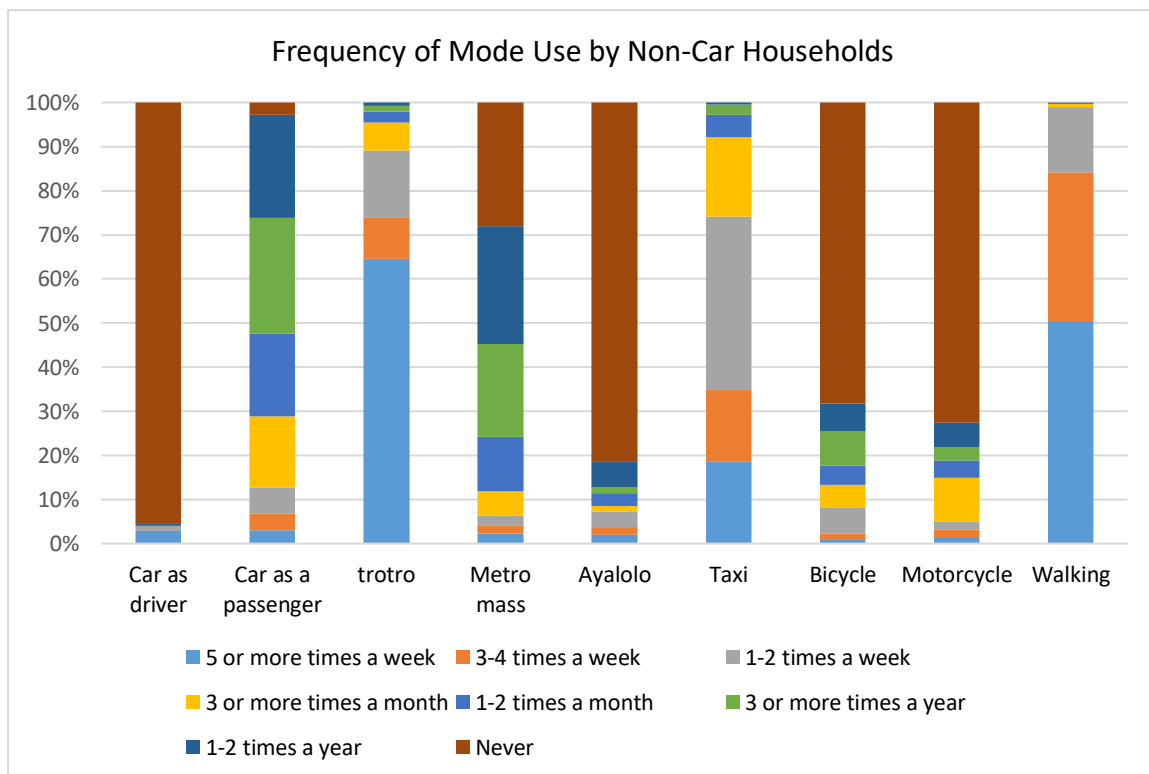
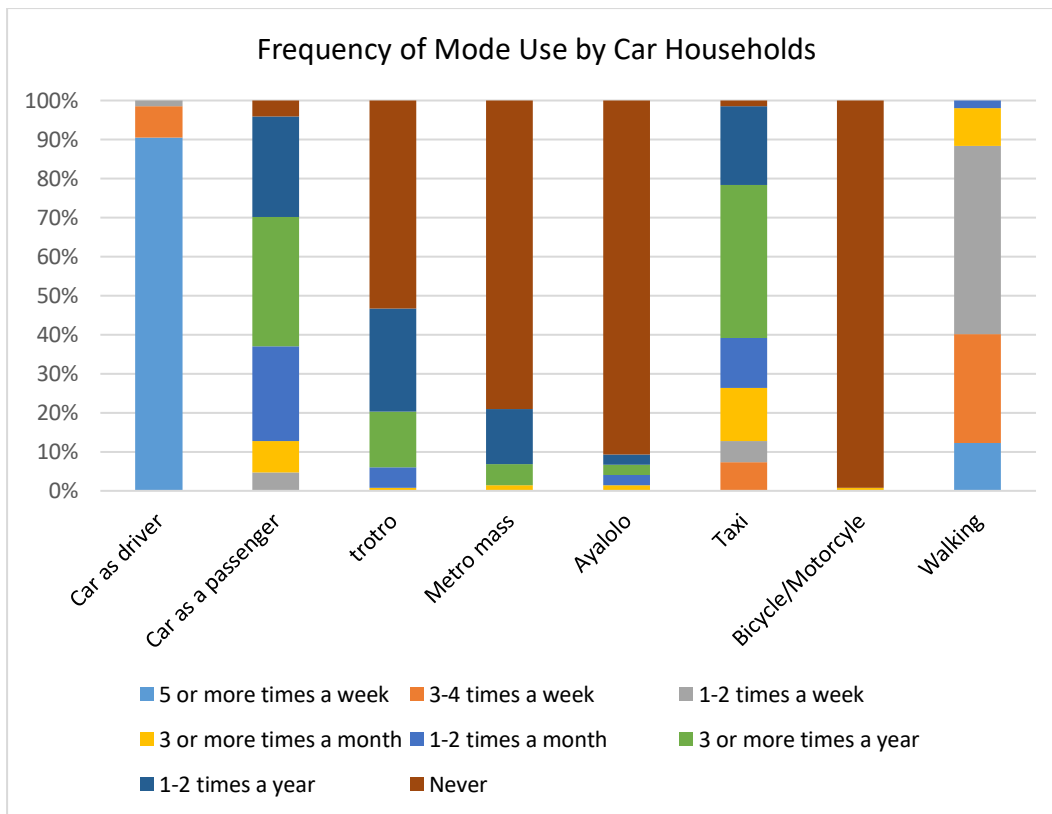


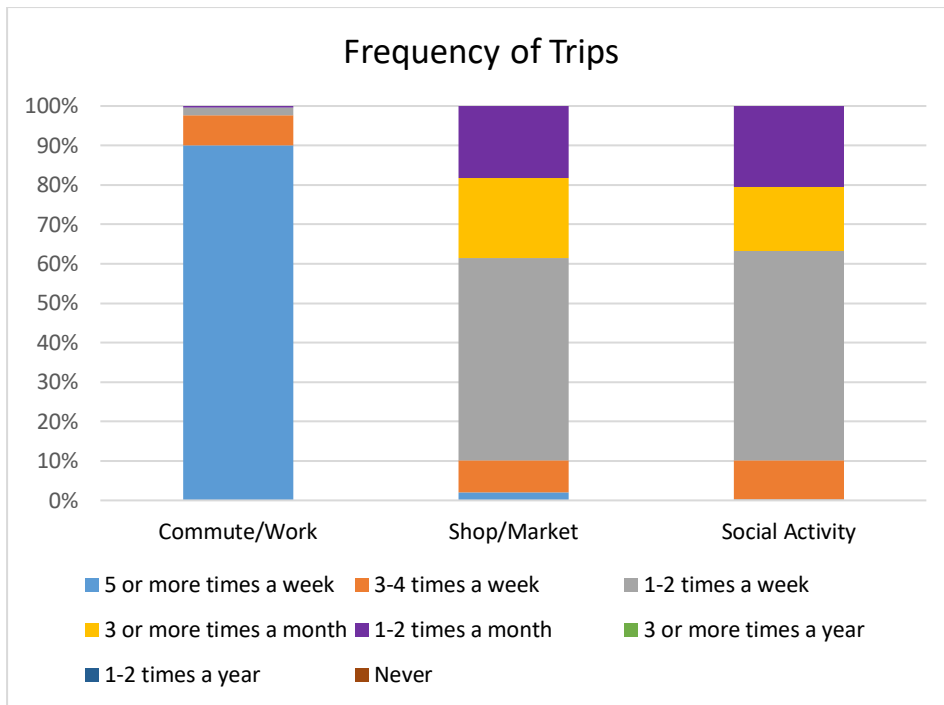
Figure 5. 4: Frequency of Mode Use by Non-Car Owning Households



**Figure 5. 5: Frequency of Mode Use by Car Owning Households**

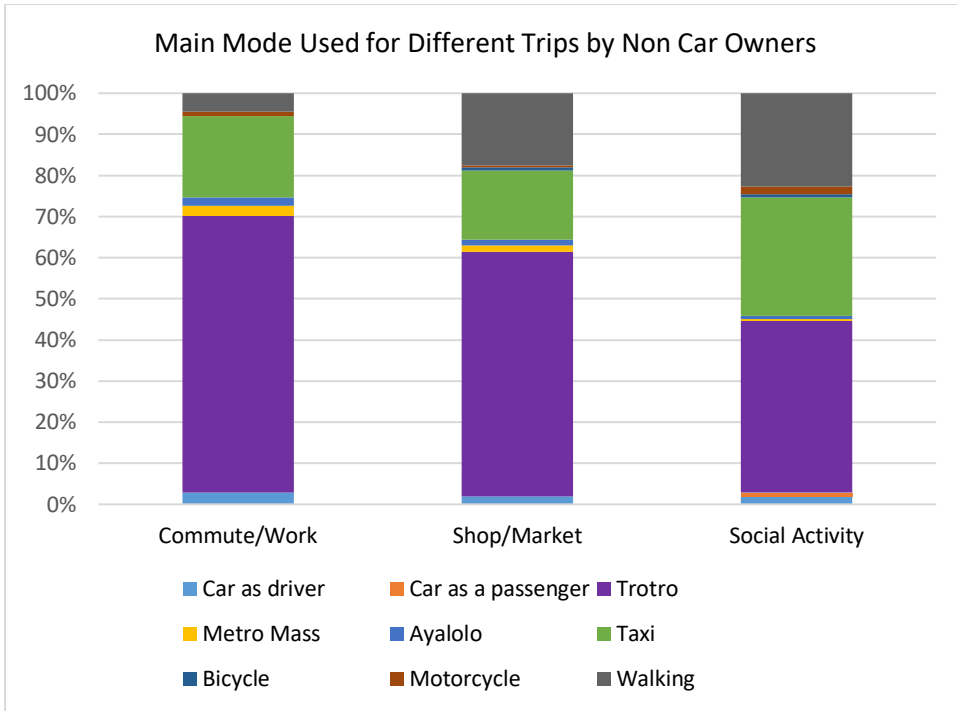
### 5.6.2 Frequency of Trips of Households

Figure 5.6 indicates the frequency of various trip purposes by households. Commuting is identified to have the highest frequency among the various purposes, followed by shopping and other social activities. Social activities that were captured including attending various activities like church, funerals and family gatherings among others. Abane (2011), undertook research in four major cities in Ghana with Accra being one of them identified that the dominant trip purpose is commute which confirms the finding in this research. It might be anticipated therefore, that the convenience of different modes for the commute will be very high importance for the Accra context relative to other places.

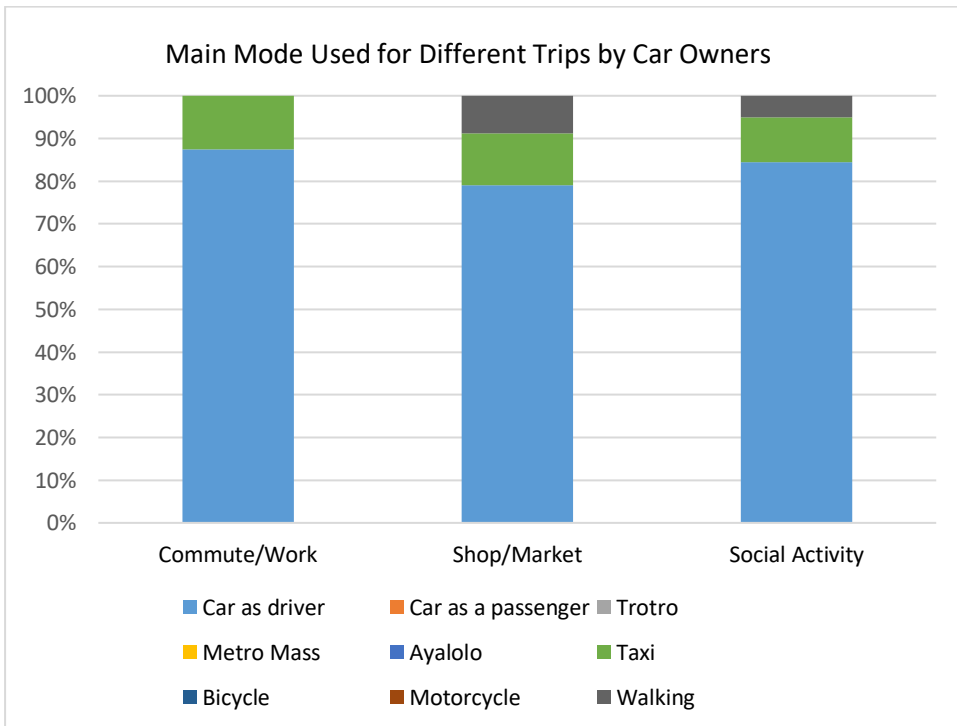


**Figure 5. 6: Frequency of Trips**

Based on the identification of various trips mostly taken, the research sought to identify the modes that are used for these trips. Figure 5.7 indicates the dominance of the use of trotro among non-car owning households. However, there exist non-car owning households (2.8%) who uses car as a means of commuting. Such people consisted of public sector worker and private sector workers who have been given cars as part of their work to enhance their movement (See Table 5.11 above). With respect to car owners, the survey indicates their reliance on their cars for most trips. However, the use of taxis is seen as an alternative for car owners for various trips as well.



**Figure 5. 7: Main Mode Used for Different Trips by Non car owners**



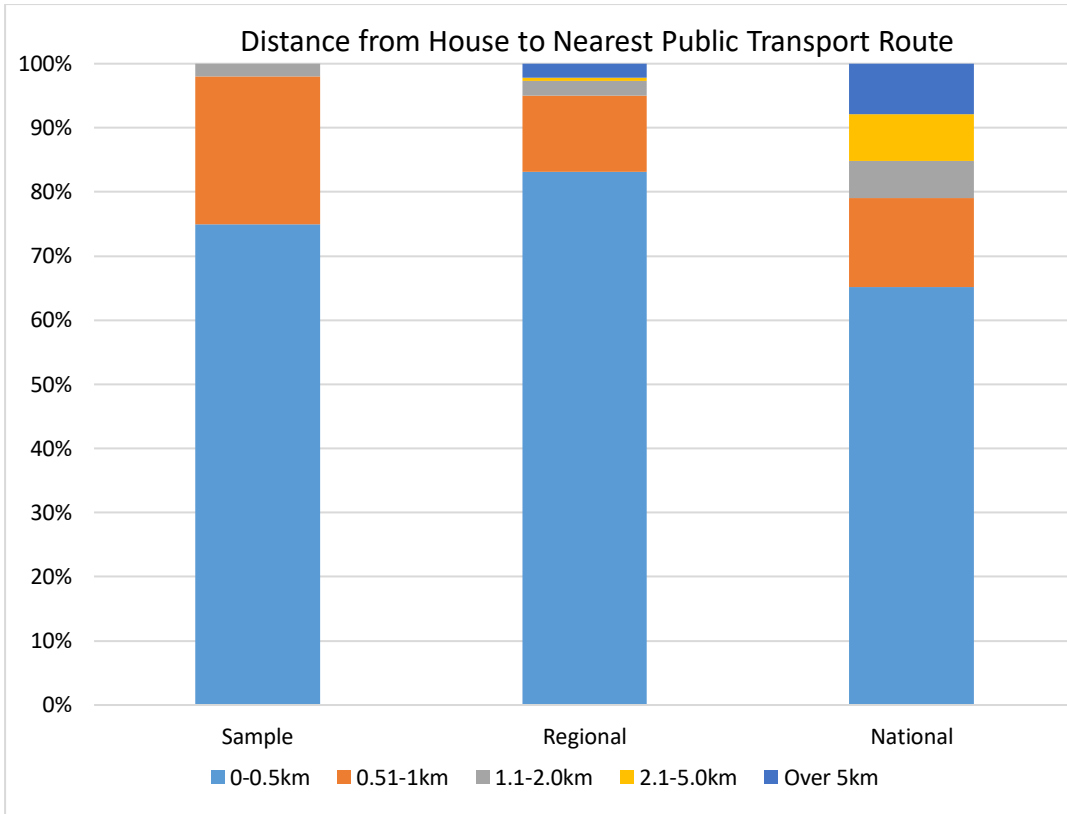
**Figure 5. 8: Main Mode Used for Different Trips by car owners**

## 5.7 Accessibility to Public Transport

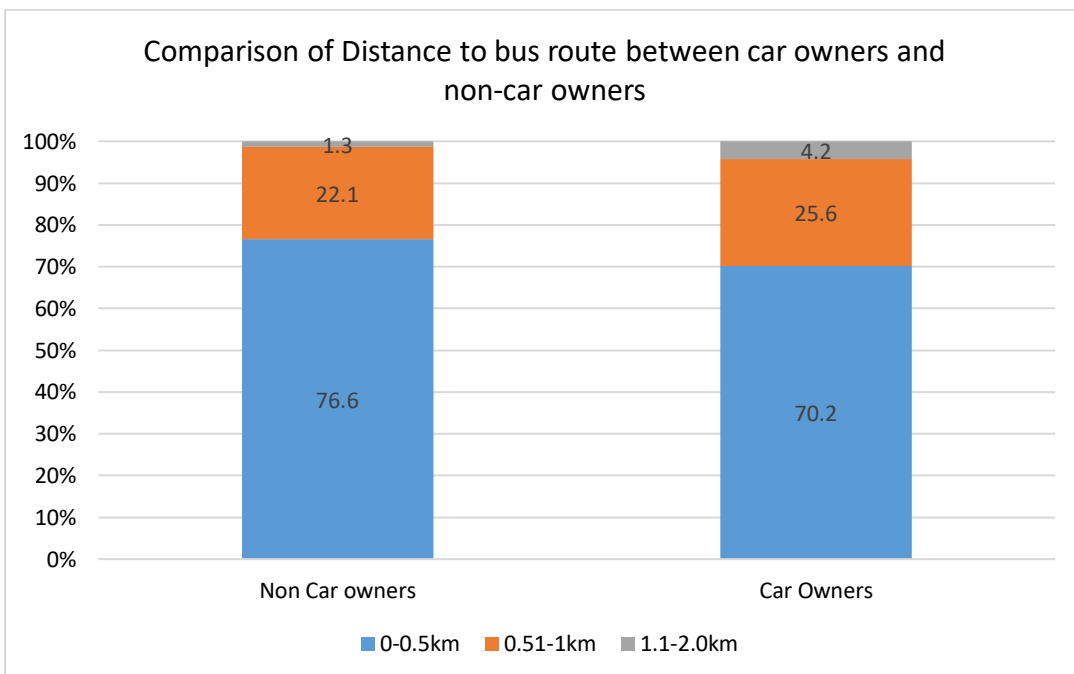
Although there existed difficulty in measuring accessibility to public transport in a city which is dominated by informal transport modes, the research used different options to better represent the context under study. An index of public transport accessibility, which was principally “accessibility to trotro” was created for each household. This is based on questions which asked the time it takes to reach a bus route (walking) and the waiting time at the bus stop. These measures help to capture the accessibility of public transport in a context in which the services are not run based on time-tables as well as having no regular bus stops. Time has been selected as a metric of accessibility based on evidence that it is perhaps more important than distance or cost in choosing travel modes (Frank et al., 2008, Salon, 2009, Mavoa et al., 2012). The researcher adopts the subjective answers the respondents gave with respect to their travel time to bus stop and waiting time. While most studies investigating travel behaviour commonly employ objective travel time data (Gunn, 2000), there also exist other set of researchers who suggest that people base their travel decisions on their perceptions of the world rather than its objective attributes (Grisolía and de Dios Ortuzar, 2010). Also, in practice, subjective travel time are used in situations where it is difficult or even impossible to obtain objective times (Tenenboim and Shiftan, 2018). Even where walk times are possible to estimate from mapping tools, the point at which people wait for a trotro or the typical wait time cannot be known in the Accra context.

This research therefore used subjective responses from respondents. However, in order to understand the likely validity of the responses, the researcher measured the distance from respondents’ houses to the nearest public transport route or boarding point using Google Map application on phones. This exercise was undertaken whilst on location rather than a desk based exercise since it will be difficult to map the exact spot the data collection exercise took place.

Figure 5.9 presents the comparison of average distance from the respondents house to the nearest public transport route between the sample, regional and national data. Majority of households (75.0%) interviewed had distance within 0.5Km from their house to the public transport route. The much greater distances seen in the regional and national figures could be due to the inclusion of rural and urban areas across the country whilst the sample demography is solely within the city of Accra.



