THE RESPONSE OF OTHER DRIVERS TO MINIBUS TAXI DRIVERS' ON-ROAD AGGRESSIVE BEHAVIOUR: A CASE STUDY IN CAPE TOWN, SOUTH AFRICA

by
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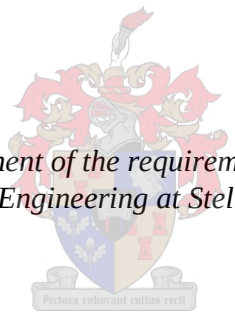

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Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own original work, that I am the authorship owner thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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Abstract

Every year, more than 1.24 million traffic related deaths are registered globally with the highest fatality rates in middle- and low income countries. Minibus taxis represent the most dominant mode of public transportation associated with road traffic crashes and injuries in most African countries. From a safety perspective, aggressive driving behaviour is one of the main causes of road traffic crashes. This study examined the nature and the frequency of the most common types of the minibus taxis drivers' on-road aggressive behaviour as well as the corresponding response behaviour of drivers of other vehicles to those behaviours. The research was done through video observations in Cape Town, South Africa. Through questionnaires, this study also explored the effect of driver age and gender of minibus taxi drivers on the on-road aggressive behaviour. The effect of age and gender of drivers frustrated by minibus taxi drivers' aggressive on-road behaviours on levels of anger aroused as well as on the response behaviours reported was investigated from within the framework of a frustration and aggression model of aggressive driving.

In a total of 7,266 minibus taxis observed from three different sites, 943 aggressive driving behaviours noted were divided into three categories: traffic obstructions (stopping in the road or outside bus stops), disregarding traffic signs and signals (red light running and violating stop lines), and improper passing behaviours (cutting in too close, overtaking on road shoulder or on yellow lane, crossing solid lines to pass vehicles in the next lane, inappropriate lane utilisation). Observations were coded based on pre-determined evaluation indices. The more frequent response manoeuvres by drivers behind aggressive minibus taxis were swerving to the next lanes, accelerating to refuse gaps for minibus taxis, running behind minibus taxi red light runners, and hooting. The results from the questionnaire survey revealed that driver age and gender affected both the minibus taxi drivers' on-road aggressive behaviours and the response behaviours reported by other drivers. Respondents reported that younger minibus taxi drivers exhibit more on-road aggressive behaviour than old minibus taxi drivers. Male and younger drivers frustrated by minibus taxis' on-road aggressive behaviours reported riskier and more severe forms of reactions than frustrated female and older drivers.

The responses of drivers of other vehicles to the minibus taxi drivers' on-road aggressive behaviours have parallels with the responses of individuals to social bullying or victimisation, as researched and explained in social-psychological theory. More work is needed to explore this relationship but it is possible that the responses of drivers of other vehicles to the minibus taxi drivers' aggressive behaviours could be explained by these theories.

Opsomming

Elke jaar word meer as 1.240.000 verkeer verwante sterftes met die hoogste sterftekoerse in die middel- en lae-inkomste lande geregistreer. Minibus-taxi's verteenwoordig die mees dominante vorm van openbare vervoer wat verband hou met verkeer ongelukke en beserings in die meeste van die Afrika-lande. Wat veiligheid betref, is aggressiewe bestuursgedrag een van die belangrikste oorsake van die verkeers-ongelukke. Hierdie studie ondersoek die aard en die frekwensie van die mees algemene vorme van minibus taxi-bestuurders se aggressiewe padgedrag sowel as die reaksies van bestuurders van ander voertuie op dié gedrag. Die navorsing is deur middel van video waarneming in Kaapstad uitgevoer. Hierdie studie het ook die effek van die minibus taxibestuurders se ouderdom en geslag op aggressiewe padgedrag met vraelyste ondersoek. Die uitwerking van aggressiewe bestuurgedrag op die vlakke van woede wat deur ander bestuurders ervaar word, sowel as op hul reaksies is vanuit die raamwerk van 'n frustrasie en aggressie model van aggressiewe bestuur ondersoek.