**Figure 5. 9: Comparison of distance from house to Public transport route between sample, regional and national.**

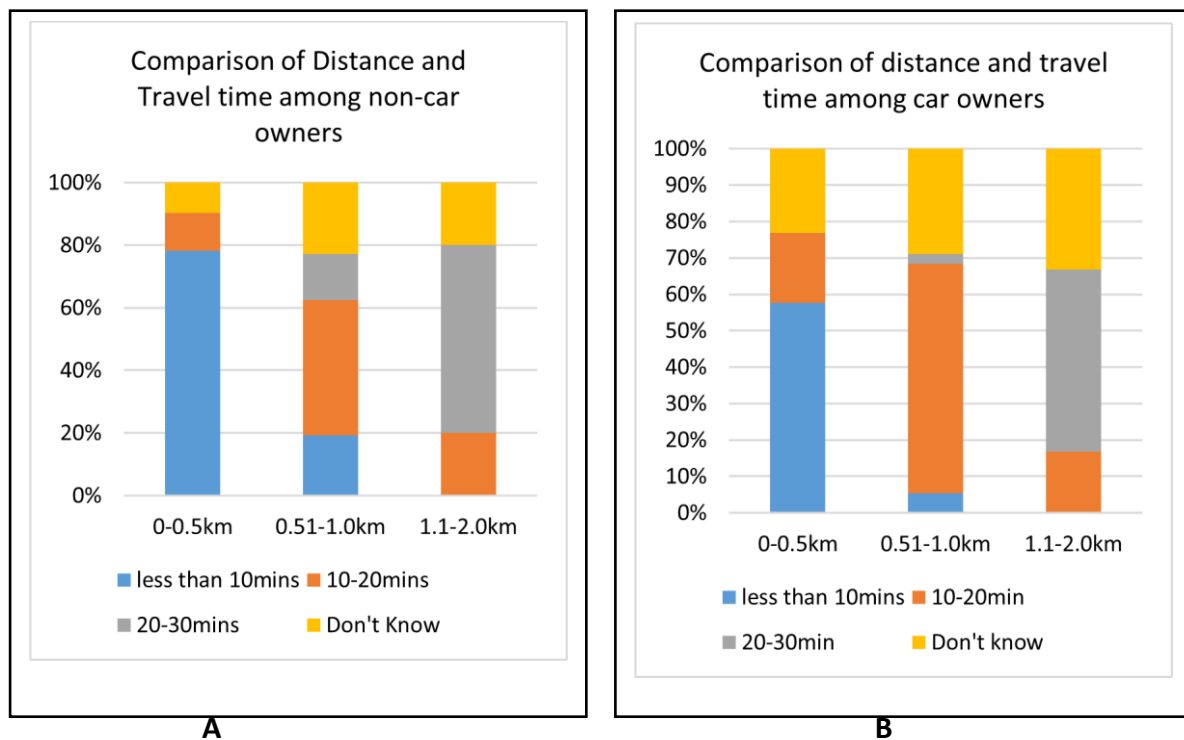


**Figure 5. 10: Comparison of Distance to bus route between car owners and non-car owners**

Figure 5.10 compares the travel distance between car owners and non-car owners using figures obtained from google maps. Figure 5.10 indicates that the distance to bus route between car owners and non-car owners is not significant.

### 5.7.1 Self-Reported Travel time to Bus route

The self-reported travel time and google map distance to bus route is compared between car owners and non-car owners as indicated in Figure 5.11a and 5.11b. One limitation of this measure, however, is finding is the proportion of missing data due to many respondents claiming not to know the travel time to the bus route. This is reported as “do not know”.

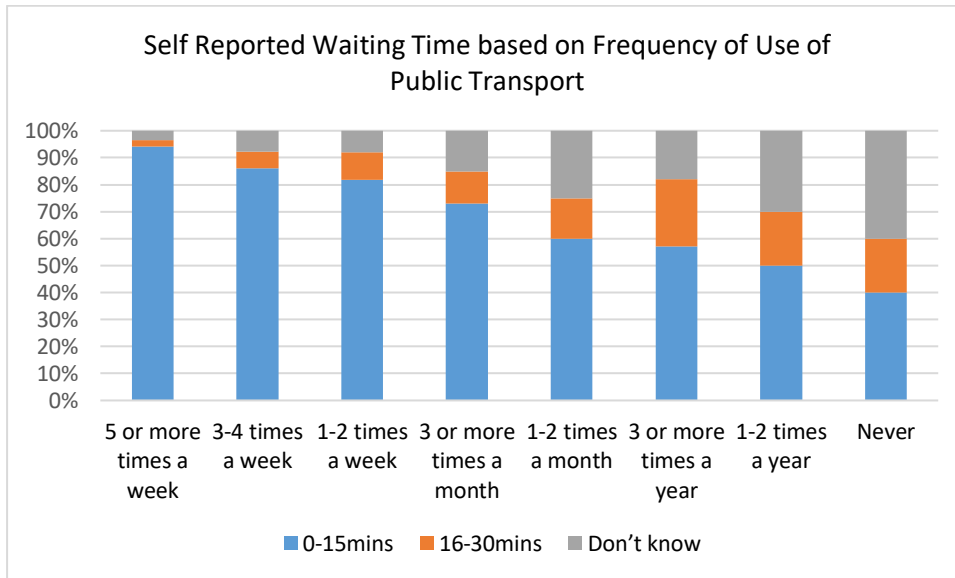


**Figure 5. 11.A-B : Comparison of distance and travel time among car owners and non-car**

From Figure 5.11a and 5.11b, it can be realised though there exist a number of respondents who could not report on the travel time by indicating “do not know”, most of them can be found among the car owners. This can be explained as a result of car owners not been regular user of public transport. Also car owners can be seen to be reporting to take much longer time to travel as compared to non-car owners within the same travel distance. For instance whilst 78.1% of non-car owners report that a distance of 0-0.5km can be travelled in less than 10mins, only 57.6% of respondents with cars report to use similar time for the same distance.

### 5.7.2 Self-Reported Waiting Time

The waiting time of public transport buses as discussed in Chapter three is seen not be regularised. Figure 5.12 provides the reported waiting time for various respondents based on their frequency of use of public transport. The difference of 15 minutes was used in the survey to reflect the same proportions as reported in the national travel survey (MOT and GSS, 2013).



**Figure 5. 12: Self-reported waiting time based on Frequency of use of Public Transport**

The average waiting time reported in the research is seen to be lower than (11 minutes) than the national average of 20minutes. This can be due to the inclusion of rural areas with respect to the national data. However, among the sample surveyed there exists a direct relationship between the frequency of use of public transport service the time reported as waiting time. For instance the more a respondent uses public transport 5 or more times a day the higher the probability of respondent reporting of waiting for less than 15 minutes. The high waiting time reported by respondents who seldom use public transport could be attributed the perception of delay in accessing the service. Also, the reliance on public transport could affect the selection of place of residence of respondents who rely on them hence choosing a location that have high accessibility as compared to those who do not have use them frequently. In addition, most of respondents who seldom use public transport reported on not having an idea of the waiting time for public transport service.



## **5.8 Attitudes towards Car and Public Transport**

### **5.8.1 Difference in attitude towards Car between Car owners and Non-car owners**

The difference in attitudes towards car were tested for both car owners and non-car owners. The Mann-Whitney U Test is used. The attitudinal questions were answered on a 1-7 Likert scale where 1 indicates fully disagree increases to 7 representing fully agree. As can be seen from Table 5.12 there are some significant difference between the two groups. Based on the results Table 5.12 it can be seen that cars are generally appreciated by both car owners and non-cars with majority of the positive attributes of car having a mean of more than 5 for both car owners and non-car owners.

With respect, to instrumental and independence use of car, there appears not to be significant difference between the responses given by car owners and non-car owners. Statements like 'a car allows you to choose your own route', 'one can feel free and independent in his/her car' and 'you can generally get to places quicker in a car' are seen to be well appreciated by both groups.

With regards to "direct negative attributes" of car such as 'cars are environmentally friendly', non-car owners tend to disagree more than the car owners. It must be noted that there could exist a number of reasons for this result. Car owners might downplay the negative effects of driving their car on the environment or might not be aware of the side effects. Also, in a context where most public transport vans are rickety, car owners might be responding more positively towards car than other modes with respect to environmental effects. On the other hand, it could be the case that non-car owners are truly more aware of the externalities caused by owning and driving a car.

In addition, car owners tend to have a higher appreciation of the societal expectation on owning a car than non-car owners. For example, whilst both car owners and non-car owners tend to agree with statements capturing attitudes towards societal expectation (such as: 'there is societal pressure to have a car' and 'transport mode other than car are looked down upon in society') cars owner tend to give greater value to them.

**Table 5. 12 Attitudinal difference on Car between car owners and non-car owners**

Variable	Non-Car Owners (399)		Car Owners (148)		Significance level (p-value)
	Mean	Std Dev	Mean	Std Dev	
A car allows person to distinguish themselves from others	4.86	1.37	5.68	0.91	0.00
A symbol of success in life	4.96	1.34	5.39	0.93	0.02
There is societal pressure to have a car	4.65	1.54	6.18	0.86	0.00
Transport mode other than car are looked down upon in society	5.13	1.48	6.15	1.08	0.00
A car is an object with which you can show others the way you are and your taste	4.63	1.27	5.16	1.12	0.00
Owning a car is useful for daily activities	5.79	1.38	6.31	0.76	0.00
Driving a car is relaxing way to travel	5.56	1.07	6.16	0.79	0.00
Car allows you to transport more items and people	5.70	0.73	6.18	0.67	0.00
cars are trendy	5.05	1.11	5.70	0.87	0.00
using a car provides privacy	5.49	1.03	6.36	0.74	0.00
a car allows people to feel more in control of their life	5.49	1.18	6.28	0.76	0.00
a car allows you to choose your own route	5.73	0.74	6.22	0.65	0.00
cars allow you to travel anytime	5.64	1.29	6.25	0.68	0.00
You can generally get to places quicker in a car	5.93	1.44	6.36	0.74	0.07
People are at risk in their car	2.82	1.83	3.04	1.51	0.01
cars are not environmentally friendly	3.10	1.35	3.87	1.48	0.00
cars do not disturb one's neighbourhood	3.36	1.56	4.32	1.51	0.00
Driving is frustrating	2.50	0.91	2.74	1.10	0.07
Cars are luxury goods	5.53	1.35	5.17	1.24	0.00

### **5.8.2 Difference in Attitude towards Car between Car owners from Face to Face and Drop and Collect Methods.**

As already discussed, the difference in data collection method has been identified to be skewed towards the distribution method in terms of households with car. For instance although 12% of the total number of households sampled were from the drop and collect method, 35.2% of households with cars were from this method. The researcher, thus in turns wants to identify whether the data collection method has affected the response given in relation to attitudinal statements for car among the two groups. Hence comparison is made for difference in attitude towards car owners between the two methods.

As can be seen from Table 5.13 there are only three statements that are significantly different at 5% level of significance. The statements are 'A car allows a person to distinguish themselves from others', 'cars are trendy' and 'cars allow you to travel anytime'. In general car owners who answered the questions based on the drop and collect method tend to have a higher appreciation of the value of cars than car owners who used the face to face method. This could be seen in their high appreciation of the positive aspects of the car whilst at the same time down playing other negative related aspects of the car. The mean scores of car owners through the drop and collect method are marginally higher than those of the face to face method. There could be several reasons for the difference obtained. One could be that whilst car owners interviewed through face to face could have muted their response in order not be 'snobbish', those who answered them through drop and collect had the liberty of providing answers they deemed appropriate without been influenced by pressure. Because the differences were only on a small subset of items the decision was taken to treat the response together rather than by survey collection method for future analyses.

**Table 5. 13: Difference in Attitude towards Car between Car owners from Face to Face and Drop and Collect Methods.**

Variable	Car Owners— Face to Face (96)		Car Owners— Drop and Collect (52)		Significance level (p- value)
	Mean	Std Dev	Mean	Std Dev	
A car allows person to distinguish themselves from others	5.52	0.91	5.96	0.81	0.00
A symbol of success in life	5.35	0.90	5.41	0.94	0.73
There is societal pressure to have a car	6.10	0.93	6.22	0.82	0.43
Transport mode other than car are looked down upon in society	6.07	1.19	6.29	0.82	0.48
A car is an object with which you can show others the way you are and your taste	5.16	1.08	5.17	1.20	0.59
Owning a car is useful for daily activities	6.30	0.80	6.33	0.67	0.93
Driving a car is relaxing way to travel	6.09	0.83	6.29	0.69	0.18
Car allows you to transport more items and people	6.11	0.63	6.31	0.72	0.06
cars are trendy	5.55	0.88	5.96	0.81	0.01
using a car provides privacy	6.36	0.79	6.37	0.65	0.74
a car allows people to feel more in control of their life	6.25	0.80	6.35	0.68	0.61
a car allows you to choose your own route	6.17	0.62	6.33	0.70	0.11
cars allow you to travel anytime	6.10	0.64	6.42	0.72	0.00
You can generally get to places quicker in a car	6.36	0.79	6.37	0.65	0.74
People are at risk in their car	3.06	1.50	3.00	1.48	0.89
cars are not environmentally friendly	3.76	1.50	4.08	1.44	0.21
cars do not disturb one's neighbourhood	4.26	1.51	4.44	1.52	0.36
Driving is frustrating	2.87	1.17	2.67	1.06	0.24
Cars are luxury goods	5.06	1.29	5.37	1.13	0.16
A car gives a person prestige	5.55	0.88	5.96	0.81	0.12

Significance level (p-value) is 0.05

### **5.8.3 Difference in attitude towards Public transport between car owners and Non Car Owners**

The difference of attitudes towards public transport was tested for both car owners and non-car owners as seen in Table 5.14. Since the attitudes variables are ordinal and have two independent variables the Mann-Whitney U Test is used. As can be seen from Table 5.11 there are some significant difference between the two groups.

In terms of the positive attributes of public transport, there seems to be an agreement between car owners and non-car owners. For instance statements like 'Public transport is accessible', 'public transport is affordable' and 'public transport is reliable' obtains positive response even though non-car users tend to have a higher mean as compared to non-car users. The acceptance of public transport as accessible by both groups is not surprising as 74.95% of respondents had their residence to be between 0-0.5km from the nearest public transport route as seen in Figure 5.9

With respect to the on-board experience of using public transport there seem to generally negative attitude by both car owners and non-car owners, with particularly high disagreement with 'There are comfortable seats for passengers' and 'Passengers and their goods are safe'. However, car owners indicates even higher agreement with negative statements such as 'It's hard to relax on PT' and 'Use of PT is time wasting'. Also PT vehicles were identified not to be environmentally friendly by both groups. The statements on attitude of staff of public transport services, though, elicited differences between car and non-car owners, whilst car owners indicated that staff on public transport vans are aggressive, non-car owners mostly disagreed with this as indicated in the average mean obtained.

**Table 5. 14: Attitudinal difference on Public Transport between car owners and non-car owners**

Variable	Non-Car Owners (399)		Car Owners (148)		Significance level (p-value)
	Mean	Std Dev	Mean	Std Dev	
It's hard to relax on PT	5.13	1.48	5.96	1.09	0.00
PT use is a hassle	4.65	1.54	6.18	0.86	0.00
PT are accessible	5.72	0.93	5.13	0.82	0.00
Use of PT is time wasting	5.03	1.43	6.07	0.80	0.00
The staff on PT are aggressive	3.79	1.44	5.70	.878	0.00
PT are affordable	5.42	0.90	5.53	1.15	0.12
Traffic regulations are not respected by PT drivers	4.09	1.56	5.07	1.67	0.00
Travelling by PT is for those who cannot afford a car	4.86	1.35	5.14	1.08	0.05
People who are successful travel by PT	3.96	1.43	2.41	0.84	0.00
PT vehicles are environmentally friendly	3.71	1.20	2.83	1.12	0.00
PT vehicles are rickety	4.74	1.41	5.39	0.93	0.00
PT vehicles are esteemed	3.86	1.36	2.53	0.86	0.00
PT vehicles are noisy	3.97	1.14	6.18	0.68	0.00
There are comfortable seats for passengers	3.08	1.58	1.69	0.76	0.00
Passengers and their goods are safe	4.26	1.36	3.04	1.18	0.00
Public Transport is simple to use	3.02	1.45	1.84	1.04	0.00
PT is reliable	5.55	0.94	4.93	0.84	0.00

Significance level (p-value) is 0.05

With an average of 81% of trips of car owners to work, shop and social activity being undertaken with the use of car, the researcher sought to identify any differences in attitudes between those car owners who used public transport to different degrees. Table 5.14 provides a summary of the various groupings. Three groupings were used including; frequent users, occasional users and non-users. Frequent users of public transport were considered to be those who use public transport 5 or more times a week, 3-4 times a week and 1-2 times a

week. Occasional users were considered to be those who use public transport 3 or more times a month, 1-2 times a month, 3 or more times a year and 1-2 times a year. The non-users are those who have never used public transport.

The Kruskal-Wallis Test was adopted since there existed three independent variables that were ordinal in form. From Table 5.15, it can be witnessed that whilst there exists a general agreement to some negative attributes of public transport among all groups, the mean of the groups increase as the frequency of use reduces. Hence, non-users of public transport are more likely to agree with the negative attributes of public transport more than occasional users and frequent users. Generally, frequent public transport users have “more positive beliefs” about public transport service than non-users and in most cases perceive fewer barriers to using them which is consistent with the findings from previous studies (Ibrahim, 2003, Anderson and Stradling, 2004, Beale and Bonsall, 2007, Beirão and Cabral, 2007). According to Beale and Bonsall (2007) and Beirão and Cabral (2007) people who never use public transport or are occasional users have very negative image of the public transport service which may be due to their lack of actual knowledge about bus service and how they have improved. Although the findings in this research largely agree with those existing in literature as stated above, there seems to be a general agreement with respect to the attitude towards service delivered by public transport been negative with varying degrees based on the frequency of use.

**Table 5. 15: Difference in attitude towards Public transport between Users of Public Transport**

Variable	Frequent Users		Occasional Users		Non users		Significance level (p-value)
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	
It's hard to relax on PT	5.11	1.50	5.71	1.28	5.94	0.99	0.00
PT use is a hassle	4.60	1.56	5.70	1.25	6.24	0.77	0.00
PT are accessible	5.72	0.93	5.26	0.99	5.27	0.76	0.00
Use of PT is time wasting	5.01	1.46	5.65	1.08	6.16	0.70	0.00
The staff on PT are aggressive	3.78	1.45	4.91	1.35	5.78	0.92	0.00
PT are affordable	5.42	0.89	5.32	1.15	5.77	1.01	0.04
Traffic regulations are not respected by PT drivers	4.08	1.57	4.56	1.54	5.32	1.75	0.00
Travelling by PT is for those who cannot afford a car	4.87	1.33	4.99	1.18	5.19	1.25	0.52
People who are successful travel by PT	3.96	1.42	3.04	1.36	2.37	0.82	0.00
PT vehicles are environmentally friendly	4.30	1.20	4.82	1.27	5.08	1.17	0.00
PT vehicles are rickety	4.72	1.42	5.08	1.07	5.54	0.97	0.00
PT vehicles are esteemed	3.84	1.35	3.13	1.33	2.48	0.79	0.00
PT vehicles are noisy	3.94	1.13	5.32	1.28	6.30	0.64	0.00
There are comfortable seats for passengers	4.88	1.63	5.85	1.09	6.38	0.64	0.00
Passengers and their goods are safe	3.71	1.37	4.46	1.34	5.14	1.07	0.00
Public Transport is not simple to use	4.96	1.48	5.71	1.23	6.29	0.87	0.00
PT is reliable	5.55	0.94	5.15	0.89	4.95	0.93	0.00

Significance level (p-value) is 0.05

#### 5.8.4 Principal Component Analysis for Attitude towards Car

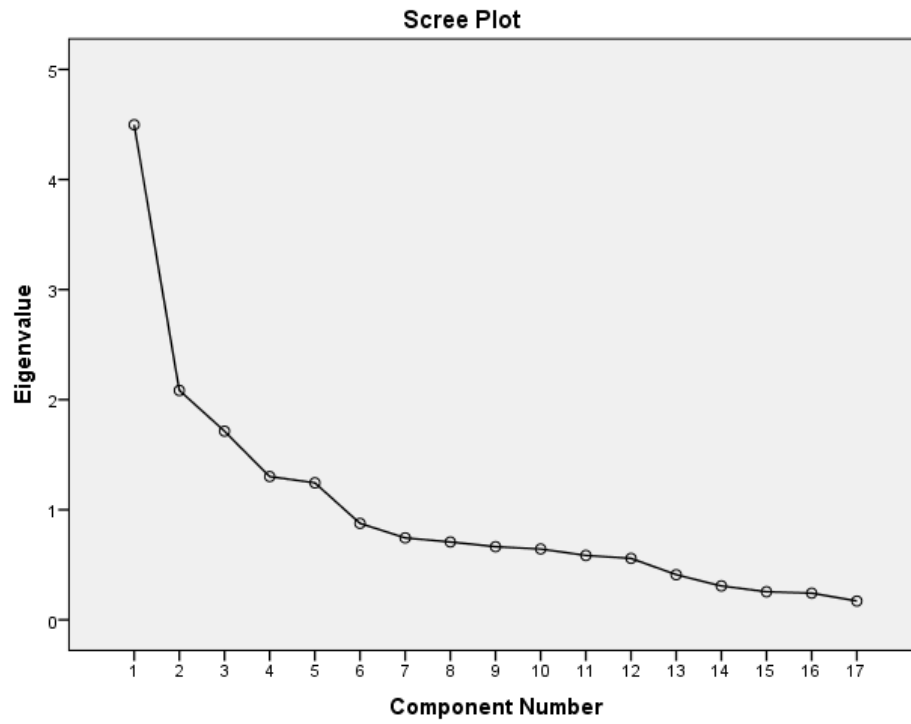
The attitudinal responses towards car were examined using principal component analysis (PCA) to identify important attitudes of participants. The PCA steps followed are discussed in



Section 4.9.4. PCA is a method of data reduction where in the process it groups correlated variables into uncorrelated factors (Fabrigar et al., 1999, Field, 2013). Of the 19 items, only 17 remained in the final analysis. Initially 2 items were discarded because they did not correlate with any other item in the set. The items discarded included 'driving is frustrating', 'and people are at risk in their car'. These statements were discarded after the correlation matrix was examined with the aim of examining the magnitude of individual correlation coefficients. While most of the statements maintained had a considerable number of correlation coefficients above 0.3 (the generally recommended level) (Hair et al., 2006) the discarded ones did not. In addition the discarded items did not have a correlation of 0.40 with at least one other variable.

The scree plot, as shown in Figure 5.13 indicates a clear break after the fifth factor. Based on Cattell's scree test (Cattell, 1966), it was decided that five factors would be used for further analysis. The 5 five factors identified by the varimax rotation with eigenvalues  $> 1$ , explains 63.76% of the total variance. In order to produce a clearer factor pattern and to align the PCA better with subsequent analysis, the coefficient display format was set to suppress coefficients below 0.40. The scale diagnostics have also been calculated covering the Kaiser Meyer Olkin (KMO) test of sampling adequacy and Barlett's test of sphericity.

The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis, KMO = 0.801 which is considered meritorious according to Hutcheson and Sofroniou (1999). The Barlett's test of sphericity is 3299.97. The internal consistencies measured by the Cronbach's alpha for all the five factors were accepted. Particularly for exploratory social science research, Hair et al. (2006), maintains that if the goal is not to produce from scratch a psychometric instrument that is precise and trustworthy enough for clinical use, but to measure a trait with enough accuracy to establish the existence of relationship with other traits for research purposes, then can accept lower values. To that extent, the Cronbach alpha obtained for the other five factors were considered cohesive and the results were therefore considered acceptable for the purposes of this study. Table 5.13 provides summary of the PCA including an interpretation of the five latent dimensions. Further detailed information of the factor analysis provided at the Appendix D.



**Figure 5. 13: Scree Plot for PCA of Attitudes towards car**

**Table 5. 16: Principal Component Analysis for Car**

	Factor Loading	% Variance Explained	Cronbach's Alpha	Interpretation
<b>Instrumental (CARINS)</b>		<b>26.45%</b>	<b>0.83</b>	These five statements encompasses the benefits one gets from owning a car. The statements included in this factor can be summarised as "Instrumental" since it contains statement which indicates the ability of the household head and the household to enjoy certain benefits that a car provides which are not seen to be provided by other modes of transport in the city of Accra especially the use of public transport. The instrumental aspects captured in the statements listed here include: privacy, control of time, getting to places on time and relaxing way of travel.
1. Driving a car is relaxing way to travel	0.87			
2. Owning a car is useful for daily activities	0.86			
3. using a car provides privacy	0.81			
4. a car allows people to feel more in control of their life	0.65			
5. You can generally get to places quicker in a car	0.57			
<b>Symbolic Affective (CARSYM)</b>		<b>12.25%</b>	<b>0.81</b>	The five statements reflect the ability of one to differentiate themselves from others as a result of owning a car in society with few households owning cars. The three statements 'a car allows a person to distinguish themselves from others', 'A car is an object with which you can show others the way you are and your taste' and 'a symbol of success in life' indicates
1. A car allows person to distinguish themselves from others	0.89			
2. A car gives a person prestige	0.85			
3. cars are trendy	0.84			

4. A car is an object with which you can show others the way you are and your taste	0.64			a way differentiating among various people in a society based on one's ability to own a car.
5. A symbol of success in life	0.44			
<b>Independence (CARIND)</b>		<b>10.07%</b>	<b>0.60</b>	The statements represented in this factor clearly indicates the independence that owning a car brings to a household. The ability of a household to be able to control their time of travel, route to use to travel and ability to transport more people and items indicates the independence that owning a car provides.
1. Car allows you to travel anytime	0.75			
2. a car allows you to choose your own route	0.73			
3. Car allows you to transport more items and people	0.71			
<b>Social Stigma (CARSOS)</b>		<b>7.65%</b>	<b>0.74</b>	The two statements captured in this factor indicates the influence of society in one's decision to own or not to own a car.
1. Transport modes other than car are looked down upon in society	0.86			
2. There is societal pressure to have a car	0.85			
<b>Social Orderliness (CARSOD)</b>		<b>7.32%</b>	<b>0.53</b>	This dimension represents the awareness and concern for the potential harmful outcomes of owning a car. The statements captured in this category indicates the impact of the ownership use of car on the environment and one's neighbourhood.
1. cars are environmentally friendly*	0.80			
2. cars are not disturbing to one's neighbourhood	0.79			
<b>Total Variance Explained</b>	<b>63.76%</b>			

### **5.8.5 Principal Component Analysis for attitude towards Public transport**

The attitudinal responses towards public transport were also examined using principal component analysis (PCA) using the same selection criteria and test as explained in Section 5.8.4. Of the 17 items, only 16 remained in the final analysis. Initially 1 item was discarded because they did not correlate with any other item in the set. The five factors identified by the varimax rotation with eigenvalues  $> 1$ , explains 69.16% of the total variance after some items were removed. The Kaiser-Meyer-Olkin (KMO) was 0.78 which is considered middling according to Hutcheson and Sofroniou (1999). The Barlett's test of sphericity is 3465.45. Table 5.17 provides summary of the PCA with the detailed information of the factor analysis provided at the Appendix E.

**Table 5. 17: Principal Component Analysis for Public Transport**

	<b>Factor Loading</b>	<b>% Variance Explained</b>	<b>Cronbach's Alpha</b>	<b>Interpretation</b>
<b>On board Experience (PTOE)</b>		<b>24.47%</b>	<b>0.88</b>	The five statements collectively capture the experience that one has whilst on board PT. It is no surprise that these five variables are combined to form one dimension as upon reflection they are similarly worded. Item 1 has to do with travelling time. Item 2 to 5 has to do with convenience and comfort. With this factor explaining 24.47% out of the 69.16% total variance obtained, analysis indicates the importance of passengers' experience on PT on their attitudes towards it.
1. Use of PT is time wasting	.86			
2. It's hard to relax on PT	.84			
3. PT is simple to use*	.82			
4. There are comfortable seats for passengers*	.77			
5. PT use is a hassle	.76			
<b>Staff Conduct and Safety (PTSCS)</b>		<b>13.58%</b>	<b>0.77</b>	The items in this factor collectively represent safety of goods and passengers whilst on public transport as well as the conduct of staff. Item 1 and 2 whilst concentrating on the behaviour of staff of public transport also underscores the issue of safety since action of staff do affect the safety of passengers. This factor and factor 1 which captured on board experience together deals with the service provided by PT.
1. Traffic regulations are not respected by PT drivers	.84			
2. The staff on PT are aggressive	.81			
3. Passengers and their goods are safe on PT*	.75			
<b>Social Orderliness (PTSOD)</b>		<b>9.97%</b>	<b>0.68</b>	This factor collectively emphasises on the state of vehicles that are used. These negatively worded statement and the factor loading indicates the general feeling of dissatisfaction with the vehicles. The
1. PT vehicles are environmentally friendly*	.78			

2. PT vehicles are rickety	.76			identification of statements capturing this factor can be seen to be similar to work by Van and Fujii (2011) who identified that there exist certain attributes with respect to vehicles used for public transport services in developing countries which are different from those seen in the developed countries.
3. PT vehicles are noisy	.70			
<b>Instrumental (PTINS)</b>		<b>9.59%</b>	<b>0.87</b>	This factor captures a positive attribute with respect to people's attitude towards public transport services. The statements for this factor indicates the level of reliability and accessibility of public transport services.
1. PT are accessible	.93			
2. PT is reliable	.91			
<b>Social Stigma (PTSOS)</b>		<b>7.52%</b>	<b>0.53</b>	This factor captures the perception that the society has towards the users of public transport and the level of respect accorded to PT vehicles. This generally indicates the negative perception people have towards PT vehicles. The statements captured indicate that society does not expect well to do people to use PT service. This factor corresponds to the Social Stigma factor identified under the attitudes towards car. Based on both Social stigma factors it can be seen that society generally does not view the use of public transport vehicles as a better alternative for people who can afford to use car.
1. PT vehicles are esteemed	.79			
2. People who are successful travel by PT *	.73			
3. Travelling by PT is for those who cannot afford a car	.55			
<b>Total Variance Explained</b>		<b>69.16%</b>		

### 5.8.6 Group Difference of Attitudinal Factor Loadings

This section seeks to identify the relationship between different socio-demographic variables and attitudes towards car and public transport. The ten factors extracted during the principal component analysis are used. Table 5.15 displays the differences that exist between various socio-demographic factors and attitudes towards car whilst Table 5.16 displays that of public transport. In order to undertake this analysis, independent sample T-test and One-way ANOVA was adopted. Independent sample T-test was adopted when comparing variables with only two categories like car ownership status of household and households with license. One-way ANOVA is adopted when comparing variables with more than two categories such as main mode used by a household. With respect to the Independent sample T-test the mean difference is used to provide the absolute difference between the mean values in the two different groups of the variable under consideration. In terms of variables with more than two categories the difference was identified using Tukey Multiple Comparison test. The Tukey test is used after the ANOVA test leads to the conclusion that there is evidence of group mean difference. The Tukey test is then further used to investigate which of the means within the variable are different (Bland and Altman, 1995). Another statistical technique that was adopted in Table 5.15 and 5.16 is the use of effect size. Effect size is the magnitude of the difference between groups (Sullivan and Feinn, 2012). While the p-value can inform whether effect exists, the p-value does not reveal the size of the effect. Thus the researcher has reported the substantive significance (effect size) and the statistical significance (p-value) in this work. In this work two effect size statistics are used for analysis and they are: Cohen's d and eta squared. The Cohen's d approach is adopted whilst using the Independent sample T-test whilst the eta squared is used specifically in ANOVA models. There exist ranges for both Cohen's d<sup>7</sup> and eta squared<sup>8</sup> which helps in interpretation

Table 5.15 indicates the difference between various groups (i.e. households with or without license, car ownership status and main mode used by household head). In each case, there is a statistically significant difference in the attitudinal responses of the households with different levels of license holding, car owning or modal use. To highlight where some of the

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<sup>7</sup> Cohen's D ranges Small: 0.2, Medium: 0.5, Large: 0.8, Very Large: 1.3 See: FERGUSON, C. J. 2009. An effect size primer: a guide for clinicians and researchers. *Professional Psychology: Research and Practice*, 40, 532.

<sup>8</sup> Eta squared ranges Small: 0.02, Medium: 0.13, Large: 0.26



strongest differences exist, the effect sizes are used. For instance, households with different levels of car ownership are especially likely to have differences with respect to Independence and Social stigma as compared to Symbolic Affective and Instrumental factors. Also groups were compared based on the main mode of travel, to test whether particular modes influenced the attitude towards car ownership. Whilst there existed difference in attitude with respect to the various attitudinal factors, the effect size was considered to be small and medium indicating that the difference between the users of the various modes is not largely significant.

When analysing the differences in the attitudinal factors towards car ownership across the populations groups, the factors that explained most of the variance are “Independence”, “Social Stigma” and “Instrumental”. The independence indicates the flexibility that owning a car provides to a household whilst social stigma reflects the societal influence on a household’s decision to own a car. The Instrumental indicates the comfort and relaxing atmosphere in which the car provides for travel. Generally the car owning households tend to value these factors more than households without a car. The literature indicated that familiarity with car ownership and its associated benefits could also be a predictor of the attitude towards car ownership (Döring et al., 2014, Luke, 2018). Households who owned a car and held licenses were found to have high mean rankings regarding the valuation of the car especially the benefits than those who do not have a car. Also the groups were compared based on the mode of travel, to test whether particular modes influenced the car ownership attitudes. Households who own cars generally ranked cars as providing instrumental benefits and independence and being better than the public transport and other modes reflecting that the advantages appear larger to those who have cars than those who use other modes.

Table 5.16 also provides the difference between various groups and attitudes towards public transport. Two variables were considered in the table which include car ownership status and main mode of travel. With respect to comparing the car ownership status against the attitudes towards public transport, there is a large effect size for the factors “on board experience”, “staff conduct and safety”, “social orderliness” and “social stigma”. However, the instrumental factor had a small effect size which was largely because both car owners and non-car owners provided similar response to the statements relating to the factor. With

respect to the main mode used, the effect size was largely recorded to be small or medium. When analysing the differences in the attitudinal factors towards public transport across the populations groups, the factors that explained most of the variance are “on board experience”, “staff conduct and safety” “social orderliness” and “social stigma”. Three of the four factors listed have to do with the experience or the perceived experience of one using a public transport service. However, the “instrumental” factor which has to do with reliability and accessibility which was identified to be a positive attribute of the public transport service has less of the variance. The study identified that generally, car owning households had low mean ranking for the various attitudinal factors relating to public transport. This indicates that those who are more familiar with cars (and perhaps less familiar with public transport) valued the benefits of car more highly against other modes like the public transport.

**Table 5. 15: Test of differences of attitudes towards car between groups within the Sample**

Test	License			Car ownership status			Main Mode Used		
	Independent Sample T-test			Independent Sample T-test			One way ANOVA		
H0	Sig (p value)	Mean diff (Std error)	Effect size (Cohen's d)	Sig (p value)	Mean diff (Std error)	Effect size (Cohen's d)	Sig (p value)	Difference (Tukey test)	Effect size (Eta squared)
The distribution of ' <b>Instrumental</b> ' is the same across categories of...	0.00	-0.41 (0.09)	0.43	0.00	-0.43 (0.09)	0.47	0.00	Car & trotro Car & other modes	0.04
The distribution of ' <b>Symbol Affective</b> ' is the same across categories of...	0.00	-0.28 (0.08)	0.29	0.00	-0.41 (0.08)	0.45	0.00	Car & trotro Car & mass transit Trotro & mass transit	0.05
The distribution of ' <b>Independence</b> ' is the same across categories of...	0.00	-0.60 (0.08)	0.61	0.00	-0.82 (0.10)	0.83	0.00	Car & trotro Car & taxi Car & mass transit	0.13
The distribution of ' <b>Social Stigma</b> ' is the same across categories of...	0.00	-0.60 (0.08)	0.64	0.00	-0.76 (0.07)	0.88	0.00	Car & trotro Car & taxi Car & mass transit Trotro & Taxi	0.13
The distribution of ' <b>Social orderliness</b> ' is the same across categories of...	0.00	-0.33 (0.08)	0.33	0.00	-0.52 (0.10)	0.51	0.00	Car & trotro Car & taxi	0.05

**Table 5. 16: Test of differences of attitudes towards public transport between groups within the Sample**

Test	Car ownership status			Main mode of travel		
	Independent Sample T-test			One way ANOVA		
H0	Sig (p value)	Mean diff (Std error)	Effect size (Cohen's d)	Sig (p value)	Difference (Tukey test)	Effect size (Eta squared)
The distribution of ' <b>On board Experience</b> ' is the same across categories of...	0.00	-0.66 (0.06)	0.79	0.00	Car & trotro Taxi & trotro Car & other modes	0.13
The distribution of ' <b>Staff Conduct and Safety</b> ' is the same across categories of...	0.00	-0.95 (0.07)	1.12	0.00	Car & trotro Taxi & trotro	0.16
The distribution of ' <b>Social orderliness</b> ' is the same across categories of...	0.00	-0.92 (0.07)	1.09	0.00	Car & trotro Taxi & trotro Car & mass transit Car & other modes	0.17
The distribution of ' <b>Instrumental</b> ' is the same across categories of...	0.00	0.45 (0.08)	0.47	0.00	Car & trotro	0.35
The distribution of ' <b>Social Stigma</b> ' is the same across categories of...	0.00	0.67 (0.07)	0.76	0.00	Car & trotro Taxi & trotro Car & mass transit Car & other modes	0.09

## 5.9 Chapter Conclusion

This chapter has presented an empirical analysis of various socio-demographic factors of households in Accra as well as provided analysis of accessibility to public transport in the city and attitude of households towards cars ownership and public transport. This empirical analysis has confirmed that, in relation to the Accra general population, this survey of households over-represents those with higher income. This was however, a research approach adopted as explained in Section 4.5.1 with the aim of identifying car owners in a relatively low car owning context. As a result of this, the average car ownership is also higher.

The socio-demographic analysis undertaken in this chapter presents some findings that are identified to be distinct in the context of this study as against other car ownership studies which have mainly concentrated in the developed economies. For instance, based on the descriptive statistics, the majority of household heads (71.8%) interviewed were male indicating the dominance of male over female in the response provided. In this regard, the extent to which the preferences, attitudes and mobility needs of female impact on the decision making process of car ownership is limited in this research.

With respect to car ownership, it was indicated that less than a third of the sampled households owned cars. Also among those who owned cars, the majority owned one car which is characteristic of most developing countries. The research also identified that there also exist a number of households that have at least one license but do not own cars. In relatively low car owning contexts such as is the case under study, further analysis will be taken in next chapter to identify the difference in attitudes towards car by separating households who do not own car with license and those without. In terms of the reason for owning a car by car owners and desire to own car by non-car owners, the research has identified that there existed similarity between respondents. The positive attitudes towards cars given by both groups mostly had to do with the instrumental benefits the car provides rather than the symbolic benefits of a car. This indicates that the ownership of a car in Accra is more of a utility purchase and that life is harder without a car in the city.

In terms of the main mode used by various households, whilst there were majority of households that used trotro as their main mode of use, car owners were identified to be reliant on their cars for various journey purposes. There existed a good accessibility for most

households with respect to the trotro service with most households being within 0.5km to a public transport route. In addition the waiting time for trotro service was identified to be within mostly less than 10 minutes. As discussed in Section 3.7 of Chapter Three, whilst there existed other mass transport services (Metro Mass Transit and Ayalolo), the research confirmed the findings in Chapter Three that they operated limited service and had limited access to most communities. As a result of this, public transport for most respondents was equated to the trotro service. This showed the lack of coordination between various transport services that are being run in the city. To this end, questions, relating to public transport were answered with the trotro as the proxy service.

Using principal component analysis, five main factors were identified as factors for attitudes towards car and five factors for attitudes towards public transport. The identified factors were used to undertake some preliminary analysis by identifying those that were significant to car ownership and mode choice. Based on the analysis taken so far, "Instrumental", "Independence" and "Social Stigma" have been identified to be the most important factors so far. With respect to the public transport the identified factors so far have to do with the experience of passengers on public transport services. There exists a relationship between the dominant factors between attitudes towards car and public transport which are considered significant. Mainly they have to do with the ease with which the car provides for travel over public transport service.

The chapter summarised the characteristics of the sample and how these might be carried forward for further analysis. These will be subjected to further scrutiny by identifying factors that play significant role in car ownership among households in Accra by considering the variables in combination in Chapter 6.

## **CHAPTER SIX: HOUSEHOLD CAR OWNERSHIP MODELLING**

### **6.1 Introduction**

This chapter presents a multivariate analysis to identify factors that play a significant role in car ownership among households in Accra. Chapter Two underscored the need to understand household car ownership in a context in which most vehicles are imported second-hand vehicles, few households own cars and there is a plentiful supply of informal public transport. Chapter Four and Five, have provided a descriptive analysis of household socio-demographic factors and accessibility to public transport in Accra, to that extent this chapter will aim at identifying the role such variable plays in car ownership decision of household. In addition to this, the role of attitudes of households towards car and public transport will be assessed. Aside these, other well established variables which are known to affect household car ownership (like income) will be explored to ascertain their level of importance and whether they affirm or contradict established literature.

### **6.2 Chapter Organization**

In this chapter, the researcher applies the modelling framework called the multinomial logit model and nested logit (as discussed in Section 4.10) to help in understanding the role of various variables in understanding household car ownership. Section 6.3 discusses the model structure and the estimation procedure. The various variables used in undertaking the model are discussed as well. As discussed in Chapter Five, the variables used ranges from household socio-demographic variables, built environment variables and attitudinal variables. Section 6.3 describes the various variables that are used in the model.