In totaal van 7266 minibus-taxi's is waargeneem op drie verskillende plekke. Die 943 voorvalle van aggressiewe ry-gedrag is in drie kategorieë verdeel naamlik verkeer obstruksies, verontagsaming van verkeerstekens en -seine, en onbehoorlike gedrag. Gedrag is gekodeer deur van voorafbepaalde evaluering-sindekse gebruik te maat. Hierdie gedrag het ingesluit belemmer in a van verkeer, insny voor ander verkeer, kruising van soliede lyne, onvanpaste laangebruik, verbysteek op pad-skouers of op die geellyne, verontagsaming van rooi verkeersseine, en die oortreding van stoplyne. Die mees waargenome reaksies deur voertuie agter aggressiewe minibus-taxi's is wegswenk na die volgende lane, versnelling om gapings vir minibus-taxi's te weier, naloop agter taxi wat deur verkeerseine ry, en die gebruik van die toeter. Die resultate van die vraelysopnames het getoon dat die bestuurder se ouderdom en geslag beide die taxi- bestuurders se aggressiewe padgedrag en die reaksie-gedrag daarop bepaal. Resondente het aangedui dat jonger minibus-taxi-bestuurders meer aggressiewe padgedrag as ouer minibus taxi-bestuurders toon.

Die response van die ander bestuurders op taxibestuurders se aggressiewe padgedrag het ooreenkomste met die reaksies van individue tot sosiale boeliegedrag of viktimisering , soos nagevors en verduidelik in sosiaal-sielkundige teorie. Verdere werk is nodig om hierdie verhouding te verken, aangesien dit moontlik is dat die reaksies van bestuurders van ander voertuie op minibustaxi- bestuurders se aggressiewe padgedrag deur hierdie teorieë verklaar kan word.

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Dedication

This book is dedicated to my beloved parents,

Mr. Vincent Kalima and Mrs. Colette Mukamugema,

My brothers and sisters,

My friends

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List of symbols and abbreviations

AAA : American Automobile Association
BRT : Bus Rapid Transport
CCTV : Closed Circuit Television Camera
d : Distance to the Stop Line at the onset of a Yellow Light (meters)
D : Estimated density (veh/km)
d_{ac} : Degree of accuracy expressed as a proportion
DAS : Driver Anger Scale
DAX : Driver Anger Expression
DBQ : Driver Behaviour Questionnaire
DSI : Driving Skill Inventory
DTA : Dominant Theory of Aggression ()
DZ : Dilemma Zone
e : Tolerance in error (assumed ±1 m)
EBS : Event-Based Sampling
F-A : Frustration and Aggression
f_i : Frequency
FS : Focal Sampling
H : Estimated minimum spacing (meters)
HCM : Highway Capacity Manual
HRM : Heart Rate Monitor
ILO : International Labour Organization
K : t-value for a confidence interval of 95%
L : Length of the segment (m)
LT : Left Turn
N : Number of observed values or observations (Population size)
n : required sample size
NATDO : National Taxi Drivers' Organization
NaTIS : National Traffic Information System
NHTS : National Household Travel Survey
NHTSA : National Highway and Traffic Safety Administration
OZ : Option Zone
P : Population proportion
R : Ratio
RL : Right Turn
RLR : Red-Light Running

S : Estimated average travel speed (km/h)

S : Intersection approaching speed (km/h)

SA : South Africa

SANTACO : South African National Transport Council

SATAWU : South African Transport and Allied Workers' Union

SS : Scan Sampling

STA : State-Trait Anger

S_{td} : Standard deviation of sample

T_{av} : Estimated average travel time (seconds)

t_d : Time delay (seconds)

t_f : Time when the road was free (seconds)

Thro : Through

TMC : Traffic Management Centre

TRP : Taxi Recapitalization Program

TS : Time Sampling

t_s : Time when obstruction started (seconds)

TTC : Time to Collision

TTI : Time to Intersection (seconds)

UK DAS : United Kingdom Driver Anger Scale

v : Estimated flow rate (veh/h)

VCCAV : Victorian Community Council Against Violence

X : Arithmetic mean delay (seconds)

X^2 : Table value of chi-square for 1 degree of freedom at the desired confidence level

x_i : Mid-point value

YL : Yellow Lane

Chapter 1 INTRODUCTION

1.1 Background

The minibus taxi industry witnessed a rapid boom in the early 1990s in many African cities. This followed the failure by many governments to continually maintain, fund and plan for the future expansion of their existing monopoly on subsidised buses and trains (Kumar & Barrett, 2008). Some of the reasons behind such failure include the fact that most African governments were pushed to legalize informal sources of transport. Secondly, existing government-supported buses and trains were unable to respond to the high transportation demand in urban centres. Thirdly, most of the African governments started to privatize some of their public transport companies to the private business sector in order to respond to the aid conditions imposed by international donor institutions such as the World Bank (WB) and the International Monetary Fund (IMF) (Tripp, 1997).