### **6.3 Empirical Analysis**

#### **6.3.1 Dependent Variables**

Numerous car ownership studies in literature have classified car ownership levels as no car, one car, two cars etc (Potoglou, 2008, Caulfield, 2012, Wong, 2013, Bento, 2003, Salon and Aligula, 2012). Potoglou and Kanaroglou (2008), indicates that although such categorization are primarily used, the selection of dependent variables incorporate contextual considerations into the specification of models in order to better reflect the prevailing conditions of the area of study. To this extent, in this studies the researcher has classified the

dependent variables into three categories namely: no license and no car, license and no car, household with a car. There exist varied reasons for the adoption of this categorisation. Firstly, few households own more than one car in the sample (representing 10.2%). Secondly, the data collected showed that all households with car had driving license but some households had driving license without car. The contribution of income and license holding of households were seen to have a higher explanatory power of about 80% giving less room for control for other variables as shown in APPENDIX G. To that extent, the researcher inculcated the license holding of a household into the dependent variable.

Also, the data indicated that 33.33% of households with driving license do not have a car. With the studies undertaken in a relatively low car ownership context, adopting the traditional classification of no car, 1 car, 2 cars etc. has not provided better understanding of the trajectory of car ownership and also excludes an important section of people perhaps closest to the transition to owning cars. To make use of a car as a driver requires a driving license. A driver's license could serve as a measurement proxy for vehicle ownership because a license allows the independent, personal use of a vehicle if one is available (Kar et al., 2017). Licensure may encourage independent car travel among households whereas non-licensed households need to rely on other people if they want to commute by vehicle (Simons et al., 2014).

To this extent, although households without a car can be seen as one group, a license holding household without a car provides a better opportunity to access the characteristics that exist within such circumstance. The inclusion of households with driving license and no car helps to identify the characteristics of households in this phase which will not be easy to identify if they are included generally in households with no car. This is particularly relevant in case study context as Table 5.4 showed that access to license was considered expensive by households without them. Hence understanding the demographic characteristics of household within this phase will help in understanding the car ownership trajectory in Accra. Lastly, the researcher resorted to using: no license and no car, license and no car, household with a car without further breaking the number of license holders especially among the car owning households as they were seen to yielding similar results and also to avoid having smaller observations as seen in Table 6.1.



**Table 6. 1: License holders and Car Ownership Categories**

Number of License holders per household	Car ownership status		
	No car (%)	One car (%)	Two or more cars (%)
0	324 (81.2%)	0 (0%)	0 (0%)
1	74 (18.5%)	63 (68.4%)	4 (7.1%)
2 or more	1 (0.3%)	29 (31.6%)	52 (92.9%)
Total	399 (100%)	92 (100%)	56 (100%)

### 6.3.2 Independent Variables Considered

The explanatory variables tested in the model specifications were informed by review of previous theoretical and empirical work on car ownership modelling as well as data availability. In general, the independent variables used could be classified into three groups namely: household socio-demographic factors, built environment attributes and attitudinal variables.

Drawing on the literature from Section 2.3 and the questionnaire, the following socio-demographic variables are included in the modelling: household income, number of household members employed, number of children in a household, marital status of household head, age of household head, sector of employment of household head and educational level of household head.

In response to the need to try and understand the role of public transport in an informal transport setting some measures of accessibility to public transport were used in the survey as discussed in Section 4.5.3.6.

The researcher asked questions relating to time and distance to the nearest public transport route from the perspective of the respondents whilst also using google map to get estimates of distance from the house of the respondents. This was done to be able to compare the subjective answer given by the respondents as against the objective results obtained from the google map. Whilst the subjective responses were thoroughly discussed in Section 5.7 the objective distance to the transport route using the google map were used as pseudo measure of accessibility in the modelling exercise. This variable was used as a built environment indicator within the model.

Section 2.3.2 in the literature review chapter underscores to identify the impact informal public transit accessibility on car ownership. With a lot of studies undertaken in a formalized public transport system in both developed and developing countries context, the inculcation of the impact of accessibility in to an informal public transport system in a low car owning context will help in filling a research gap.

Section 2.5 of the literature section underscores the point that car ownership decisions are about much more than the economic considerations which have emerged in the aggregate and disaggregate modelling literature. Together with the focus group discussions which indicated the relevance of certain context specific attitudinal considerations ten attitudinal factors were obtained whilst undertaking the Principal Component Analysis in Section 5.8. The five attitudinal factors towards car (i.e. Instrumental, Symbolic Affective, Independence, Social Orderliness and Social Stigma) and five for attitudinal factors towards public transport (On Board experience, Staff Conduct and Safety, Social Stigma, Instrumental, Social Orderliness) are used in the modelling process to identify the role of such factors in a relatively low car owning context.

### **6.3.3 Exclusion of Variables**

In general, alternative specific constants capture unobserved information (Ben-Akiva et al., 1985) Specifically, in models of car ownership, alternative specific constants capture the costs associated with vehicle ownership, namely, maintenance and operation fees as well as the cost for purchasing vehicles (Ryan and Han, 1999). An alternative way to introduce motoring costs in the model would be to assign a fixed annual ownership cost per vehicle (Ben-Akiva et al., 1976). However, this would not represent a real-world situation, because vehicle costs vary significantly with age, class, type of engine and mileage at the time of purchase. Specifically in this research, most respondents did not provide data on the purchase cost and maintenance cost of their cars hence it was used. Therefore, the researcher preferred not to include a car-ownership-costs variable and leave this to be captured endogenously by the alternative specific constants.

With respect to the residential parking impact on household car ownership, preliminary assessment and focus group discussion resulted in the variable been excluded as it was not considered a factor in influencing car ownership. The residential density of selected communities were found to highly correlated with the income groupings and hence was

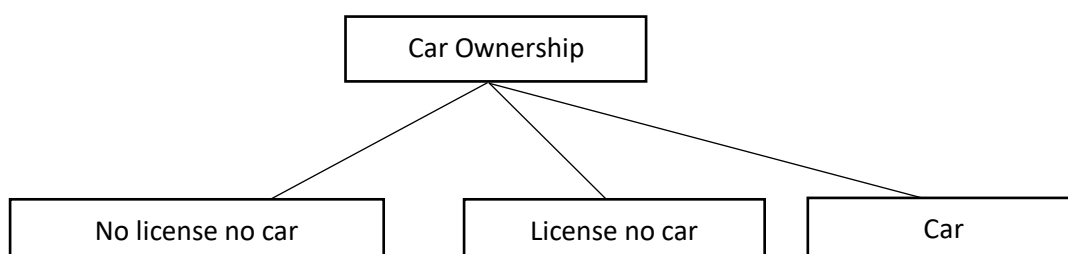
dropped in the modelling process. High income households were seen to be having low residential density whilst low income household were seen to be residing in high residential density zones.

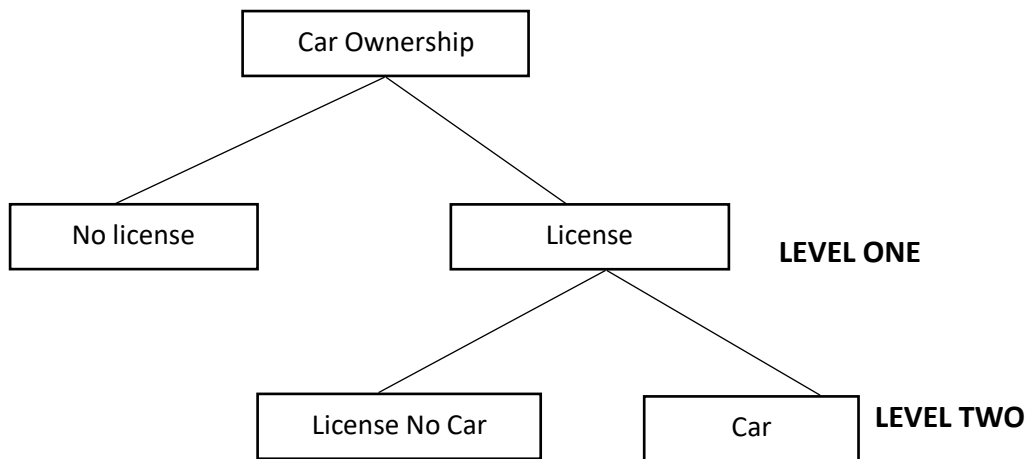
#### 6.3.4 Model Structure

The model structure adopted for this research is the combination of the multinomial logit (MNL) and the nested logit (NL) models. Section 4.11.1 and Section 4.11.2 provides a detailed description of the model formulation for the two models chosen. The primary model used in discussing the role of various variables on household car ownership is the MNL. Hence testing the performance of the model based on the addition of subsequent variables is done using the MNL model. The comparison between the two models is done when the final model of MNL is compared to the NL model using the same variables. A major drawback of the MNL model is the lack of Independence of Irrelevant Alternatives (IIA) and this can be addressed by the NL model. Figure 6.1 indicates the structure of the MNL in which there is no relationship among the three dependent variables.

The NL model provides an opportunity to formulate the household car ownership decision as a choice process among different alternatives using a nested logit structure. A number of nested logit structures can be proposed for any context in which the number of alternatives is not very small. In the case of the three dependent alternatives used in this work, one nest structure was explored. The appropriate nested logit structure was chosen using the nesting parameter estimates which were expected to be between 0 and 1. Figure 6.1 demonstrates such a structure. The objective of the level 1 model is predicting the relative probability of a household owning a license as compared to not owning a license. The level two provides information regarding the relative probability of owning a car with a license or not owning a car with license.

Section 6.3.2 discusses the various dependent variables that are used in undertaking the model these include: no license no car households, license no car households and households with car. Whilst these three categories will be used in both the MNL and NL models, the nesting structure adopted in this research is indicated in Figure 6.2





**Figure 6. 2: Nesting Structure for Nested Logit**

#### **6.4 Estimation Results**

The estimation process was undertaken by primarily building a base model which was developed upon by adding various variables. The base model (Model One) developed was made up of the household socio-demographic factors and built environment attribute. This model is a MNL model. Model Two was developed by adding attitudes towards car to Model One. This was done to ascertain the performance of various variables as well as the performance of various model fit statistics. The third model built was the inclusion of attitude towards public transport. The final MNL model developed is compared to NL model to ascertain which of the models performs better within the context under study.

##### **6.4.1 Model One (Household Socio-demographic and Built Environment)**

The socio-demographic characteristics of the household together with characteristics of the household head are important factors affecting the car ownership status of a household. Ghana Statistical Service (2014b) identifies the household head as a male or female who has economic and social responsibility for the household. All relationships in the households are defined with reference to the head. In this regard, the characteristics of the household head is expected to influence the ability of the household to own a vehicle. The variables considered in modelling for the household head and household characteristics include household size, number of household members employed, household income, number of children, gender of household head, age of household head, marital status and educational level of household head. Another variable that is considered as part of this model is the

distance from a house to a transport route. This variable was used as a built environment indicator within the model.

The estimated coefficients for the car ownership model are showed in Table 6.1. Modelling with “no license with no car households” as the reference option, most of the coefficient estimates have the expected signs. Based on the initial model specification, statistically insignificant variables were eliminated in stages and then variations on the subsequent specifications were tested to obtain the model. As shown in Table 6.1 most of the explanatory variables were statistically significant and conceptually interpretable. In addition, as a goodness of fit test statistics the adjusted rho-squared value is 0.46. The alternative specific constants corresponding to the various independent variables that are: license and no car and household with car is negative. The negative signs for all the alternative specific constants show that the average impact of all unmeasured variables is to reduce the probability of choosing that option. The discussion of the performance of various variables included in the model are discussed in the paragraphs below.

Household Income is one of the most important variables in determining car ownership as it provides a household with the financial means to own and maintain a vehicle (Roorda et al., 2000). This research also indicates that the highest income range provides the highest precision of the estimated coefficient. This could be seen in Table 6.2 in which the level of precision of income as a determinant of car ownership increases as income increases. This is the case even though the researcher sampled mostly from high income households. This observation agrees with a lot of studies in both the developed and developing world. Studies in developing world including Joseph et al. (2017) in Akure, Nigeria, Salon and Aligula (2012) in Nairobi Kenya, Mokonyama and Venter (2007) in South Africa, Kumar and Krishna Rao (2006) in Mumbai India, Srinivasan et al. (2007) in Chennai India, Soltani (2017) in Tehran Iran, Li et al. (2010) in China and Wu et al. (2016) support the observation that increased income is a greater determinant in household car ownership.

Households with more employed people had a higher probability of owning a car. The finding in many previous studies of the importance of this variable in explaining levels of possession of cars by households is thus highlighted in this study as well. This can be as a result of increased household income that is attained as a result of the increase in number of people employed. This finding agrees with studies by Karlaftis and Golias (2002) conducted in Greece,

Bhat and Guo (2007) conducted in San Francisco Bay, USA and Potoglou and Kanaroglou (2008) conducted in Hamilton Canada. Kim and Kim (2004) and Potoglou and Kanaroglou (2008) indicates that this happens as households with more employed people have greater mobility needs.

Increased household size was seen to be statistically significant at 90 percent confidence interval among households with license but no car. However, with respect to households with a car the size of households was identified not to be significant. This indicates that all other things being equal, households size is not a factor in explaining household car ownership in Accra. This finding is contrary to the finding of study undertaken by Salon and Aligula (2012) in Nairobi Kenya which indicated that increase in household size has a positive impact on household owning a car. On other hand studies by Kumar and Krishna Rao (2006) in Mumbai, India and Zegras (2010) in Santiago, Chile indicate support for the findings made in this study that increased household size reduce the probability of a house owning a car.

Educational level of household head is seen to impact on a household owning a car. The level of significance is increased especially for household heads with tertiary education in all the categories with households with car recording higher figures at 99% confidence interval. Whilst this indicator is scarcely adopted in a car ownership model, it provides a good understanding of car ownership in developing country cities like Accra. In most cases in Accra and other developing country cities the level of income a person gets on a job has a positive correlation with the level of education the person has achieved. Hence those with no or basic education tend to be mostly among the people with low income. Also the level of education of the household head affects various facets of the life of the household. For instance Acheampong (2017) in his study of the urban location choice and mobility pattern in Kumasi, Ghana identified that the educational attainment of heads of households had statistically significant effect on the types of dwelling a household occupied. Higher levels of education can be said to have two indirect positive impact on car ownership. Firstly, it increases the probability of getting into the labour market and increase the probability of getting higher wage.

The distance to a transport route was used as a proxy for defining access to a bus stop. An essential element in modelling access to public transport stop is the distance that people walk to get to a stop. Researchers have typically used walking distances similar to what planners

prescribe of 400 metres (0.25 miles) and 800 metres for estimating the distance people will walk to a public transport stop or station (Lovett et al., 2002, Kimpel et al., 2006, Hess, 2009, Mavoia et al., 2012). Others also use 300 metres (Mondou, 2001) and 500 metres (Chapleau and Morency, 2005). However, in this study as result of the fact that there exist mostly no demarcated bus stops to be used by passengers for boarding public transport, the researcher used the distance to nearest public transport route (i.e. this means distance from one's house to the nearest road where a public transport passes). The Table 6.1 indicated that distance to transport route had negative sign and showed that they were significant at 99% and 90% confidence interval for households with license and no car and households with car respectively. The negative sign accorded to distance to public transport route in the model therefore indicates that there exist an inverse relationship i.e. the greater the accessibility means lower car owning. The 99% significance for households with license and no car indicates that poor accessibility to PT seems to really encourage people to get license and perhaps aspire to get a car, but it is other variables like income which then have a stronger impact on getting a car.

There exist other socio-demographic variables that were used as part of the modelling process but were dropped because they were identified to be insignificant and hence in order to improve upon the model strength were removed. These variables include gender of household head, marital status of household head and age of household head. Gender, a variable with varying directional findings in previous work had a very low t-statistics and can consequently be inferred that gender is not at least directly a determinant of car ownership in the context of this work. The result on gender is however not conclusive and needs further investigations, as minority of households representing 28.1% the sample have reported females as their heads.

**Table 6. 2: Model Estimation Results for Model One**

Variable	No License	License and no car		Household with car	
		Est	T-stats	Est	T-stats

	<b>and no car</b>				
<b>Alternative Specific Constant (ASC)</b>	--	-2.20	-3.41	-2.92	-3.26
<b>Household Income</b>					
Less than 1000cedis	--	-0.13	-0.45	-1.57	-2.96***
1000-3000cedis	--	--	--	--	--
Above 3000	--	1.13	1.61	4.32	8.49***
<b>Household Size</b>	--	0.40	1.92*	0.15	0.44
<b>Number of Household members employed</b>	--	-0.04	-0.14	0.83	1.94*
<b>Number of children</b>	--	-0.18	-0.87	-0.42	-1.13
<b>Educational Level of Household head</b>					
Basic (reference)	--	--	--	--	--
Secondary	--	0.31	1.01	-0.12	-0.23
Tertiary	--	0.64	1.64*	1.46	2.73***
<b>Distance to Transport Route</b>	--	-1.48	-2.68***	-1.21	-1.81*
<b>MODEL SUMMARY</b>					
LL with constant term only LL(0)	-600.94				
LL(final)	-305.97				
Number of Observations	547				
Number of Parameters	18				
Rho-sq (0)	0.49				
Adj. rho-sq (0)	0.46				

\*\*\*Statistically significant at 0.01 level \*\*Statistically significant at 0.05 level, \*Statistically significant at 0.1 level

#### 6.4.2 Model Two (Addition of Attitudes toward Car)

Model Two comprises the addition of attitudes towards cars by households to Model One which was made of household socio-demographic factors and distance to public transport route. This addition is indicated in Table 6.3 .The attitudinal factors used in this model are the factors obtained from undertaking Principal Component Analysis in Section 5.7.4 and also discussed in Table 5.12. Based on the PCA the five attitudinal factors towards car by households include: instrumental, Symbolic Affective, Independence, Social Stigma and Social Orderliness were used as explanatory variables.

With the addition of attitudinal variables to the Model One, Model Two presents a better model fit. For instance the Rho-square improved from 0.49 to 0.56. With the addition of the attitudinal factors towards cars, the socio-demographic factors as discussed in Section 6.4.1



performed similarly in Table 6.2. The socio-demographic factors that were found to be significant in explaining car ownership which include household income, number of household members employed and educational level of household heads are seen to be significant in Model Two as well. To that extent, attention is given to explaining the performance of the various attitudinal factors towards car which have been added. In all cases apart from Social Orderliness the same factors have a statistically significant association with both license holding and car owning albeit to different degrees.

Instrumental factor is seen to be significant variable considered by license and no car households and households with no car. With respect to household with license and no car, the instrumental factor was seen to be significant at 95% confidence level whilst for households with a car the factor was significant with a confidence level of 99%. The importance of the instrumental factor as indicated in the model confirms earlier analysis in Section 5.4.3 and Section 5.4.4. In Section 5.4.3, non-car owning households in expressing their desire to own cars showed that instrumental factors such as helping in the movement of the family and ease movement of work made up about 49% of the reason for the desire to own cars. Also in Section 5.4.4 car owning household indicated that the instrumental factor of helping in the movement of families and easing journey to work explained 44.9% of the reason for owning a car. This indicates the extent of usefulness that the car is seen to provide in a relatively low car owning city like Accra. It also shows the extent to which there exist no viable alternative that can compete with the benefits the car provides.

Symbolic Affective factor is surprisingly seen not to be a significant factor in explaining car ownership. This is contrary to results in some developing and developed countries (Belgiawan et al., 2016b, Van et al., 2014) in which symbolic affective factor has been seen to be significant factor in car ownership. One reason why this factor may not emerge as important could be due to the purchase context in Ghana which is not the same as in much developed western literature. There, a new car purchase is largely based on the role of the car as a status symbol. Whilst this has some parallels in Accra, most of the cars are imported as second hand cars. What stands out from attitudinal analysis is the utility value of the car. Hence, the purpose the car serves is seen to be more important in a context in which there exist low levels of car ownership.

Independence factor is also seen to be significant. With respect to household with license and no car, the independence factor was seen to be significant at 95% confidence level whilst households with car had a confidence level of 99%. The independence factors refers to time and route travel flexibility. The researcher finds that the t-statistic loading of Independence especially among the car owning households is the highest indicating that it has the most influence. This result is partly in disagreement with findings from Steg (2005) and Gatersleben (2011), who find that independence is less significant compared to symbolic/affective factors. The different context again helps to understand the importance attached to independence factor in Accra given the low quality of service and longer journey times of trotro.