In South Africa, the minibus taxi movement started in 1970s during the years of the apartheid government (Ahmed, 2004). Three elements characterised the development of the minibus taxi industry in South Africa. Firstly, many black businessmen and commercial businesses in urban centres started to be inspired and attracted by minibus taxis services, secondly, finance capital began to penetrate in the black community, and thirdly, vast numbers of black South Africans started to operate their own minibus taxis (Khosa, 1994).

A study carried out by the Word Bank on urban transportation in fourteen large African cities, revealed that minibus taxis account for about fifty per cent (50%) of all motorised traffic on some corridors in Africa cities and their daily trips amount to double those of large buses. They congest roads during peak hours more than any other type of vehicle. To date, minibus taxis form the largest and the most common mode of public transport for a majority of daily commuters in most African cities (Kumar & Barrett, 2008).

In the Cape Metropolitan Area (CMPA), public transport service is offered by rail, buses, and minibus taxis. Both rail (operated by Metrorail) and buses (operated by Golden Arrow Bus Services (GABS)) offer scheduled services. Minibus taxis, on the other hand, provide unscheduled services to passengers but their services are efficient in terms of passenger utilization as a percentage of capacity provided (Figure 1) when compared with rail and buses. This is due to the fact that minibus taxis leave from ranks or loading points when they are full. Secondly, they operate shorter distances when compared with long distances covered by trains and buses. Thirdly, they charge reasonable commuting fares and they are better to serve long dispersed origins and destinations (Clark & Crous, 2002:77).

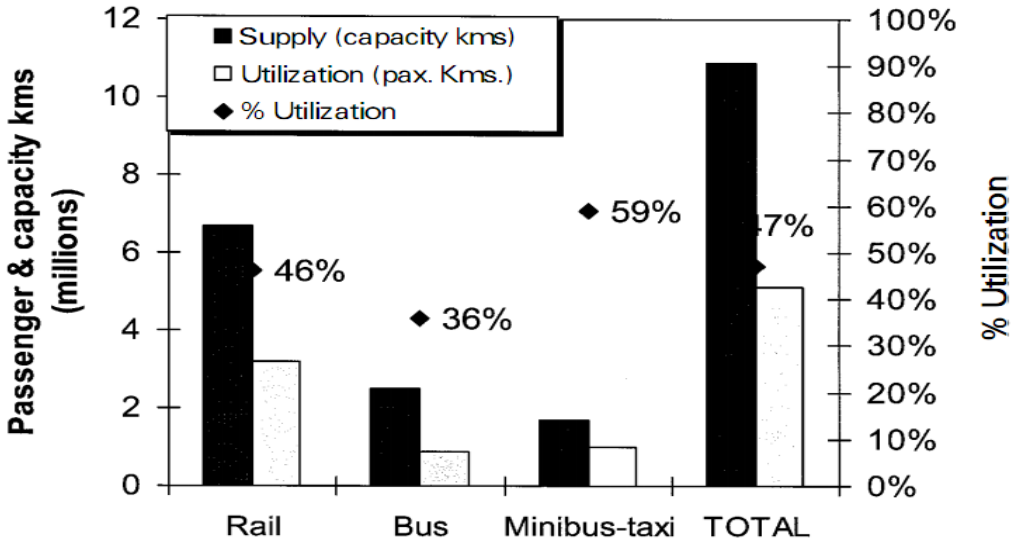


Figure 1 Supply and utilization of public transport in a.m. peak (Clark & Crous, 1998)

Rail provides the most capacity (seat and standing per km) in the CMA and had the largest market share in terms of passenger-kilometers (Figure 2) when compared to minibus taxis and buses. However, this is not the case in other South African urban areas since minibus taxis alone account for about 65 percent of the public transport market share (Clark & Crous, 2002:77).