Social Stigma factor is also seen to be a significant factor. Whilst the individual evaluation of the symbolic affective factor of a car is seen to be low, there exist a positive social appreciation attached to owning a car. With respect to household with license and no car, the social stigma factor was seen to be significant at 95% confidence level whilst households with car had a confidence level of 99%. The social stigma factor entails the comparison of the car to other modes of transport primarily public transport and the pressure that exist for a household to own a car. Given the ubiquitous nature of the existing public transport, a second hand car as seen to be the case of most households in Accra can be seen to be valued higher in society than using public transport.

Social orderliness was seen to be significant among car owners but was insignificant when compared to households with license but no car. The car owning households tended to see the car to be environmentally friendly. This result implies a subjective evaluation of social orderliness especially by the car owning households perhaps to reinforce the positive feelings behind their decision to own a car.

The attitudinal factors towards car discussed above are all positive in that they do not have any negative signs. This is expected especially in a relatively low car owning city. The significance level among various attitudinal variable between car owning households and households without a car are also seen to be similar.

**Table 6. 3: Model Estimation Results for Sociodemographic Factors and Attitude towards Car**

Variable	No License	License and no car		Household with car	
		Est	T-stats	Est	T-stats

	<b>and no car</b>				
<b>Alternative Specific Constant (ASC)</b>	--	-2.22	-3.24	-4.50	-4.03
<b>Household Income</b>					
Less than 1000cedis	--	0.03	0.11	-1.37	-2.42**
1000-3000cedis	--	--	--	--	--
Above 3000	--	1.25	1.76*	4.41	6.42***
<b>Household Size</b>	--	0.45	1.90*	0.23	0.71
<b>Number of Household members employed</b>	--	-0.06	-0.20	0.93	2.12**
<b>Number of children</b>	--	-0.21	-0.86	-0.42	-1.12
<b>Educational Level of Household head</b>					
Basic (reference)	--	--	--	--	--
Secondary	--	0.31	0.99	0.62	0.93
Tertiary	--	0.64	1.58	1.90	3.04***
<b>Distance to Transport Route</b>	--	-1.67	-2.69**	-1.59	-1.86*
<b>Attitude towards Car</b>					
Instrumental	--	0.32	2.20**	0.87	3.83***
Symbolic Affective	--	0.09	0.58	0.33	1.60
Independence	--	0.30	1.98**	1.41	6.31***
Social Stigma	--	0.30	2.05**	1.75	5.36***
Social Orderliness	--	0.05	0.41	0.85	3.67***
<b>MODEL SUMMARY</b>					
LL with constant term only LL(0)		-600.94			
LL(final)		-263.63			
Number of Observations		547			
Number of Parameters		28			
Rho-sq (0)		0.56			
Adj. rho-sq (0)		0.51			

\*\*\*Statistically significant at 0.01 level \*\*Statistically significant at 0.05 level, \*Statistically significant at 0.1 level

#### 6.4.3 Model Three (Addition of Attitudes toward Public Transport)

Table 6.4 comprises the addition of public transport attitudes into the MNL which was made of household socio-demographic factors, distance to public transport route and attitude towards cars. The attitudinal factors used in this model are the factors obtained from undertaking Principal Component Analysis in Section 5.7.4 and also discussed in Table 5.12. Based on the PCA the five attitudinal factors towards public transport that are used in the

MNL model as explanatory variables include: On Board Experience, Staff Conduct and Safety, Social Orderliness, Instrumental and Social Stigma.

With the addition of attitudinal variables towards public transport to the Model One and Two, Model Three provides the best model fit. For instance the Rho-square improved from 0.56 to 0.66. This indicates that the addition of the attitudinal variables has helped provide a better explanation with respect to car ownership among households in Accra. With the addition of the attitudinal factors towards public transport, the socio-demographic factors and attitudes towards car as discussed in Section 6.4.1 and Section 6.4.2 performed similarly in Table 6.4 to Table 6.3. The socio-demographic factors that were found to be significant in explaining car ownership which include household income, number of household members employed and educational level of household heads are seen to be significant in Model Two as well. In addition the attitude towards car were seen to have similar explanatory power. To that extent, attention is given to explaining the performance of the various attitudinal factors towards public transport which have been added. Based on the results shown in Table 6.3 with regards to the attitudes towards public transport, there exist a generally negative outlook on the various factors. This direction is seen to be followed by both dependent variables (i.e. households with license and no car and households with car).

On Board Experience and Staff Conduct are more negative for the car owners and stand out as more significant than the difference between no car license owners and no car no license. This despite the fact that the car owners do not appear to use the public transport. On Board Experience and Staff Conduct and Safety factors which are seen to be distinct from other studies in relationship to attitudes towards public transport is due to the prominence given by participants of the focus group discussion who indicated the relevance of these statements to the use of public transport in Accra. Hence On Board Experience factor captures how a person who uses public transport views the experience whilst on board. In addition, the Staff Conduct and Safety Variable also indicates the conduct of staff of public transport towards users. The low rating of On Board Experience by households is seen to be in tandem with a study conducted by Abane (2011) in four cities in Ghana (i.e. Accra, Kumasi, Tamale and Sekondi-Takoradi) who found that public transport service (i.e. trotro) had the lowest rating of services on board by respondent. In addition, in relation to Staff Conduct and Safety, Abane

(2011) indicates the quality of driving which is associated with safety was found to be low for public transport operators.

Social Orderliness factor is seen to be prominent among developing countries as result of the mode of operations of the public transport system (Van and Fujii, 2011, Van et al., 2014). This factor in this research characterizes the nature of vehicles used for public transport services and the environmental concerns. Based on the findings, it can be realized that both car owners and non-car owning households agree to the rickety nature of the vehicles used and therefore the resulting impact of pollution on the environment. The agreement of the negative view of the social orderliness on public transport can be inferred to have result in the positive outlook for social orderliness with respect to cars.

A positive attribute which was found among the attitudes towards public transport Instrumental factor. With respect to household with license and no car, the instrumental factor was seen to be significant at 99% confidence level whilst households with car had a confidence level of 95%. Although there exist a strong importance attached to this factor by both dependent variables, household with license and no car who are seen to patronise public transport more are seen to recognize this advantage more than households with car. This factor captures the accessibility and reliability of public transport services. With the ubiquitous nature of operations of this public transport service, a positive attribute of being accessible to users can be seen as an advantage that can be harnessed in an attempt to improve upon the services of public transport.

With the aforementioned attributes of the public transport service, the negative attribute of the Social Stigma factor is expected. The model results indicate an agreement between both car owning households and non-car owing households on the stigma attached to public transport. The Social Stigma factor captured statements that had to do with how the society views those who use the public transport and the affordability of the service. The factor brings to bare the finding that although there exist a lot of negative attachment to public transport service it is mostly patronised because of its affordability (Abane, 2011).

It is interesting that both car and non-car owning households share similar attitudes to public transport use. There is significant negative reaction to safety, on board experience and social

orderliness. This is however stronger among car owners than non-car owning households who mostly patronise the public transport service.

**Table 6. 4: Model Estimation Results for Sociodemographic Factors and Attitude towards Car and Public Transport**

Variable	No License and no car	License and no car		Household with car	
		Est	T-stats	Est	T-stats
<b>Alternative Specific Constant (ASC)</b>	--	-2.21	-3.42	-5.14	-4.91
<b>Household Income</b>					
Less than 1000cedis	--	--	--	-1.78	-2.92***
1000-3000cedis	--	--	--	--	--
Above 3000	--	0.90	1.03	4.33	4.38***
<b>Number of Household members employed</b>	--	0.42	1.29	1.43	3.00***
<b>Number of children</b>	--	0.22	1.75*	-0.14	-0.83
<b>Educational Level of Household head</b>					
Basic (reference)		--	--	--	--
Secondary		0.21	0.62	--	--
Tertiary		0.70	1.69*	1.53	3.53***
<b>Distance to Transport Route</b>		-1.83	-2.83***	-1.92	-2.11**
<b>Attitude towards Car</b>					
Instrumental	--	0.48	2.51**	1.70	5.28***
Symbolic Affective	--	0.12	0.70	0.42	1.74*
Independence	--	0.35	1.87*	1.72	5.49***
Social Stigma	--	1.00	3.08**	4.05	4.93***
Social Orderliness	--	0.01	0.09	0.82	3.02***
<b>Attitude towards Public Transport</b>					
On Board Experience	--	-0.53	-1.75*	-2.24	-3.20***
Staff Conduct and Safety	--	-0.31	-1.65*	-0.93	-3.43***
Social Orderliness	--	-1.01	-4.48***	-1.01	-4.48***
Instrumental	--	0.81	4.67***	0.58	1.97**
Social Stigma	--	-0.44	-2.90***	-0.44	-2.90***
<b>MODEL SUMMARY</b>					
LL with constant term only LL(0)	-600.94				
LL(final)	-202.20				
Number of Observations	547				
Number of Parameters	38				
Rho-sq (0)	0.66				
Adj. rho-sq (0)	0.61				

\*\*\*Statistically significant at 0.01 level \*\*Statistically significant at 0.05 level, \*Statistically significant at 0.1 level



#### 6.4.4 Comparison of MNL and NL Results

In order to define and estimate the NL model, it is suggested to estimate a MNL model first for each level (Forinash and Koppelman, 1993, Miller and Mohammadian, 2003). Then the MNL and NL model estimation results should be compared and the best model adopted. In adopting this approach, the researcher kept in mind the logit model's IIA property, which can be violated for multiple-choice decisions where some alternatives are expected to be correlated. Moreover, it is often true that the satisfactory utility specification in the context of one structure specification may be unsatisfactory in another specification and *vice versa*. Considering all these issues, both MNL and NL models were explored in order to obtain the best fit. In this section the MNL model which has been discussed extensively in Model 1, Model 2 and Model 3 is compared to Nested Logit model using the same variables that were used in the final model of the MNL model which is the Model Three.

All the variables were put into the model in a stepwise manner for achieving better model fit. Insignificant variables were discarded from the final model. The MNL and NL models with linear parameters were estimated with the three alternatives including no license no car, license no car and car owners. The no license no car household was taken as the reference alternative in the estimation process. The model estimation results are given in Tables 6.4.

An important consideration for assessing the NL model is the nesting parameter or the nesting coefficient. As explained in Section 4.10.2, the nesting parameter is a function of the underlying correlation between the unobserved components for pairs of alternatives in that nest, and it characterizes the degree of substitutability between those alternatives. For the nested logit model, we observe a nesting parameter significantly different from 1, suggesting that we should reject the MNL model. This is confirmed by the likelihood ratio test which informs us that the NL model has a significantly better fit than the MNL model. For the other parameter estimates, we see no substantial changes from the NL model in comparison to the final MNL model. The results of the MNL and NL model are seen not to differ in relation to the relevant t-statistics of the various independent variables and the signs that associate the various co-efficient of the variables. To that extent, the various explanations and implications drawn from undertaking the MNL model can be said to apply to the NL model. However, the NL model is identified to be a better model because it also captures a significant correlation between alternatives.



Table 6. 5: Comparison of MNL and NL results

Variable	No License and no car	MNL				NL			
		License and no car		Car Owners		License and no car		Car Owners	
		Est	T-stats	Est	T-stats	Est	T-stats	Est	T-stats
<b>Alternative Specific Constant (ASC)</b>	--	-2.21	-3.42	-5.14	-4.91	-2.05	-3.67	-2.20	-3.25
<b>Household Income</b>									
Less than 1000cedis	--	--	--	-1.78	-2.92***	--	--	-0.42	-1.13
1000-3000cedis (reference)	--	--	--	--	--	--	--	--	--
Above 3000cedis	--	0.90	1.03	4.33	4.38***	2.16	3.14***	2.78	4.37***
<b>Number of Household members employed</b>	--	0.42	1.29	1.43	3.00***	0.59	2.00**	0.75	2.422**
<b>Number of Children</b>	--	0.22	1.75*	-0.14	-0.83	0.17	1.49	0.06	0.51
<b>Distance to Transport Route</b>	--	-1.83	-2.83***	-1.92	-2.11**	-1.82	-3.11***	-2.14	-3.59***
<b>Educational Level of Household head</b>									
Basic (reference)		--	--	--	--	--	--	--	--
Secondary		0.21	0.62	--	--	0.22	1.14	--	--
Tertiary		0.70	1.69*	1.53	3.53***	0.93	2.92***	0.92	3.02***
<b>Attitude towards Car</b>									
Instrumental	--	0.48	2.51**	1.70	5.28***	0.60	3.27***	0.80	3.44***
Symbolic Affective	--	0.12	0.70	0.42	1.74	0.15	1.00	0.27	1.51
Independence	--	0.35	1.87*	1.72	5.49***	0.54	3.31***	0.75	3.36***
Social Stigma	--	1.00	3.08***	4.05	4.93***	1.30	3.87***	2.04	3.40***
Social Orderliness	--	0.01	0.09	0.82	3.02***	0.15	1.08	0.28	1.54
<b>Attitude towards Public Transport</b>									
On Board Experience	--	-0.53	-1.75*	-2.24	-3.20***	-0.65	-2.14**	-1.12	-2.47**
Staff Conduct and Safety	--	-0.31	-1.65*	-0.93	-3.43***	0.45	-2.49**	-0.53	-3.04***
Social Orderliness	--	-1.01	-4.48***	-1.01	-4.48***	1.07	-4.99***	-1.07	-4.99***
Instrumental	--	0.81	4.67***	0.58	1.97**	0.54	2.93***	0.11	0.50
Social Stigma	--	-0.44	-2.90***	-0.44	-2.90***	-0.51	-3.49***	-0.51	-3.49***

<b>Lamda</b>							0.13		7.76
<b>Summary Statistics</b>									
LL with constant term only LL(0)									-600.94
LL(final)									-195.90
Number of Observations									547
Rho-sq (0)									0.66
Adj. rho-sq (0)									0.61
Likelihood ratio test									$12.6 \times 10^{-4}$

\*\*\*Statistically significant at 0.01 level

\*\* Statistically significant at 0.05 level

\*Statistically significant at 0.1 level

## 6.5 Model Predictions

Model prediction is undertaken after the model estimation. In undertaking the model prediction, the household income variable was used. Since the household income used in the modelling were categorical in nature (i.e. below 1000cedis, 1000-3000cedis and above 3000cedis), the researcher resorted to increasing a particular income group level by one instead of using percentages. To this extent the income category of below 1000cedis (low income) was moved to 1000-3000cedis (middle income) as shown in Table 6.6. Also the income category of 1000-3000cedis (middle income) was moved to 3000 and above (high income). However the highest income category of Above 3000cedis could not be moved as there exist no other category from that. With respect to Table 6.6 it could be identified that movement of households from low income to middle income does not result in the increase in car owners with the mean been 2.4percent (i.e. there will be an average of 2.4 percent increase in car ownership among this group). However an increase from middle to high income is seen to increase the number of car owners with a mean of 21.8percent (i.e. there will be an average of 21.8 percent increase in car ownership among this group). This indicates that an increase in household income into the high income category results in the biggest increase in the household car ownership.

**Table 6. 6: Change in Probability from Low to Middle Income**

	<b>No License and no car</b>	<b>License and no car</b>	<b>Car Owners</b>
<b>Min</b>	-2.074e-01	-0.3698150	0.0000000
<b>1<sup>st</sup> Qu.</b>	8.332e-05	-0.0143027	0.0000474
<b>Median</b>	1.705e-03	-0.0072767	0.0006932
<b>Mean</b>	-4.509e-03	-0.0197225	0.0242317
<b>3<sup>rd</sup> Qu.</b>	6.434e-03	-0.0020475	0.0117021
<b>Max</b>	1.385e-02	-0.0000886	0.4726458

**Table 6. 7: Change in Probability from Middle to High income**

	<b>No License and no car</b>	<b>License and no car</b>	<b>Car Owners</b>
<b>Min</b>	-0.423751	-0.65864	0.0000066
<b>1<sup>st</sup> Qu.</b>	-0.231400	-0.09882	0.0247354
<b>Median</b>	-0.143919	-0.01041	0.0247354
<b>Mean</b>	-0.159052	-0.05959	0.2186445
<b>3<sup>rd</sup> Qu.</b>	-0.071885	0.02157	0.3873209
<b>Max</b>	-0.003211	0.15176	0.7330428

## 6.6 Conclusion

This chapter serves a continuation of the previous chapters. In Chapter five the various household socio-demographic factors and attitudinal variables were analysed separately to understand the context of study and also provide a background for undertaking modelling in this chapter. Chapter Six has provided an understanding of the various factors that are seen to be a contributory factors in understanding car ownership in the city of Accra. A distinctive feature of this chapter is the classification of dependent variables for the modelling in which the classification was done using a combination of availability of license and car ownership status rather than just the traditional car ownership status use. To that extent dependent variables used were classified into: households without license, household with license and no car and household with car. In addition, although a MNL model was adopted to provide a step by step addition of variables in order to develop a final model, the NL model was seen to perform better with the given data than the MNL model.

With respect to the performance of various independent variables, household income was seen to play an integral role in explaining car ownership among households. It comes as no surprise that income is an important driver in household car ownership decisions. In particular incomes above GH¢ 3000 are more strongly associated with ownership. Income remained a strongly associated variable despite the fact that the researcher had a skewed income profile already in terms of the selection of households. In addition, number of household members employed and education level of household head were also seen to influence car ownership. These two factors are identified to be related to income of the household. Surprisingly, most of the other household socio-demographic variables like household size, household type,

marital status of household head etc. were seen to be insignificant and therefore removed from the modelling exercise.

It seems difficult, given the very widespread coverage of informal transit to make meaningful assessments of the role of public transit in car ownership decisions. Questions about walk times to stops and wait times are difficult to answer. Overall distance to bus route using google maps are perhaps easier to capture. Though the research indicates that most households are within close proximity to public transport route, the finding indicates that there is an inverse relationship between car ownership and accessibility to public transport. With respect to the attitudes towards car ownership by various dependent variables, the findings of the research indicate a positive attitudes by both car owners and non-car owners. All the attitudinal variables towards car ownership were seen to be significant with the exception of Symbolic Affective factor which was surprisingly identified not to be significant for both households owning cars and households with license and no car. Attitudes towards public transport is generally negative for both car owners and non-car owners with the exception of Instrumental factor which was seen to have a positive relationship. The findings in this chapter presents some important consideration that will be discussed in Chapter Seven.

## CHAPTER SEVEN: DISCUSSION AND CONCLUSION

### 7.1 Introduction

The study was premised on three research questions which were presented in Section 1.3 of Chapter One. These were:

1. Which household socio-economic factors explain car ownership decisions in developing world context where informal public transport is plentiful?
2. Which attitudes towards cars influence car ownership?
3. Which attitude towards public transport influence car ownership?

These research questions have been addressed through the literature review, focus group discussion and the household survey which was undertaken in ten communities in the city of Accra. In this concluding chapter, the thesis draws together the findings of each phase of the study, explicitly in relations to the research questions. It also sets out to explain, in light of the findings, what the unique contributions are of the study to the wider literature on car ownership. The findings are organised by drawing together the evidence to answer each research questions. This is followed by a discussion on the key contributions to knowledge that have emerged from this study. The chapter also discusses the limitations of the study and also the suggestions for further research.

### **7.2. Research Question 1: Which socio-economic factors explain car ownership decisions in a developing world context where informal public transport is plentiful?**

This research question aimed at discussing the various household socio-demographic factors that influence car ownership decisions in a developing country city like Accra. As noted in Chapter Two, specifically Section 2.4 there has been a plethora of research about the contribution of various socio-demographic factors to car ownership decisions. The researcher categorized the available variables primarily into: Individual and household demographic factors and built environment attributes. Based on the literature review the variables considered important under the individual or household demographic factors which were carried forward into this research includes; household income, household size, number of people employed in household, household head attributes, educational level of household members, gender of household head, marital status of household head, age of household head, number of children, number of license holders and family type. The built environment

attribute considered include public transport accessibility. The contribution of the various variables considered are undertaken in the context of an almost universal and saturated but poor quality informal public transport system.

### **Household Demographic Characteristics**

The literature review undertaken in Section 2.4.1 underscores the importance of income as a major factor that underpins the ability of a household to own a car especially in developing countries where there exist low standard of living (Belgiawan et al., 2014, Wu et al., 2016, Luke, 2018). In addition to the dominance of income, the review also indicated the importance of various other household variables like gender of household head, size of household, type of family among others. This study confirms the dominance of income as the single biggest explanatory factor. The household characteristics that were identified to be the significant apart from household income were number of household members employed and educational level of the household head. Analysis of the correlations suggest that educational level and number of employed household members added explanatory power to income so are not the same, but clearly there is some logical association with both variables relating to the likelihood of income being available for owning a car. Hence the higher the level of education of the household head is seen to positively affect the income and this can also be said of the number of household members employed. This finding suggest that with a higher GDP and increasing income in Accra and Ghana, we expect car ownership levels to rise.

Another household factor that was seen to influence the car ownership of household had to do with number of license holders in a household. The study indicated a strong link between license holding and ownership of cars. A novel finding resulted from the selection of dependent variables for car ownership modelling. Whilst most previous works are seen to have use the categorisation of; household with no car, household with one car, household with two or more cars etc as their dependent variables in undertaking modelling this research adopted a different approach which involved intermediate category of households with drivers license. It also limited the car owning category to simply households with one or more cars. This was done as a result of a number of reasons. Firstly there existed few households with more than one car (forming 10.2% of respondents and, because of the sampling approach, the reality is that this group is even smaller percentage of the overall population of

Accra). Secondly, there existed quite a large proportion of households with license but no access to car. This is not a category which exists to the same degree in developed countries and might therefore say something interesting about the group of people who, at least from a practical licensing perspective were closest to being able to own a car. It, at the very least, allowed an exploration as whether this group had distinctive characteristics to the no-car no license group and the household with car and license group. Hence the dependent variables used for the modelling exercise included: household with no license, household with license and no car, and household with car. This was in fact a differentiating fact in the models as shown in Section 6.4.

### **Public Transport Accessibility**

A review of various public transport accessibility measures were undertaken in Section 2.4.2 of Chapter Two. The review indicated that whilst many studies have been undertaken in measuring the impact of transit accessibility on car ownership, most of the studies reviewed had been done in the developed countries who are seen to have formalized public transport system. With respect to the developing countries where such studies were undertaken, the research identified that they also measured transit accessibility impact using services which were seen to be regularised with no evidence from areas where public transport were seen to be operating in an informal environment. In attempting to rectify this shortcoming in the literature the research encountered methodological challenges. For example, in Accra the non-existence of bus stops which could be used as reference point for assessing accessibility to public transport is problematic and questions about walk times to stops seemed difficult for participants. Similarly, in the absence of timetabled service wait times were difficult to answer. It seems difficult, given the very widespread coverage of informal transit to make meaningful assessments of the role of public transit accessibility in car ownership decisions. Overall distance to nearest major streets using google maps were easier to capture and at least provided a common methodological position. In undertaking the measurement of accessibility as discussed in Section 5.6, the research adopted both subjective and objective measures. The subjective measure had to do with asking respondents the likely time it takes to get to a bus route (i.e. travel time to bus stop) and the waiting time for bus. The objective measure on the other had to do with using google maps to access the distance from a respondents house to the nearest public transport route. The use of these two measures



afforded the researcher to be able to measure the relationship between the actual distance and the perceived time that was seen to be used by a respondent. The study indicated that car owners were seen to be reporting higher travel time and waiting time as compared to the non-car owners. The analysis in Section 5.7.1 and 5.7.2 show that the higher reported time is because of difference in perception.

An advantage identified in measuring the transit accessibility had to do with the low levels of travel distance that existed in accessing public transport service. Generally it was identified that 76.6 percent of households lived within 500m of a bus route. This is an indication that generally, households within Accra can be seen to have close proximity to public transport services.

With this measure, the research used distance to a transport route as a proxy for defining access to transit in undertaking car ownership modelling. The models in Section 6.4.1 show that there was a negative relationship between public transport access and car ownership, suggesting either that car owners can manage their activities whilst living in housing less accessible by public transport or that they prefer to be away from public transport routes. As the data in Figures 5.13 shows, once a car is owned it is used for the overwhelming majority of all journeys for all purposes, suggesting that it allows for living further from routes without a loss of convenience. The findings indicate that poor accessibility seemed to be a strong factor (stronger than income within this sample) in encouraging people to get a license and aspire to getting a car. However, it was income that had a stronger impact on actually getting a car.

### **7.3 Research Question 2: Which attitudes towards cars influence car ownership?**

The aim of this research question is to ascertain how attitudes towards car supports the growth of car ownership in a Sub Saharan African city. The literature from the developed world context and more recently, India and China shows that there is a positive association between attitudes to the car and car ownership. The direction of causality is not clear as it could be that the decision to own a car leads to an adjustment of attitudes in order to avoid dissonance amongst owners. However, it is hypothesised here that the role of attitudes could be different, not least because only 5% of cars in the country are brand new, most are imported and the average age of a car that is purchased is nine years. The understanding of

the car as status symbol may also be distributed very differently within the population where other more basic needs in housing for example might be more important. To accomplish this task, review of literature and undertaking focus group discussion provided the needed statements that were used in the data collection exercise. Principal Component Analysis (PCA) was used to determine the major factors that stand out of the list of statements used. Based on the factors obtained in the PCA analysis, they were further subjected to modelling to understand their role in car ownership decisions. The PCA of 19 statements revealed five factors namely; Instrumental, Symbolic Affective, Independence, Social Stigma and Social Orderliness. Together the five factors were identified to explain 63.76% of the total variance. The first two factors explaining attitudes of households towards car are the instrumental and symbolic affective. These factors are seen to be consistent with previous studies by Steg et al. (2001) and Steg (2005) about car ownership and use and generally agreed with Dittmar (1992) model of material possession which had instrumental, affective and symbolic as motives for possessing goods.

The strong loading on the first factor which is the instrumental factor (explaining 26.45% of variance) suggests that living in the city of Accra without a car is perceived to be difficult to cope with. The strong loading of the instrumental factor can also be suggested to one of the drivers of the high intentions of car ownership among non-car owning households, evidenced by a reported desire to own percentage of 97.7. The relevance of the instrumental nature of owning a car was affirmed in the MNL and NL models in which they were identified to be a significant determinant of car ownership. As income has been identified to be the major determinant of car ownership in Accra, without efforts to improve the quality of alternative modes of transport like the existing public transport system then the perceived relative instrumental importance of owning a car will further support the growth of ownership.

The second factor that was identified was the symbolic affective factor. Whilst the symbolic affective factor has been determined to be a major factor, generally loading more than the instrumental factor in most developing countries where such studies has been undertaken this research presents a different picture (Van and Fujii, 2011, Van et al., 2014). This could be attributed to the context of the study. This is because in Accra, the research found that most cars are aged second hand (As shown in Section 5.5.5) hence what stands out from the attitudinal analysis is the utility value of the car rather than any emotional attachments. This

was reflected in the MNL and NL models in which symbolic affective factors were found to be insignificant determinant of household car ownership. This can be seen as an advantage that can be exploited in an attempt to ensure the reduction in the growth of car ownership since the emotional attachment to car ownership is lower. It is certainly a potentially important finding to other researchers considering ownership decisions where the market is mostly older second hand cars.

The third factor that was identified was independence. This factor also indicates the positive attributes the car possess that makes it more attractive as compared to other modes of transport. To that extent it was identified to be a significant determinant of car ownership in the NL and MNL models. However, car owners were identified to value independence more as compared non-car owning households. This factor is of much importance especially when comparison is made of the comfort and convenience the use of one's car provide as compared to using public transport. The findings related to the significance of independence emphasizes that in Accra, the public transport system seems to not offer the same feeling of independence. It is, for example, necessary to wait for trotro drivers to fill their vehicles before setting off and it is possible that they will divert from routes.

Social Stigma appeared to be a factor that makes this study distinctive from the previous studies. This factor reveals the existing perceived social expectation and comparison among transport modes. Whilst it has been established that car is seen to have a superior preference in the city of Accra as compared to public transport, this factor reveals an unseen influence the society plays in promoting car ownership. Hence it can be deduced that aside income and the instrumental advantage the car provides, the expectation of the society encourages households to own car once the resources exist. This clearly indicates the need to educate the population even with the improvement of public transport as such improvements alone cannot deal with the perception of the society on the superiority of car over public transport. Social orderliness has been identified to be a factor that is seen mostly in the developing country context as a result of the peculiarity of environment (Van and Fujii, 2011). The factor captured statements that had to do with environmentally friendliness of a car and how disturbing a car is to one's neighbourhood. The study reveals that the average mean score for social orderliness statements for the car is neutral. The NL model reveals that social

orderliness factors is considered to be insignificant among car owning and non-car owning households.

The factors discussed in this section indicates that positive attitudes towards car is a major force in the support of car ownership. The findings also show that residents of Accra, regardless of their car ownership status and use of travel modes, perceive cars as superior to public transit in most respects. Whilst car in Accra presents unparalleled advantages, the underperformance of the public transport system together with the societal view of cars can be seen as incentives for the continuous positive view of car ownership.

#### **7.4 Research Question 3: Which attitudes towards public transport influence car ownership?**

This research question sought to understand how the attitudes towards public transport influence car ownership. This study can be said to be distinct from previous literature on attitudes to car and public transport because specific statements reflecting the state of public transport in Accra were used instead of using similar statements for both car and public transport. This is because the views that were expressed by participants during the focus group discussion indicated the nature of statements that needed to be adopted rather than using only generic statements found in literature (See Section 4.5.3.5 for statements used). The five factors obtained after the PCA explained 69.16% of the total variance. The five factors were named On-board Experience, Staff Conduct and Safety, Social Orderliness, Instrumental and Social Stigma. The five factors obtained in the PCA were further used in the modelling exercise.

The factors captioned as 'On-board Experience' and 'Staff Conduct and Safety' represent aspects of public transport use which have not been prominent in the literature. These factors indicate the uneasiness which users of public transport feel exposed to whilst on board together with the conduct of operators of such services. Because of the informal nature of their operations there exist limited standards in terms of customer satisfaction. Whilst some studies indicate that car owners and public transport users view their respective modes more positively than others (Beirão and Cabral, 2007), this research presents a case in which both public transport users and car owners have similar attitudes towards public transport which is mainly negative. The strong loading of On-board Experience and Staff Conduct (i.e. 24.5%

of total variance explained) which is generally considered to be negative especially among public transport users also indicate that, these users are currently captive users on a service that they do not like.

Social Orderliness and Social Stigma were found to produce similar results between non-car owning households and car owning households. First, the social orderliness aspect of public transport was a common concern of the respondents in Accra. This implies the desirability of improving public transport service in terms of “social orderliness”. The social orderliness aspect of attitudes towards public transport in this research reinforce the importance of this factor in developing countries as reported by Van and Fujii (2011) and Van et al. (2014).

Whilst the study has indicated the existence of a lot of negative attributes of the public transport service in Accra, the instrumental factor presents a different picture. The instrumental factor captures the accessibility and reliability of the existing public transport service. Generally the results indicate that there exist a public transport service that is widely available in the city of Accra. This can be explained to be due to the comparison between the two modes by car owners. The positive attribute of the instrumental factor especially among the non-car owners provides an advantage that can be exploited and developed by policy makers.

Most of the studies reviewed, in both developing and developed countries, suggested that high car ownership intentions can be moderated by the provision of appropriate public transport. If set against the widespread availability of public transport, it appears that the questions of provision in Accra relate to other concerns about the service. The PCA for public transport supported the findings of the literature review (Salon and Aligula, 2012, Verma, 2015, Wu et al., 2016, Luke, 2018), suggesting that mere provision of public transport service is inadequate to drive behaviour change, and that public transport service should provide comfortable and efficient service in order to be a viable alternative to the car. This could be particularly important here, as the car does not have the same symbolic appeal to individuals as cars are generally imported as second hand models and have a high average age.

### **7.5 Policy Recommendations based on findings of Research**

One key aim of this research is to provide policy relevant insights concerning reducing the growth of car ownership based on findings from RQ1 to RQ3. Accra presents an important

case study of an African city's transportation system, its corresponding challenges car ownership pathway. Accra is currently in an early or a relatively young phase of motorization, when assessed by vehicle ownership per capita. This findings suggest that automobile ownership and use will increase rapidly and successively with income growth, thus problems associated with motorization such as traffic congestions and air pollution will go from bad to worse.

There exist many potential pathways for Accra in relations to the transportation system, some of them include: the pathway towards a more auto-centric African city or; the pathway towards a more environmentally sustainable city. A shift towards a more environmentally friendly city requires a better understanding not only socio-demographic factors of households and attitude towards various transport modes available within the city but also various policies that can be implemented within the city to affect motorization. Based on this premise, the researcher highlights various policies and interventions that can be implemented within the city of Accra to help reduce the influx of car ownership. Evidence suggests that policies should be designed towards specific target groups (Anable, 2005). Segmentation's real value lies in its ability to be used in the design of achievable strategies by using the information to guide decision. Policies discussed in this section targets the majority of households who do not own cars and car owning households. The various policies considered are discussed below.

### **Minibuses/Paratransit System Upgrading**

Based on the findings in Chapter Three with respect to policies implemented to ensure sustainable transport within Accra and to a large extent Ghana, it was realized that the concentration over the years has been aimed at improving public transport. This is primarily because of the low car ownership levels within the city. Also, it is important to note that several prior studies found that once a car is owned, the owner's driving tendency is not influenced by the transit system, no matter how efficient and convenient it is (He and Thøgersen, 2017). Hence it is critical for more sustainable mobility patterns in Accra and that the city authorities continue their effort to develop and implement transport policies that effectively stop people from perceiving a need or benefit from owning a car in the first place. Fortunately as shown in this study, the share of public transport modes in Accra is still relatively high due to the low income level and absence of alternative modes of travelling

hence provision of good public transport system will help to reduce the shift from public transport use to car ownership by households. A review of various policy interventions and implementation over the years have led to the continuous dominance of the trotro usage even though they are seen to have poor quality of service. This is currently acting as a push factor towards car ownership. Currently, paratransit reform tends to be addressed mainly through BRT projects, which have become popular in transportation planning in Africa through a complex process of “policy transfer” from Latin America (Klopp and Cavoli, 2019). As explained in Section 3.6.2 and Section 3.6.3, the introduction of high capacity bus fleet with good service have not necessarily led to usage of these services in Accra. As a result of these underlying factors, trotro (which has low capacity with rickety fleet) continues to enjoy dominance among households that use public transport in the city of Accra. Given all these indications, it suggests that the trotro system in Accra is likely to be core part of the public transport networks well into the future as realized in other parts of Africa (Behrens et al., 2015, Klopp and Cavoli, 2019). To this extent, rather than focus primarily on mass transit and Bus Rapid Transit, transport planning within the city will need to embrace and work better with the paratransit regardless of the difficulties and complexities. While engagement with the paratransit system is difficult, the continuous dominance of the system suggests that engagement must continue in new contextually appropriate ways and not just within BRT projects as realized to be the case in Accra. Hence, there should be shift from “displace and replace” to “embrace, engage and upgrade” (Jennings and Behrens, 2017).

The study has echoed previous concerns about the poor service delivery of minibuses with respect to on-board experience, staff conduct and safety. To this extent policies must be implemented with the aim of improving paratransit system in the city of Accra by upgrading their service and integrating them into the overall public transport network within the city. To this extent the researcher suggests the various approaches to be adopted in improving trotro services in Accra.

Firstly, transport planning authorities in the city of Accra should see the improvement of the trotro system as a major project rather than a subsidiary to other projects like the planning of BRT projects only. To this extent the trotro system in Accra should not be seen as an obstacle for implementing reform or competition for any formal system. To be able to comprehensively address the issues in order to be able to improve the services of the trotro

system, the gap in data on the operation of minibuses in the city seems important to address. This data should include routes, stops, frequencies, passenger volumes, fares, ownership structures and revenues of the trotro system. The existence of such data would allow better understanding of the performance and functioning of the trotro service within the overall urban public transport system. It would allow more fine grained corridor by corridor analysis and an understanding of which communities are better served, as well as revealing how large scale projects can impact the system that majority of citizens rely on. One major intervention that is seen to be important in understanding the operations of the paratransit system is the mapping of minibuses. Cities like Maputo and Nairobi have undertaken such exercises with the aim of facilitating the process of formalizing the paratransit system (Klopp and Cavoli, 2019). This research has revealed that households rely mostly on user experience to indicate the distance and waiting time for trotro services. Saddier et al. (2016) and (Saddier et al., 2017) undertook study to map trotro network using smartphones in Accra. The research found that most paratransit routes appear to be relatively stable in Accra suggesting that the operations of trotro buses are not perhaps as remote from mass transit as might be suggested. With this study limited to some areas within the city, the researcher suggests a citywide study so as to be able to map trotro services which can help in the formalisation of the service and also improving reliability and accessibility. This could enable more fine-grained car ownership models to be developed against different service criteria, something which is currently impossible.

Another major policy initiative that would need to be advanced by the Greater Accra Passenger Transport Executive (GAPTE) in order help in the upgrade of the trotro system is to modernize fleets and improve road worthiness of trotro buses. A major finding from the questions on households' attitude towards public transport revealed that on board experience was a push factor to car ownership. Also attitudes towards the trotro services captured the nature of buses which were seen to be rickety and noisy. Whilst the environment did not come out as a very important factor, renewing the fleet on comfort grounds could further advance this goal. An advantage that exists within the trotro system that can be harnessed is the existence of strong and influential cooperative bodies like the Ghana Road Transport Union (GPRTU). The findings from this study should make the GPRTU realise the importance of engaging and improving their system in the long-term interests of the market



for their members. The GAPTE together with the Ministry of Transport can work with the various bodies within the trotro system to develop vehicle renewal incentives such as providing cooperative loans for owners of vehicles. With the implementation of this plan, GAPTE could, over time, determine the specification of buses that qualify to be used.

Another finding that had to do with the conduct of operators of trotro service which affected the service quality that are delivered. Section 3.6.1 indicates that each trotro van has two people working on it which includes the driver and the assistant (mate). In order to improve upon the conduct of these operators, there is the need to provide training using their cooperative unions as a medium. In addition, there should be stringent qualification measures put in place by GAPTE, so as to reduce the number of untrained drivers who operate the trotro system.

### **Hybrid Public Transport System**

Section 3.6 describes the three main forms of public transport in the city of Accra which include the trotro system, Metro Mass Transit (MMT) and Aayalolo service. Whilst the trotro system is seen to be dominated by private operators, the MMT and Aayalolo service have been government led initiatives. The research has indicated that with the exception of the Aayalolo service which sought to inculcate the operations of the trotro system mainly as a feeder system there seems not to be any proper plan of coordination among these services in the city. As a result all these service run various routes simultaneously hence preventing the benefits of especially the mass transit services like the Aayalolo to be clearly seen by users of these services. Also, Aayalolo service did try to address a lot of the concerns of the users of public transport but because it was not really integrated properly and priority was not given on all roads, the actual benefits diminished. This is one reason why coordination is necessary to properly enhance the quality of some, particularly longer distance trips. There is therefore the need for the GAPTE which is mandated for the management and execution of public transport reforms to undertake various policies that is aimed at ensuring the existence of hybrid public transport system in Accra.

### **Restrictions on Car Use**

The research indicates the overwhelming desire of non-car owning households to own a car when they can afford to do so. Also there exist a strong reliance of car owners on using car

for various trips purposes because of the instrumental convenience factor. In addition to these, there exist positive attitudes toward car by both car owners and non-car owners. The positive attributes of Independence, Instrumental and Symbolic Affective are identified to be factors that propel car ownership. One major indicator that have been identified to restrict the growth of car ownership in the city of Accra is income of households. Hence with improved standard of living, there will be upsurge of car ownership without policies that directly limit the use of cars. It is important to note that, whilst car ownership levels are relatively low, congestion levels and parking issues are not at all as severe as they will inevitably become if growth in car ownership and use is left unchecked. How attractive car use will become will be dependent on the choices which are made about giving priority to bus and trotro services and to managing the demand for road space and parking. Implementing policies that directly limit the use of car has a dual advantage of restricting car owners from freely using their cars and also serving a detractor to non-car owning households in purchasing vehicles. One major means of restricting the use of car is to reduce access of cars to the city centre whilst enhancing access for public transport. Given the importance of the city centre as a site of economic activity, starting here and improving the relative cost and convenience of public transport could be a major signal to dampen the perceived value of car ownership.

Another policy implication of our findings is that income is associated with ownership. By income it really means disposable income and so policies that make the acquisition, holding or use of cars will curb the growth in the number of cars. Interventions such as these can be justified by the fact that car owners do not pay for the full external costs of driving (Steg, 2003). Hence making cars expensive to own is a necessary component of any effective policy to curb the growth in the acquisition of popular products such as cars. Given the lack of domestic car industry, the government has a potential tool of import taxes or purchase taxes to limit growth.

## **7.6 The contributions of this research**

The primary contribution of this research is empirical, providing an in-depth case study on car ownership among households in a developing country city especially in a Sub Saharan Africa.

The contribution of the research provides a detailed account for other researchers and policy-makers to utilise. The original contribution of this research is centred around the following key areas: utility value of a car, the importance of the license no car category, defining accessibility to public transport in a ubiquitous system and dominance of informal transport system. These novel findings are discussed below.

### **Utility Value of a Car**

The purchase context in Ghana is not the same as in much of the developed Western literature. There, new car purchase is largely based on the role of the car as status symbol. Whilst this has some parallels in Accra, most cars are second hand (93.2% of respondents own second hand cars) and what stands out from the attitudinal analysis is the utility value of the car. This is further supported by the finding that majority of the cars owned were purchased when they were over ten years (54.4% of respondents have cars aged over ten years when purchased). This is an important source of difference between car ownership decisions in Accra and more developed economies. With sampling in this studies skewed towards households in high income communities, the finding indicates that even those who are more affluent in society are likely to be buying second hand vehicles, some very old indeed.