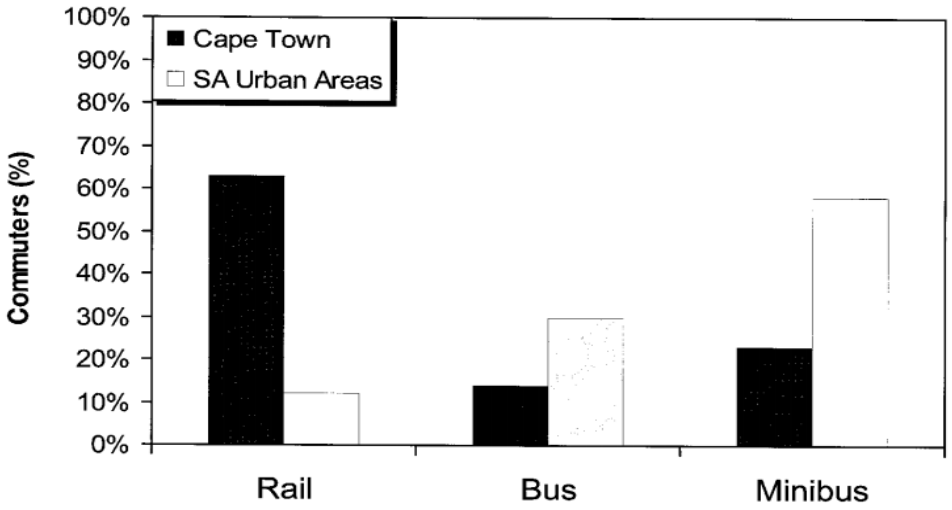


Figure 2 Public transport market share a.m. peak period (Clark & Crous, 1998)

The rate of motorization in Africa is estimated at four per cent (4%) of the world's motor vehicles (Chen, 2010:247). Africa leads in road traffic accident fatalities by ten per cent (10%) worldwide in spite of its small rate of motorization (Chen, 2010:247; Jacobs & Aeron-Thomas, 2000). Developing countries with approximately seventy two percent (72%) of the world's population and fifty two percent (52%) of the world's registered vehicles account for eighty percent (80%) of road traffic deaths.

The fatality rate in developing countries is 20.1 per 100, 000 population, whereas those in high and low-income countries are 8.7 and 18.3 per 100,000 respectively (World Health Organization, 2009). Nigeria

with 33.7 deaths and South Africa with 31.9 deaths per 100,000 populations are the highest in Africa (WHO, 2013). Between 1990 and 2011, the number of road traffic fatalities in South Africa increased by twenty five percent (25%) peaking in 2006 with 15,419 deaths. The rapid urbanisation and motorisation were the two major causes to road traffic crashes (WHO, 2013). According to the World Health Organization (WHO, 2013), about 3,200 people are killed on the world's roads every day. Road traffic injuries are the eighth leading cause of death, and the leading cause of death for young people aged 15-29 (WHO, 2013). South Africa contributes nearly 40 deaths per day and 14,000 deaths per year with a fatality rate of 28 per 100 000 citizens. It is one of the worst in the world (arrivealive, 2013).

Factors that contribute to road traffic related accidents and inherent human causalities have been traditionally classified into three major categories: human, vehicle, and highway infrastructure (Chen, 2010:247). Several studies on road accident causation factors confirm that human errors are the major causes of road accidents. Near one-quarter of road traffic crashes result from a combination of road and road users factors (Mansfield & Britain, 2008). According to Austroads (2002), three factors that contribute to vehicle accidents were ranged as follows: human factors (involved in crashes at about 95%), environment factors (involved in crashes at 28%), and vehicle factors (involved in crashes at 8%). In South Africa in the year 2005, the three contributory factors to road accidents were as follows: human factors (75%), road factors (14.5%), and vehicle factors (10.2 %) (Vogel & Bester, 2005). In 2009, human factors contributed around eighty three percent (83 %) to fatal crashes and eighty five percent (85%) in 2010. Vehicle factors decreased from 9.13% in 2009 to 5.79% in 2010 and road factors contributed 8,02% in 2009 and 9.3% in 2010 (arrivealive.co.za, 2013).

In South Africa, minibus taxis are involved in road traffic accidents more than other type of vehicles (Barrett, 2003; Govender & Allopi, 2007). In Cape Town, minibus taxis were involved in crashes at a rate of 6.5% although they represented only 3.2% of all registered vehicles in 2003 (Lomme, 2008). Between 1991 and 1998, minibus taxis had the highest road traffic fatality rate per 100 million vehicle kilometres travelled in South Africa when compared with buses and freight vehicles (Ribbens et al., 2000). During the same period, the fatality rate for accidents involving buses was estimated at 10 fatalities per million vehicle kilometres travelled whereas that for minibus taxis laid between 15 and 20 fatalities per million vehicle kilometres travelled. Passenger transport vehicles i.e. buses and minibus taxis were involved in crashes at a rate of about 3.5 times higher than that of freight vehicles (Ribbens, Botha & Khumalo, 2000).

Several studies have been conducted in the developing world to examine factors that contribute to minibus taxi crashes. In South Africa, factors which include driving over the prescribed speed limit, disregard for traffic signals and violation of traffic signs, ignoring rights of other road users, overloading passengers, night time driving, and unworthiness of vehicles were identified as the major causes of accidents involving minibus taxis (Govender & Allopi, 2007; Ribbens, Botha & Khumalo, 2000). In

Singapore, Chin and Huang (2009) used two binomial logistic models to study factors that contributed to the occurrence of minibus taxi crashes. Firstly, their models displayed factors related to the minibus taxi drivers' behavioural problems and secondly outlined factors linked to the minibus taxi operational problems. The factors associated with minibus taxi driving behaviours including excessive speed, night time driving, failing to keep a proper lookout, failing to give way, ignoring traffic signs and signals, changing lanes and turning without signalling, failing to have proper control, increasing age of the driver, and tailgating other drivers in front overlapped factors related to road conditions (Chin & Huang, 2009:47; La, Lee, Meuleners & Van Duong, 2013:451). These unsafe and often risky driving behaviours listed by previous researchers as the contributory factors to the minibus taxi crashes fit in one way or the other into the list of aggressive driving behaviours (Tasca, 2000). Based on these findings, this study defined minibus taxi drivers as aggressive drivers or perpetrators of aggressive driving behaviours and drivers of other vehicles as victims of aggressive driving behaviours.

1.2 Aggressive Driving and the Frustration and Aggression (F-A) Model

Three aspects of on-road driving behaviours have been previously defined as aggressive driving behaviours (Dula & Geller, 2003:559). These are: negative feelings behind the wheel (frustration and anger); purposeful or deliberate acts of physical or psychological aggression to other road users (verbal abuse and obscene gestures); and risk-taking behaviours (dangerous manoeuvres performed to save time). However, there have been differences between the various ways previous researchers defined aggressive driving. Hauber (1980) and Mizell (1997) defined aggressive driving as an intended driving behaviour performed by a driver to physically or psychologically cause danger to another driver. It is an event in which an angry motorist deliberately harms another road user in response to a traffic challenge. This definition reflects a very severe form of aggression i.e. road rage (Hauber, 1980:461; Mizell, Joint & Connell, 1997). Shinar (1998) proposed a more complete definition of aggressive driving based on the Frustration and Aggression (F-A) Theory also known as the Dominant Theory (DT) in Psychology. He defined aggressive driving as any driving behaviour directed at another road user with the intention to physically or mentally harm that person (Shinar, 1998:137). The F-A theory states that the level of aggression will depend on the level of frustration suffered by the driver. It will also depend on the expected negative consequences for aggression as well as on the extent to which the frustration is deemed unfair (Shinar, 1998:137).

From the F-A, Shinar distinguished two categories of aggressive behaviours: hostile aggression and instrumental aggression. The *hostile aggression* was defined as an aggression characterized by strong emotion and includes behaviours intended to make the offender feel good. The primary goal in hostile aggression is to do harm. For instance, a driver who decides to follow a vehicle that cut him off abruptly on the roadway is displaying hostile aggression. *Instrumental aggression* refers to aggressive behaviour demonstrated by the victim with the intention to overcome frustrating events. It is not intended to harm

other drivers but to overcome frustrating situations. It stops as soon as the source of frustration has been removed. For instance, a driver who decides to weave in and out of the traffic because s/he is late for an important conference for example is demonstrating instrumental aggression. Shinar defined aggressive driving behaviours as instrumental behaviours resulted from annoyance with other drivers or deliberate dangerous driving to save time at the expense of other road users. In his definition, he included driving behaviours such as disregarding traffic signs and signals, tailgating vehicles in front, obstructing other vehicles from passing, weaving in and out of the traffic, and flashing lights and horn-honking fit in his definition. However, he omitted speeding in his list as he believed that speeding is a purposeful behaviour and does not necessarily result from frustration or annoyance (Shinar, 1998:137).

In 2000, the National Highway and Traffic Safety Administration (NHTSA) and the American Automobile Association (AAA) defined aggressive driving as the operation of motor vehicle in a way that endangers or is likely to endanger other people or property (Goehring, 2000). In their list of driving behaviours they include; speeding, tailgating other drivers, failing to yield to other drivers, weaving in and out of traffic, improper passing manoeuvres, unsafe lane changing, running stop signs and red lights, making hand and facial gestures, hooting and flashing lights (Goehring, 2000). The NHTSA definition differs from the definitions proposed by Hauber and Mizell in the sense that it does not include behaviours associated with road rage. It also differs from the Shinar's definition of aggressive driving as it includes speeding in the list of aggressive driving behaviours. The NHTSA definition included speeding in the list because they believe that several aggressive driving behaviours are linked. For example a driver needs to increase his or her speed to start tailgating another driver in front of him or her (Goehring, 2000).