The prevailing purchase context has given rise to different attitudinal consideration for cars which is more related to the utility value the car provides. The attitudinal analysis indicates a strong rating of factors such as instrumental and independence factors. These factors projects the utility value the car projects over and above the status symbol value the car gives which was represented with symbolic affective. The finding in this studies projects a different conclusion in similar studies undertaken in some emerging economies in Asia. For instance, the finding in this research is contrary to results in some emerging countries like Philippines, Vietnam and Indonesia (Belgiawan et al., 2016b, Van et al., 2014) in which symbolic affective factor has been seen to be significant factor in car ownership over and above utility considerations like the instrumental factor.

The dominance of the utility value of cars by respondents were reported both in the focus group discussion and the household data collection process. The studies have shown that, in a relatively low car owning environment with a purchase context of mostly second hand cars

which are mostly aged, the attitudinal response indicates the utility value placed on the car more than the emotional attachment the car presents.

### **The Importance of the License No Car Category**

Another contribution the research makes is the novelty of understanding the license no car category used in the modelling, being clear this is a distinctive group within Accra. This is not considered in the western studies where it is a dichotomous car/no car decision. One of the factors which explains the category of households with license and no car is access to other cars which appears to come from a broader range of sources that in developed countries.

The research indicates that 60.4% of households who have access to other cars are households who do not own car. This was identified to be an indicator of households who do not own cars but have licenses (24.7% of households with license but do not own car indicates that access to other cars influenced their decision to own cars).

The source of access to other cars as presented in this research also indicates different and peculiar sources that seen not to be noticed in the literature. For instance, 55.8% of household who have access to other cars indicate that the source of access is from government agency. This means that as a result of working for a government agency, a member of the household is able to access a government owned car. The second dominant access to cars that was reported in the research was private companies (forming 32.6%). Access to cars from relatives was identified to the lowest (forming 11.6%). Whilst these findings are preliminary they provide a platform for further research into the effects of access to cars from sources such as private companies and government agencies have on car ownership research.

### **Defining Accessibility to Public Transport in a Ubiquitous System and Dominance of Informal Transport System**

An attempt was made to capture the impact of accessibility of public transport in an informal certain on car ownership. Whilst the factors used were both objective and subjective, the findings indicated that like the developed world where accessibility to public transport is seen to influence car ownership, in Accra there exist a relationship. This appears to relate to the widespread coverage of informal public transport which is recognised by both car owners and non-car owners. However, the measures developed to capturing accessibility to public

transport in an informal context can be improved. In addition, it appears that access to destinations rather than access to services could be preferable as a measure given the importance of the instrumental benefits of a car and more door to door services. However, the lack of formal timetables and route coordination makes such destination based measures difficult to establish. Mobile phone traces of routes over repeated periods might be one way of backwards estimating destination accessibility.

In addition, the research reveals the continuous dominance of an informal transport system in the phase of attempts for improvement through mass transit means. Section 3.6 describes the three main forms of public transport in the city of Accra which include the trotro system, Metro Mass Transit (MMT) and Ayalolo service. Although, the research indicates a number of negative attribute of the existing informal public transport system, policy interventions by the government seem to have focussed on creating new types of services and have been seen to be unsuccessful. Efforts to reform the quality and operational conditions of the existing fleet are revealed to be potentially important to influencing car ownership.

### **7.7 Transferability of Results**

The research undertaken sought to understand household car ownership among developing countries with emphasis on Sub-Saharan African countries. However, as a result of resource and time constraints, Accra was chosen as a case study. The potential benefit of an improved understanding of the applicability and transferability of research findings is particularly great for low income countries, which have fewer resources to conduct their own research and are therefore more likely to have to look elsewhere, if they are to use research in their decision-making (Burchett et al., 2013). Although Accra was chosen as a case study, the research presents an opportunity for some of the findings and methods to be applicable to other Sub-Saharan African cities. Given (2008), indicates that to increase transferability, researchers should focus on two key considerations: (a) how closely the participants are linked to the context being studied, and (b) the contextual boundaries of the findings. To this extent, the case study context is compared to some SSA cities in order to identify some areas of similarities that exist among them which in turn increases the ability to transfer some of the research findings to those context.

Accra as a case study context compares favourably to a number of SSA cities within a number of prevailing characteristics. The research indicates that there exist virtually no car assembling and production in Ghana hence the country relies heavily on imported cars. Also, this research indicates that 93.2% of cars owned are second hand cars. Other SSA countries also have higher imported second hand cars. For instance, more than 96% cars imported into Nairobi are second hand cars (Baskin, 2018). In addition in Addis Ababa and Lagos second hand imported account for more than 80% of cars owned (Baskin, 2018). Another similar characteristic that exist among SSA cities is the dominance of informal public transport. In this research, the trotro is seen to be the most frequently used mode with 71.2% of mode share. In Lagos, the informal public transport minibuses known as “danfos” has a mode share of over 70% in 2017 (Alcorn and Karner, 2020). In addition the “matatus” in Nairobi, Kenya also has a mode share of over 75% in 2017. (Klopp and Cavoli, 2019). Another similar characteristic that exist among SSA countries is the use of old cars. According to this research the average age of car used in the city of Accra is 14years. The average age of cars used in Lagos and Nairobi is 15years in 2015 (Schiller et al., 2016). The factors enumerated above shows that there exist similar prevailing situations between Accra and other SSA cities. Hence although, Accra was the only chosen research area, the similarities provides a foundation for selecting Accra as a representative of SSA city.

Although, there exist similarities, the data collection approach adopted in this research needs to be considered when considering the findings for other SSA cities. Firstly, the data collection approach used surveyed predominantly high and medium income households. This was undertaken in order to increase the chance of getting households that own cars. Hence, the findings cannot be said to be representative of the entire city of Accra and by extension to other SSA cities such as Lagos. However, the approach used in this research provides a foundation for undertaking car ownership studies in developing country cities with limited resources and lack of time series data to undertake analysis. The key factors which the study identified such as importance of income, utility value of car and perceptions of the quality of public transport all seem to resonate with descriptive literature on the state of transport in other SSA cities.

### **7.8 Similarities and Differences between Accra and other Developed country cities.**

The research has identified explanatory variables which can be seen to be similar in some respects to those experienced in the developed city context whilst having some important differences. The prominent explanatory variable that was identified as similar in the both contexts is the positive influence of household income. In this research high income was identified to correspond positively with a household's ability to own a car. This finding is in tandem with numerous car ownership studies which have been undertaken in the developed world context. Most car ownership in developing world cities indicate that car ownership tends to increase with increasing household income (Anowar et al., 2014, Eakins, 2013, Potoglou and Kanaroglou, 2008). Another variable that was identified to have similar influence in Accra as well as most developed countries is the number of household members employed. The study found that the number of household members employed was identified to increase the probability of a household owning and car. Research conducted by Karlaftis and Golias (2002) conducted in Greece, Bhat and Guo (2007) conducted in San Francisco Bay, USA and Potoglou and Kanaroglou (2008) indicates that households with more employed people and increased license holders have higher probability of owning cars. Kim and Kim (2004) and Potoglou and Kanaroglou (2008) indicates that this happens as households with more employed people have greater mobility needs. There will also be a relationship between the number of employed people and household income. Also, the level of education of household heads was identified to positively influence household car ownership. This finding was identified to be similar with some car ownership studies in the developed world context. For instance, Nolan (2003) and Nolan (2010) in undertaking car ownership studies in Ireland also found significant positive effects for the education of the head of household. Higher levels of education have two indirect positive effects on car ownership. Firstly, it increases the probability of getting into the labour market and secondly, it increases the probability of getting a higher wage.

There exist other variables that were identified to be different in Accra as compared to other developed cities. For instance, Symbolic Affective factor is surprisingly seen not to be a significant factor in explaining car ownership. This is contrary to results in some developed countries (Belgiawan et al., 2016b, Van et al., 2014) in which symbolic affective factor has been seen to be significant factor in car ownership. One reason why this factor may not

emerge as important could be due to the purchase context in Ghana which is not the same as in much developed western literature. There, a new car purchase is largely based on the role of the car as a status symbol. Whilst this has some parallels in Accra, most of the cars are imported as second hand cars. Steg (2005) performed two studies to examine various motives for car ownership and use. In the first study in Groningen (Netherlands), the results based on exploratory analysis showed that symbolic-affective factor was the most important fact for car use decision. In the second study which took place in Rotterdam also indicated that car ownership was mostly related to the symbolic-affective factors and not to instrumental motives. This is different from the context of Accra in which there is the dominant emphasis on the utility value of cars. This research has shown that, in a relatively low car owning environment with a purchase context of mostly second hand cars which are mostly aged, the attitudinal response indicates the instrumental or utility value placed on the car more than the emotional attachment the car presents. The strong emphasis on the instrumental value of cars is also reinforced by the nature of informal public transport services which operate in the city of Accra. The public transport in operation in Accra are mostly informal with no timetables, designated bus stops and use of rickety vehicles. To this extent, there existed negative attitudes towards public transport by both car owners and non-car owners and therefore providing no viable alternative for car ownership.

Table 7.1 summarises the key similarities and differences identified from this study with the findings from developed world studies.

**Table 7. 1: Similarities and Differences between identified explanatory variables in Accra and other developed country cities**

<b>SIMILARITIES</b>		
<b>Factor</b>	<b>Accra</b>	<b>Developed World (Europe/Northern America/Australia/Japan)</b>
Income	Positively impact car ownership	Positively impact car ownership
Number of household members employed	Increases the probability of owning a car	Increases the probability of owning a car
Educational level of Household Head	Resulted in higher probability of owning a car	Resulted in higher probability of owning a car
<b>DIFFERENCES</b>		
Number of Children	Identified to be insignificant	Is seen to impact on car ownership both positively and in other context negatively



Symbolic Affective attitude towards cars	Not seen as significant factor	Identified as significant factor
Attitude towards public transport	Mostly negative by both car owners and non-car owners	Mostly negative attitude by car owners.

### **7.9 Lessons from Developing City (Accra) for other Developed Cities**

A case study on car ownership among households in a developing country city especially in Sub Saharan Africa presents a number of situations that make it distinct from carrying out similar studies in a developed city like Leeds. The various areas of distinction include the data collection methods to adopt, stage of motorization of the city and forms of urban transport available. Firstly, with respect to undertaking the survey, the proven method for data collection especially in Accra was identified to be face to face collection mainly because of levels of education and access to the internet. To this extent, online based methods which are patronised by developed cities like Leeds was not adopted. Although drop and collect method was used as means of data collection it had the minimum contribution of 23.4% of the questionnaires collected.

Another reason that undertaking a car ownership study in the city Accra is different from a developed city like Leeds had to do with the stage of motorization that is been experienced. Whereas a city of Accra can be seen to be in the early stages of motorization, most developed city are dealing with peak stages of motorization. The purchase context in Accra is not the same as in much of the developed Western literature. There, new car purchase is largely based on the role of the car as status symbol. Whilst this has some parallels in Accra, most cars are second hand (93.2% of respondents own second hand cars) and what stands out from the attitudinal analysis is the utility value of the car. This is further supported by the finding that the majority of the cars owned were purchased when they were over ten years old (54.4% of respondents have cars aged over ten years when purchased). This is an important source of difference between car ownership decisions in Accra and more developed economies.

Thirdly, a major difference in undertaking car ownership studies in Accra is the form and operations of public transport. Whilst, a city like Leeds has formalized public transport with known routes and timetables there exist different scenario in Accra. The study has revealed

that most of the public transport services in operation in Accra are informal in nature. The study indicates that whilst there exist no formalized way of measuring accessibility there appears to be widespread coverage of informal public transport which is recognised by both car owners and non-car owners. Issues like reliability of services when there is no timetable become more socially constructed and safety sometimes involves crush and overloading which are normalised in Accra but not in developed economies. The levels of training of staff and vehicle maintenance are all very different. So whilst it is possible to ask the same questions with the same words, the meaning to the respondents is very different.

### **7.10 Relevance of this Research to City Authorities**

This research presents a number of benefits to the city authorities that can help inform policy and various interventions in dealing with household car ownership in a developing city like Accra. The relevance of this research to the city has been outlined below.

- **Introducing Household Car Ownership Studies**

Although, there exist a plethora of car ownership studies as discussed in the Chapter Two, such studies has not been undertaken in the city of Accra. This is especially important in the context of Accra because of the stage of motorization the city finds itself. Accra is currently is in an early or a relatively young phase of motorization, when assessed by vehicle ownership per capita. This findings suggest that automobile ownership and use will increase rapidly and successively with income growth, thus problems associated with motorization such as traffic congestions and air pollution will go from bad to worse. There exist many potential pathways for Accra in relations to the transportation system, some of them include: the pathway towards a more auto-centric African city or; the pathway towards a more environmentally sustainable city. A shift towards a more environmentally friendly city requires a better understanding not only socio-demographic factors of households and attitude towards various transport modes available within the city but also various policies that can be implemented within the city to affect motorization. This research therefore provides an opportunity for the city authorities to aim at projecting the impact of household car ownership in the city generally rather than concentrating on addressing the issues of public transport alone which has been the case in many years. The introduction of discussion of

household car ownership in a relatively low car owning context like Accra will also help to introduce policies that help address the numerous externalities that has bedevilled cities with high car ownership per households. The earlier such decisions are taken the easier they may be to implement, as it is still very much the minority of people in Accra who have access to a car.

- **Provides empirical background for promoting and improving Informal public transport**

This studies has re-echoed the dominance of the use of public transport as the main mode of transport for households in Accra. Among the various public transport options available in Accra, the trotro continues to dominate as the main mode of transport as shown in Section 5.6. However, public transport reform tends to be addressed mainly through BRT projects, which have become popular in transportation planning in Africa through a complex process of “policy transfer” from Latin America (Klopp and Cavoli, 2019). As explained in Section 3.6.2 and Section 3.6.3, the introduction of high capacity bus fleet with good service have not necessarily led to usage of these services in Accra. As a result of these underlying factors, trotro (which has low capacity with rickety fleet) continues to enjoy dominance among households that use public transport in the city of Accra. Given all these indications, it suggests that the trotro system in Accra is likely to be core part of the public transport networks well into the future as realized in other parts of Africa (Behrens et al., 2015, Klopp and Cavoli, 2019). To this extent, rather than focus primarily on mass transit and Bus Rapid Transit, transport planning within the city will need to embrace and work better with the paratransit regardless of the difficulties and complexities. While engagement with the paratransit system is difficult, the continuous dominance of the system suggests that engagement must continue in new contextually appropriate ways and not just within BRT projects as realized to be the case in Accra. Hence, there should be shift from “displace and replace” to “embrace, engage and upgrade” (Jennings and Behrens, 2017). Hence this research provides empirical findings to city authorities in the Accra to see the improvement

of the trotro system as a major project rather than a subsidiary to other projects like the planning of BRT projects only. The study has echoed previous concerns about the poor service delivery of minibuses with respect to on-board experience, staff conduct and safety. To this extent policies must be implemented with the aim of improving the paratransit system in the city of Accra.

- **Presents basis for the development of citywide car ownership model**

Another important consideration for the city authorities in Accra is the development and advancement of car ownership modelling exercise so as to fashion policies that better address contextual considerations. This study being the first of its kind in the city of Accra sought to understand household car ownership among selected communities. However, much is needed in order to improve the sample size of the research, increase variables considered in addition to helping to understand future situation of household car ownership. Undertaking a city wide car ownership model will help to understand diversity. Whilst this research adopted a static approach in modelling, the dynamic modelling approach can also be adopted when undertaking a city wide modelling exercise. Dynamic models would help to understand the actual purchase decisions and the switch points which seem to be important based on this study.

### **7.11 Limitations and recommendations for future research**

The present study has provided a valuable account with respect to understanding car ownership among households in a relatively low car owning city such as Accra in the Sub Saharan Africa. However, this study has its limitations. Whilst some of these limitations were tackled through good research design, others remained unresolved and hence provides an opportunity to provide recommendations which will guide future research in understanding car ownership in relatively low car owning city like Accra. The highlighted limitations together with various recommendations are provided below:

- The research adopted a cross sectional approach with respect to the data collection as a result of the lack of existing data. Whilst this provides a basis for understanding the current situation with respect to car ownership in Accra, it only provides a snapshot of household car ownership without helping us to understand the trajectory

of car ownership in a relatively low car owning city. Incorporating panel data on the other hand would help to understand changes in household attitude towards car and public transport in addition to observing changes in household socio-demographic circumstances. One might argue that current attitudes towards car ownership do not necessarily reflect future car ownership attitudes, especially if households change their lifestyle. Therefore, this study does not claim that the findings should be directly translated into regression models for demand forecasting even for this cohort. However, it is believed that current attitudes might be one important determinant explaining future intention.

- In this study, each household has been regarded as single utility-maximizing agent. However, households are made up of multiple individuals who play different roles in and interact in many ways in decision making. This is specially the case of households with more than one person working and have different transport needs. Therefore limiting the views of the household head do not necessarily capture the varying travel needs and preferences of other members of the household which might also affect car ownership. The data collection and subsequent analysis used in this current study can be extended to explore these complex intra-household interactions (i.e. interactions among the household members) and the impact of such interactions on household car ownership decisions.
- Another limitation of the research stems from the observation that majority (71.8%) of the household interviewed had male as household head. With the study using the views of household head as pseudo for households it leads to the study being biased towards the views of males especially on attitudes towards car and public transport. Although the dominance of the male as household head represents a true reflection of the study area, there is a need to ponder how interviewing more women will affect the results obtained. In this context, to what extent do the attitudes and preferences and mobility needs of the females impact on the decision making process for car acquisition? Perhaps this is an empirical question, but if there could be an impact, then this is a limitation of the research as the research have systematically not captured this effect by concentrating on the household heads.
- The modelling approach adopted in this research was primarily exogenous static. This approach could be extended by using endogenous models which allow for modelling

car ownership in conjunction with other household choice outcomes such as car use. In addition the adoption of MNL or NL models as used in this research could be extended by using Integrated Latent Class models. In order to undertake such exercises, further extension of this work must aim at increasing the number of households captured within the data collection exercise together with the variables that are collected.

- Another limitation of the study is the oversampling of high income households in the city of Accra. Whilst this provides an opportunity to easily identify households with cars, the research has the limitation of not presenting the actual situation in the city of Accra which is predominantly made of low income and middle income households. Hence there will be need to undertake a research that truly reflects the economic condition of the city so as to understand the prevailing situation.

### **7.12 Concluding remarks**

As a result of the high impact on the environment and liveability of cities, the cost and impact of car ownership have become a subject of scrutiny both nationally and globally. With most of the growth in car ownership projected to happen in developing countries, understanding the context and environment in which such growth happens is important. This thesis has espoused the need for such research especially in Sub Saharan African cities where there exist different contextual considerations. It has developed the survey tools and insights which, in turn, open further avenues for development for future researchers and thus makes a unique contribution to the field of study.

The findings of this research also have practical implications. It has demonstrated that despite the numerous disadvantages that exist as a result of having a highly motorized city, the intentions of households towards car ownership remain very high. This primarily appears to be based on the existence of a ubiquitous but low quality alternative in the form of public transport which can rival the advantages the car provides hence making the ownership of a car a necessity. Although there exist a strong positive attitude towards car by households, the prevailing socio-demographic conditions specifically household income has been seen to be a major determining factor of ownership. This situation, presents an opportunity for policy makers to test the viability of other policy options, specifically with the improvement of public

transport service to change the perceptions of the instrumental advantages of owning a car relative to public transport. There is also a need to manage the growth in car use as, with ever higher numbers, the instrumental advantages of owning a car will diminish through congestion as is seen today in Accra but to much greater extent in more motorized cities. With continuous improvement in the standard of living, the study has identified some locally sensitive policies that might influence car ownership decision with increasing income in a context where there is low car ownership. The empirical assessment of the impact of such policies would be a useful extension of this work.

## **Publications and Conference Papers**

### **Publications and Conference Presentations**

Below is a list of conference presentations that were published or presented during the completion of this PhD.

### **Conference Papers**

**Adjei Appiah S.,** G. Marsden. & J. Anable. 2019. Push versus Pull Factors for Household Car Ownership in Developing Countries: A Case Study of Accra. Presented at World Conference on Transport Research- WCTR, Mumbai, India, 26-31 May 2019.

**Adjei Appiah S.,** G. Marsden. & J. Anable. 2019. Impact of Household Demographic Factors on Car Ownership among Different Household Categories in Developing Countries: A Case Study of Accra. Presented at University Transport Research Group (UTSG) Conference, Leeds, UK, 8-10 July 2019.