Tasca (2000) studied 21 available research findings in traffic safety and psychology linked to aggressive driving with the aim to propose a precise definition of on-road aggressive driving. She reviewed various definitions proposed by previous researchers and formulated her definition taking into account three important guiding principles. Firstly, she concurred with Shinar (1998) that the definition of aggressive driving should not be general. It should detail specific driving behaviours to consider as aggressive driving. Secondly, after Elliot (1999), it should not include behaviours linked to road rage. Driving behaviours linked to road rage are seen as criminal offences whereas unsafe driving practices related to aggressive driving consist of traffic offences.

Road rage is an extreme form of aggressive driving (Mizell, Joint & Connell, 1997). Thirdly, it should include deliberate driving behaviours which do not envisage causing either psychological or physical danger to other road users. Those driving behaviours should be instigated by anger or attempts to save time. Those behaviours are likely to intimidate other road users, irritate or force them to take evasive actions. Tasca's definition of aggressive driving is stated as follows:

> *"A driving behaviour is aggressive if it is deliberate, likely to increase the risk of collision and motivated by impatience, annoyance, hostility and/or an attempt to save time".*

Tasca's definition of aggressive driving includes driving behaviours such as driving too close to other drivers, weaving in and out of traffic, improper passing and passing on the road shoulder, cutting in too close in front of other vehicles, failure to yield the right of way to other road users, obstructing other drivers from passing, refusal to accommodate other motorists unable to merge or to change lanes due to traffic conditions, driving over the posted speed limit, frequent and abrupt lane changes, and red lights running (Tasca, 2000). For the sake of this study, the minibus taxi drivers' aggressive driving behaviours were defined following Tasca (2000) and Shinar (2004) as the driving behaviours which affect the movement of other drivers and which are likely to increase the risk of collisions. Following Dula (2003), the driving behaviours which intend to mentally or physically harm other drivers such verbal abuse, making rude gestures to other road users, and inappropriate horn-honking were considered as aggressive behaviours in this study. These careless driving behaviours which increase the risk of crashes are instigated by annoyance and/or attempts to save time (Tasca, 2000).

The F-A Model maintains the idea that the extent to which a person is exposed to a frustrating situation defines how aggressive he or she will be (Shinar, 1998:137). However, Berkowitz, in his reformulation of the F-A theory, explained that frustration alone results in aggression only if the victim is unhappy enough to produce a high level of anger (Berkowitz, 1993). In addition to the level of anger expressed by the victim when exposed to an anger-instigating situation, individuals' characteristics and interpretation of the frustrating situations, together with the characteristics of the frustrating situation itself contribute to the expression of aggressive behavioural responses (Lajunen, Parker & Summala, 1999:225; Shinar, 1998:137). In a study to examine the relations between self-reported driver anger and aggressive driving behaviours instigated by situational factors, the level of anger experienced by male drivers and the severity of their behavioural responses decreased with age (Lajunen, Parker & Stradling, 1998:107). In a survey on records of aggressive driving incidents conducted in New South Wales (Australia) reported by the police, results revealed that the percentage of young male drivers in aggressive incidents was higher than those of female and older divers (Harding, Morgan, Indermaur, Ferrante & Blagg, 1998:221).

In another study that used anger-instigating scenarios to assess the effects of the situational factors on aggressive driving behaviours, victims showed more severe aggressive behavioural responses to young offender drivers than elderly offender drivers. For instance, when time pressure was absent, the average score for aggressive responses towards young female offender was 18.6 whereas the corresponding figure for elderly female offender was 17.5. The average anger score produced in the participants by male offenders (2.99) was higher than that elicited by female offender drivers (2.90) (O'Brien, Tay & Watson, 2004:101). Based on these finding, this study expected that young drivers exposed to the

minibus taxi drivers' frustrating situations will produce high levels of anger and will likely respond more aggressively than elderly drivers. Secondly, male drivers exposed to the minibus taxi drivers' aggressive driving behaviours will produce high levels of anger and will respond more aggressively than female drivers.

This study looks at both the minibus taxis drivers' aggressive behaviours and the behavioural responses of drivers of other vehicles. The dichotomy of on-road aggressive driving behaviours between victims and perpetrators is partially explained by the Social Information Processing Theory (SIP) in sociology (Zelli, Dodge, Lochman & Laird, 1999:150). In the context of aggressive driving, the SIP refers to the interpretation of the behaviours of other drivers in positive or negative manner. In other words, a more positive image of a given driver results in a positive interpretation of his or her driving behaviours and reduces the likelihood of severe behavioural responses (Yagil, 2001:119). The negative beliefs and attributions applied to another driver or a group of drivers tend to raise the amount of frustration and anger elicited while driving. In a sample of 150 drivers, offending male drivers attracted more negative attributions and emotional responses than offending female drivers (Yagil, 2001:119).

1.3 Research problem

In South Africa, about 73 per cent of households do not own a motor vehicle, 76 per cent have no access to train services, and 38 per cent have no access to regular public bus services (Department of Transport, 2003). The unregulated and informal minibus taxi industry plays a vital role in the public transport sector where it serves as an alternative to formal and scheduled public transport buses and trains. Minibus taxis carry about 65 per cent of all daily public transport commuters in the Republic of South Africa. They form the most popular mode of public transport for the majority of South Africans in urban areas (Barrett, 2003; Govender & Allopi, 2007; Walters, 2008:98).

Low income South Africans, mainly those in remote areas with no available train and bus services, rely on minibus taxis since they are flexible, they operate with high frequency, they pick up commuters from and drop them back at their homes, they run late-night services, they save time spent in long queues at bus and train stations, make suitable stops on long distances, and they charge reasonable commuting fares (Barrett, 2003; Browning, 2001; Govender & Allopi, 2007; Oosthuizen & Mhlambi, 2002; Walters, 2008:98).

Minibus taxis are involved in road traffic related accidents more than any other type of vehicles in South Africa (Barrett, 2003; Govender & Allopi, 2007; Walters, 2008:98). A study by Automobile Association of South Africa revealed that minibus taxis are responsible for an estimate of 70,000 road traffic accidents annually. This number is twice the number of any other mode of passenger transport (Automobile Association of South African, AASA, 2011). In 2009, the total number of vehicles involved in fatal crashes was 14,327. During that period, the number of minibus taxis accounted for 602

(4.2%) of all vehicles in fatal crashes. In 2011, the total number of vehicles registered was 9,945,021. The number of minibus buses and minibus taxis involved in fatal crashes between 2010 and 2011 was 1408 (9.6%) of 14,568 total vehicles involved in crashes. This number was high as minibuses were 285,858 (2.9%) of all registered vehicles in that period (RTMC, 2011). In Cape Town, between 2007 and 2013, the total number of minibus taxi related fatalities registered was 155. Though the number of minibus taxis related fatalities decreased from 22 in 2007 to 16 in 2013 in Cape Town, on average around 26 people are killed by minibus taxis every year (City of Cape Town, 2012). Of the 36 lives lost daily on South African roads, 3 are killed in minibus taxi incidents (arrivealive, 2013). Anecdotally, it has been noted that minibus taxi drivers travel over the posted speed limit and follow with close distances on urban roads. In peak hours, minibus taxi drivers push through on hard shoulders, use through lanes to cut in front of other traffic, ignore the right of way at road junctions, violate traffic signals and traffic signs, and perform unsafe passing maneuvers in order to make up delays encountered at passengers loading points and to increase the number of trips. In developing countries, unsafe and often irritating driving behaviors of minibus taxis drivers are one of the major causes of road traffic related fatalities and injuries on urban roads (Chin & Huang, 2009:47; La, Lee, Meuleners & Van Duong, 2013:451).

The total number of minibus taxis registered in South Africa increased from 282,941 to 285,983 between 2009 and 2010. Between 2010 and 2011, this number increased from 282,793 to 285,858 minibus taxis (Road Traffic Report, 2011). The latest update number in 2013 was 289, 193 minibus taxis (arrivealive.co.za). To date, the minibus taxi industry comprises of more than 20,000 owners and 200,000 employees. The approximate total number of minibus taxi fleets is 150,000 with an estimated turnover of more than R16, 5 billion. Minibus taxis contribute to the economy of the country taking into consideration that the majority of South Africans are poor and dependent on public transport (Barrett, 2003). This rapid increase of minibus taxi fleets coupled with the increase in aggressive driving behaviors has unwittingly led to the endangering of the lives of other road users on the South African roads.

To improve road safety through effective measures is at the centre of the transportation safety research. Previous researches into minibus taxi services focused on the factors that contribute to the minibus taxi crashes (e.g. Govender & Allopi, 2006), minibus taxi drivers' safety perception and risk-taking behaviours (e.g. Peltzer & Renner, 2002; Ferreira, 2010), and minibus taxi commuters' satisfaction (e.g. Schalekamp & Behrens, 2010). However, no attempts have hitherto been made to observe how drivers of other vehicles respond to provocative driving behaviours of minibus taxi drivers.