## LIST OF APPENDICES

## APPENDIX A: DISAGGREGATE MODELLING STUDIES

Table 1 : Summary of Previous Studies on Car Ownership in the Developed World

<b>Studies</b>	<b>Data Source &amp; Type</b>	<b>Modelling Approach</b>	<b>Vehicle Demand Form</b>	<b>Variables Considered</b>
(Karlaftis and Golias, 2002)	Greece, Road Side Interviews	Binary Logit	Vehicle Ownership	Household Demographics, Life Cycle Attributes, Built Environment, transit attributes, policy
(Ma and Srinivasan, 2010)	USA, Census Micro Data	Ordered Probit	Vehicle Ownership	Household Demographics, Individual Attributes, Life cycle attributes, Built Environment
(Whelan, 2007)	Great Britain, Travel Survey	Binary Dogit	Vehicle Ownership	Household Demographics, built environment, policy
(Bhat and Pulugurta, 1998)	USA, Activity Survey Netherlands, Travel Survey	Ordered Response Logit	Vehicle Ownership	Household Demographics, built environment
(Bhat and Pulugurta, 1998)	USA, Activity Survey Netherlands, Travel Survey	Multinomial Logit	Vehicle Ownership	Household Demographics, built environment
(Potoglou, 2008)	Canada, Internet Survey	Multinomial Logit	Vehicle Type	Household Demographics, Individual attributes, Built Environment,

(Wong, 2013)	Macao, Household travel survey	Multinomial Logit	Vehicle Ownership	Household Demographics, Life cycle attributes, built environment
(Guo, 2013a)	USA, Travel Survey	Nested Logit	Vehicle Ownership	Household Demographics, Employment Attributes, Built Environment, Transit Attributes
(Weinberger and Goetzke, 2010)	USA, Census Micro-Data	Multinomial Probit	Vehicle Ownership	Household Demographics, Individual Attributes, Life cycle attributes, Built Environment
(Bhat and Guo, 2007)	USA, Travel Survey	Mixed Multidimensional choice modelling	Vehicle Ownership	Household Demographics, Built Environment, Transit Attributes
(Bhat and Sen, 2006)	USA, Travel Survey	Mixed Multiple Discrete Continuous Extreme Value	Vehicle Type and Vehicle Usage	Household Demographics, Life cycle attributes, Built Environment,

Table 2: Summary of Previous Studies on Car Ownership in the Developing World

<b>Studies</b>	<b>Data Source &amp; Type</b>	<b>Modelling Approach</b>	<b>Vehicle Demand Form</b>	<b>Variables Considered</b>
(Zegras, 2010)	Chile, Origin Destination Survey	Multinomial Logit	Vehicle Ownership	Built Environment, Household demographics,
(Kermanshah and Ghazi, 2001)	Iran, Travel Survey	Nested Logit	Vehicle Ownership	Household demographics, Employment Attributes, Built Environment, Life Cycle Attributes

(Dissanayake and Morikawa, 2010)	Thailand, Revealed/Stated Preference,	Nested Logit Model	Vehicle Ownership	Household demographics, Employment Attributes
(Dissanayake and Morikawa, 2002)	Thailand, Travel Survey	Nested Logit Model	Vehicle Ownership	Household demographics, Individual Attributes, Employment Attributes, Life Cycle Attributes, Unobserved effects
(Gómez-Gélvez and Obando, 2013)	Columbia	Ordered Response Logit and Multinomial Logit Model	Vehicle Ownership	Household Demographics, Built Environment, Quality of Public transportation, Company cars
(Dash et al., 2013)	India, Consumer expenditure survey data	Multinomial Logit Model	Vehicle Ownership	Household Demographics, Residential location, Employment attributes
(Zegras and Chen, 2010)	China, Household travel survey	Binary Logit	Vehicle Ownership	Household demographics, residential location,
(Zegras and Hannan, 2012)	Chile, Household Origin and destination survey	Multinomial Logit	Vehicle Ownership	Household demographics, Employment attributes, residential location
(Kumar and Krishna Rao, 2006)	India, Household Survey Stated Preference	Multinomial Logit	Vehicle Ownership	Household demographics, Employment attributes
(Wu et al., 1999)	China, Stated Preference Survey	Multinomial Logit	Vehicle Type	Household Demographics, Life Cycle Attributes, Built Environment, transit attributes, policy, individual attributes

**APPENDIX B: FOCUS GROUP TOPIC GUIDE****1. INTRODUCTION**

Invite each individual to introduce themselves (where do they live, name, age, household composition, number of car owned, occupation)

**2. ASPIRATIONS/REASONS FOR CAR OWNERSHIP**

- What are the reasons for owning a car?
- Is there a desire to own a car? If yes why?

**3. ADVANTAGES/DISADVANTAGES OF CAR VS PUBLIC TRANSPORT**

- What do you think are the general advantages of owning a car
- Is there anything you find to be the disadvantage of cars
- What are the benefits of using public transport?
- What are the disadvantages of using public transport?

**4. SOCIETAL VIEWS**

- What type of people do you think usually travel by public transport?
- What type of people do you think usually travel by car?
- How does society view car owners and public transport users?

## APPENDIX C: SAMPLING PROCEDURE

### Sample Size Determination

$$\text{Sample size formula: } n = \frac{N}{1+N(\alpha)^2}$$

Where; n is the sample size

N is the sample frame

$\alpha$  is the margin of error defined at 95 percent confidence level ( $\alpha = 0.05$ )

The sample size was defined from the total number of the seven study suburbs

$$n = \frac{94706}{1+ 94706(0.05)^2}$$

$$n = \frac{94706}{1+ 94706 (0.0025)}$$

$$n = \frac{94706}{1+ 236.76}$$

$$n = \frac{94706}{237.76}$$

$$n = 398.3$$

$$n = 398$$

Hence a total of 394 households will be selected for the studies

### Determination of the K<sup>th</sup> Value

The formula is given as :  $K=N/n$ , where, N is the sampling frame and “n” is the sample size and K refers to the K<sup>th</sup> respondent to be interviewed after the first sample unit has been selected randomly.

Suburbs	Sample Frame (Total Houses)	Sample size (Household)	Kth Value
Airport	1282	64	20 <sup>th</sup>
Dzorwulu	1755	63	28 <sup>th</sup>
Abelemkpe	994	57	17 <sup>th</sup>
Cantoments	2440	68	36 <sup>th</sup>
East Legon	1746	57	31 <sup>st</sup>
Adabraka	3030	94	32 <sup>nd</sup>
Kaneshie	4178	88	47 <sup>th</sup>
Dansoman	4054	76	53 <sup>rd</sup>
Achimota	7892	162	48 <sup>th</sup>
Nima	4272	171	25 <sup>th</sup>
<b>Total</b>	<b>31643</b>	<b>900</b>	

**APPENDIX D: QUESTIONNAIRE****UNIVERSITY OF LEEDS****QUESTIONNAIRE FORM**

Code .....

Community .....

**Dear participant,**

Thank you for agreeing to answer this questionnaire. This research seeks to understand the various factors influencing car ownership in Accra, Ghana. You were chosen based on the multi-stage sampling process adopted in selecting the participants. It is anticipated that answering the questionnaire will take up to 20 minutes. Information provided will be strictly confidential. Personal information like names and addresses are not included in the questionnaire. The information you are to provide will be used for only academic and research purposes. We assure you that information provided will not be linked to you as they are collected anonymously. Your participation is voluntary and that you can decide to withdraw at any time without giving reasons. Thank you for your cooperation.

In the event you want to contact the research please use the details provided below

RESEARCHER INFORMATION	LEAD SUPERVISOR
Samuel Adjei Appiah Institute for Transport Studies (ITS) 34-40 University Road University of Leeds LS2 9JT Telephone: +447478160252 Email address: ts14saa@leeds.ac.uk	Prof Greg Marsden Institute for Transport Studies (ITS) 34-40 University Road University of Leeds LS2 9JT Telephone: +44(0) 1133435358 Email address: G.R.Marsden@leeds.ac.uk

I agree to partake in this survey by appending my signature;

Participant's signature	
Date	
Survey Assistant	
Survey Assistant's signature	
Date	





**3. How many private cars does your household own?**

- 0       1       2       3+

**4. Are there other cars that you have access to that are not owned by your household?**

- Yes       No

**5. If yes in the above, who owns the car?**

- Private Company       Government       Relative       Other

(Specify).....

**6. Which of the following travel modes does your household own? (Please select all those that are applicable and indicate the number)**

	Motorcycle <input type="checkbox"/>	Bicycle <input type="checkbox"/>	None <input type="checkbox"/>
Number			

**SECTION B--- FOR CAR OWNERS ONLY**

**7. Please fill the table below in relation to the vehicles owned by the household**

Vehicle Number	State when purchased (New/Second hand)	Year of manufacture	Number of years owned	Number of household members who drive the car
1.				
2.				
3.				

**8. What is/are your main reason(s) for owning a car? (Please select all that applies)**

- Can afford it       To help in movement of the family       Ease journey to work
- It is safer to get around by car than by public transport       I believe I would be happier with a car
- Owning a car is something to aspire to       I love driving       Other (Specify).....

**SECTION C--- FOR NON CAR OWNERS ONLY**

**9. Do you have a driving license?**

- Yes       No

**10. If No in the above, why don't you have a driving license? (Please tick as many as are applicable)**

- I cannot afford to buy a car       I do not like driving       I prefer public transport
- It is not necessary as there are other ways of getting around       Because of environmental reasons
- I cannot afford a driving school       Owning a car is too much hassle       Other (specify).....

**11. If Yes in the above, why don't you have a car? (Please tick as many as are applicable)**

- I cannot afford to buy a car       I cannot afford to run a car       I do not like driving



**FOR THOSE THAT WORK****16. What is your main mode for travelling to work?**

- Car as a driver     Car as a passenger     Trotro     Metro Mass     Ayalolo     Taxi  
 Cycling     Motorcycling     Walking

**17. What is the distance from your house to work?**

- 0-0.5km     0.51—1.00km     1.1—1.50km     1.51—2.00km     Over 2.00km     Don't know

**18. How long does it take you to travel from house to work?**

- less than 10 minutes     10-20minutes     20-30minutes     30-60minutes     More than 60minutes

**PART II---- OTHER ACTIVITIES****19. What is the most frequently used mode for these activities**

Frequency of Journey	Car as a driver	Car as a passenger	Trotro	Metro Mass	Ayalolo	Taxi	Bicycle (on the road)	Motorcycle	Walking
Shop/market									
Taking children to school									
leisure									
Social Activity eg (Church , Funeral)									

**SECTION E—ATTITUDE TOWARD CARS AND PUBLIC TRANSPORT****20. FOR CAR AND NON-CAR OWNERS**

To what extent do you agree or disagree with the following questions in relation to your GENERAL attitude about car? Use the assessment indicators provided as a *guide* (**FULLY DISAGREE 1, DISAGREE 2, SLIGHTLY DISAGREE 3, NEUTRAL 4, SLIGHTLY AGREE 5, AGREE 6, FULLY AGREE 7**) (Please circle ONLY one Assessment Indicator for EACH statement)

Statement	Assessment Indicator						
	1	2	3	4	5	6	7
A car allows person to distinguish themselves from others	1	2	3	4	5	6	7
A symbol of success in life	1	2	3	4	5	6	7
There is societal pressure to have a car	1	2	3	4	5	6	7
Transport mode other than car are looked down upon in society	1	2	3	4	5	6	7

A car is an object with which you can show others the way you are and your taste	1	2	3	4	5	6	7
Owning a car is useful for daily activities	1	2	3	4	5	6	7
Driving a car is relaxing way to travel	1	2	3	4	5	6	7
Car allows you to transport more items and people	1	2	3	4	5	6	7
cars are trendy	1	2	3	4	5	6	7
using a car provides privacy	1	2	3	4	5	6	7
a car allows people to feel more in control of their life	1	2	3	4	5	6	7
a car allows you to choose your own route	1	2	3	4	5	6	7
cars allow you to travel anytime	1	2	3	4	5	6	7
You can generally get to places quicker in a car	1	2	3	4	5	6	7
People are at risk in their car	1	2	3	4	5	6	7
cars are not environmentally friendly	1	2	3	4	5	6	7
cars do not disturb one's neighbourhood	1	2	3	4	5	6	7
Driving is frustrating	1	2	3	4	5	6	7
Cars are luxury goods	1	2	3	4	5	6	7

## 21. FOR CAR OWNERS AND NON CAR OWNERS

To what extent do you agree or disagree with the following questions in relation to your general perception about public transport in Ghana? Use the assessment indicators provided as a *guide* (**FULLY DISAGREE 1, DISAGREE 2, SLIGHTLY DISAGREE 3, NEUTRAL 4, SLIGHTLY AGREE 5, AGREE 6, FULLY AGREE 7**) (Please circle **ONLY** one Assessment Indicator for EACH statement)

Indicator	Assessment						
	1	2	3	4	5	6	7
It's hard to relax on Public Transport	1	2	3	4	5	6	7
Public Transport use is a hassle	1	2	3	4	5	6	7
Public Transport are accessible	1	2	3	4	5	6	7
Use of Public Transport is time wasting	1	2	3	4	5	6	7
The staff on Public Transport are aggressive	1	2	3	4	5	6	7
Public Transport are affordable	1	2	3	4	5	6	7
Traffic regulations are not respected by Public Transport drivers	1	2	3	4	5	6	7
Travelling by Public Transport is for those who cannot afford a car	1	2	3	4	5	6	7
People who are successful travel by PT	1	2	3	4	5	6	7
Public Transport vehicles are environmentally friendly	1	2	3	4	5	6	7
Public Transport vehicles are rickety	1	2	3	4	5	6	7
Public Transport vehicles are esteemed	1	2	3	4	5	6	7
Public Transport vehicles are noisy	1	2	3	4	5	6	7
There are comfortable seats for passengers	1	2	3	4	5	6	7
Passengers and their goods are safe	1	2	3	4	5	6	7

Public Transport is simple to use	1	2	3	4	5	6	7
Public Transport is reliable	1	2	3	4	5	6	7

### SECTION F ---- PUBLIC TRANSPORT ACCESSIBILITY

**22. What is the average journey time from your house to the closest public transport route?**

- 0-15 minutes   
 16-30 minutes   
 31-45 minutes   
 46-60 minutes   
 Over 60 minutes  
 Don't know

**23. What is the distance from your house to the nearest public transport route?**

- 0-0.5km   
 0.51—1.00km   
 1.1—1.50km  
 1.51—2.00km   
 Over 2.00km   
 Don't know

**24. What is the average waiting time for bus from the nearest public transport route ?**

- 0-15 minutes   
 16-30 minutes   
 31-45 minutes   
 46-60 minutes   
 Over 60 minutes  
 Don't know

**25. What is the average journey time from the public transport stop/station to your work place?**

- 0-15 minutes   
 16-30 minutes   
 31-45 minutes   
 46-60 minutes   
 Over 60 minutes  
 Don't know

I don't use public transport to work/I walk to work

**26. What is the distance from the public transport stop/station to your work place?**

- 0-0.5km   
 0.51—1.00km   
 1.1—1.50km   
 1.51—2.00km   
 Over 2.00km  
 Don't know   
 I don't use public transport to work/I walk to work

**27. Are there interchanges when using public transport? (Skip Questions 28/29 if the answer is No)**

- Yes     No

**28. If there are interchanges how many are interchanges are undertaken whilst travelling from your house to work**

- 1   
 2   
 3   
 4 or more

**29. If there are interchanges what is the average time spent at interchanges (transfer point) whilst travelling from your house to work?**

- 0-15 minutes   
 16-30 minutes   
 31-45 minutes   
 46-60 minutes   
 Over 60 minutes  
 Don't know

**30. What is the average amount spent on journey to work on trotro per day?**

- Less than ₦ 2   
 ₦ 3   
 ₦ 4   
 ₦ 5  
 Other specify ₦.....   
 Don't spend anything

### SECTION G: CONCLUDING QUESTIONS

**31. What is the house tenure type?**

- Own the house   
 Rent the house   
 Other (specify).....

**32. What house dwelling type does the household live?**

- Separate house/detached house
- Semi-detached house
- Apartment/flat
- Compound house
- Other (Specify).....

**33. What is the approximate monthly income of the household**

- Less than ₦ 1000
- ₦ 1000-2000
- ₦ 2001-3000
- ₦ 3001-4000
- ₦ 4001-5000
- ₦ 5001-6000
- ₦ 6001-7000
- Above 7000
- Don't want to disclose

**APPENDIX E: PRINCIPAL COMPONENT ANALYSIS FOR ATTITUDES TOWARDS CAR**

<b>KMO and Bartlett's Test</b>		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.782
Bartlett's Test of Sphericity	Approx. Chi-Square	2744.466
	df	136
	Sig.	.000

<b>Rotated Component Matrix<sup>a</sup></b>					
	Component				
	1	2	3	4	5
driving a car is relaxing way to travel	.858	.058	.015	.046	.075
one can feel free and independent in his/her car	.856	.082	.110	-.048	.101
using a car provides privacy	.798	.075	.120	.150	.120
a car allows people to feel more in control of their life	.639	.140	.150	.211	-.054
You can generally get to places quicker in a car	.585	.165	.003	.192	.028
People are at risk in their car (turned)	.458	.286	-.175	-.030	-.053
A car allows person to distinguish themselves from others	.175	.843	-.001	.133	.183
cars are trendy	.157	.791	.033	.123	.202
A car is an object with which you can show others the way you are and your taste	.018	.690	.087	-.013	-.162
A symbol of success in life	.302	.472	.058	-.068	-.044
Cars allow one to travel anytime	.117	-.014	.755	.074	.065
Cars allow one to transport more items and people	.066	.055	.718	-.006	.152
Car allow you to choose your own route	-.011	.085	.717	.112	-.036
Transport mode other than car are looked down upon in society	.129	.105	.054	.857	.020
There is societal pressure to have a car	.181	-.004	.138	.856	.090
cars are environmentally friendly (turned)	.027	.094	.116	.002	.800
cars are not disturbing to one's neighbourhood	.091	-.020	.049	.089	.793

## APPENDIX F: PRINCIPAL COMPONENT ANALYSIS FOR ATTITUDES TOWARDS PUBLIC TRANSPORT

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.782
Bartlett's Test of Sphericity	Approx. Chi-Square	3496.288
	df	136
	Sig.	.000

Rotated Component Matrix <sup>a</sup>					
	Component				
	1	2	3	4	5
Use of PT is time wasting	.855	.028	.116	-.105	-.057
It's hard to relax on PT	.844	.038	.051	-.069	.054
PT is not simple to use (turned)	.827	.110	.128	.039	-.024
There are no comfortable seats for passengers (turned)	.771	.122	.149	-.159	-.112
PT use is a hassle	.759	.143	.206	-.060	-.011
Traffic regulations are not respected by PT drivers	.037	.839	-.066	-.035	-.004
The staff on PT are aggressive	.158	.812	.139	-.141	-.144
Passengers and their goods are not safe on PT (turned)	.152	.755	-.002	.024	-.098
PT vehicles are environmentally friendly	.141	.051	.765	-.070	-.024
PT vehicles are rickety	.159	-.095	.757	-.042	-.003
PT vehicles are noisy	.130	.250	.694	-.063	-.245
PT are affordable	.103	-.072	.264	.150	.149
PT are accessible	-.105	-.081	-.024	.931	.036
PT is reliable	-.170	-.029	-.045	.911	.065
PT vehicles are esteemed	-.111	-.215	-.132	.056	.788
People who are successful travel by PT (turned)	-.011	-.309	-.219	.149	.741
Travelling by PT is for those who cannot afford a car	.001	.226	.228	-.055	.551



## APPENDIX G: MULTINOMIAL LOGIT MODEL

Variable	No Car	One Car		Two or More Cars	
		Est	T-stats	Est	T-stats
<b>Alternative Specific Constant (ASC)</b>	--	--4.71	-3.96	- 11.50	-4.60
<b>Household Income</b>					
Less than 1000cedis	--	0.01	-2.44	-7.27	-4.66
1000-3000cedis	--	--	--	--	--
Above 3000	--	2.68	4.56	4.50	4.56
<b>Household Size</b>	--	-0.41	-1.36	-2.81	-2.16
<b>Number of Household members employed</b>	--	0.26	0.50	2.24	2.86
<b>Number of children</b>	--	-0.10	-0.29	2.25	1.70
<b>Number of license holders</b>	--	5.42	4.59	7.86	5.48
<b>Educational Level of Household head</b>					
Basic (reference)	--	--	--	--	--
Secondary	--	-1.18	-1.44	-0.94	-0.66
Tertiary	--	0.25	0.37	1.31	1.03
<b>MODEL SUMMARY</b>					
LL with constant term only LL(0)		-600.94			
LL(final)		-263.63			
Number of Observations		547			
Number of Parameters		18			
Rho-sq (0)		0.80			
Adj. rho-sq (0)		0.77			

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