This study examined the nature and the prevalence of the most common types of minibus taxi drivers' aggressive driving behaviours and the corresponding behavioural responses from drivers of other vehicles. It explores the effects of socio-demographic variables such as age and gender on both the types

of behavioral responses demonstrated by drivers of other vehicles and the minibus taxi drivers' aggressive driving behaviours with the intention to improve our understanding of unsafe driving behaviours on the South African roads. Evidence gathered from this study will increase our knowledge of unsafe and frustrating driving behaviours. Furthermore, urban public transport planners, road safety experts, and policymakers will benefit from the findings of this study as they will be able to choose reliable countermeasures to lower the number of traffic accidents involving minibus taxis basing not only on the most common types of the minibus taxi drivers' aggressive behaviours but also on the various ways used by drivers of other vehicles respond to avoid crashes.

1.4 Research hypotheses

This study examined the nature and the prevalence of the most common types of minibus taxi drivers' on-road aggressive behaviors as well as the corresponding behavioral responses of drivers of other vehicles to those behaviours. From video footage, various types of the minibus taxi drivers' aggressive driving behaviours and their incidence rates were determined. Secondly, through the use of driving scenarios developed based on the types of minibus taxi drivers' aggressive driving behaviours identified in the pilot study, levels of anger generated by drivers of other vehicles and their likely behavioral responses to the minibus taxi drivers' aggressive driving behaviors were assessed. Thirdly, the effects of age and gender on the minibus taxi drivers' on-road aggressive behaviours as well as on the probable behavioral responses of other drivers subjected to frustrating situations were assessed through questionnaires. It was hypothesised that:

1. Male drivers will produce high levels of anger and will likely respond more aggressively than female drivers when frustrated by the minibus taxi drivers' on-road aggressive behaviours.
2. Young drivers will produce high levels of anger and will likely respond more aggressively than elderly drivers when frustrated by the minibus taxi drivers' on-road aggressive behaviours.

1.5Aim and objectives

This study aims to examine the nature and the prevalence of the most common types of the minibus taxi drivers' on-road aggressive behaviours as well as the influence of age and gender on those behaviours. It explored the influence of age and gender on the levels of anger reported by drivers of other vehicles as well as on the corresponding response behaviours demonstrated from within the context of a frustration and aggression model of aggressive driving. The specific objectives of this study are:

1. To investigate the nature and frequency of the most common types of the minibus taxi drivers' on-road aggressive behaviour. The specific intentions are:
    - ✓ To characterise the nature and frequency of the most common forms of the minibus taxi drivers' on-road aggressive behaviour.

- ✓ To study the effect of age and gender of the minibus taxi drivers on the various forms of on-road aggressive behaviour they display.

2. To investigate the effect of age and gender on the levels of anger aroused in drivers of other vehicles when exposed to the minibus taxi drivers' on-road frustrating situations.
3. To investigate the response behaviours of drivers of other vehicles to the minibus taxi drivers' on-road aggressive behaviours. The specific intentions are:
    - ✓ To observe and to record the response manoeuvres performed by drivers of other vehicles to overcome the minibus taxi drivers' frustrating situations.
    - ✓ To investigate the effect of age and gender of drivers of other vehicles on various forms of response behaviours showed to overcome minibus taxi drivers' frustrating situations.

1.6 Research definition

The frustrating and provocative behaviours of minibus taxi drivers examined in this study are those observed on the roads. They included behaviours such as traffic obstructions, cutting in too close in front of other cars, improper passing manoeuvres, disregarding traffic signs and signals, driving fast for the road conditions, and hostile aggressive behaviours. These behaviours were viewed and analysed from the video footage. The likely response behaviours of drivers of other vehicles to the most common types of minibus taxi frustrating behaviours investigated in this study were regarded from two perspectives: aggressive behavioural responses in case drivers of other vehicles stick to their movements and refuse cooperation with minibus taxis drivers or when they respond aggressively to the frustrating situation and non-aggressive or cooperative behavioural responses in case drivers of other vehicles decide to do nothing but to wait until the minibus taxi driver clear the space. However, reactions of drivers of other vehicles to the frustrating situations other than those caused by minibus taxi drivers such as weather changes; traffic jam, road incidents, and road works were not considered. There was no focus on the response manoeuvres of drivers of other vehicles as a function of vehicle types in this study.

1.7 Brief chapter overview

This study is comprised of five chapters. The first chapter outlines the importance of the problem and gives a clear statement of the problem. It provides the background to the study problem, research objectives, research definition, and brief organization of chapters. The second chapter provides reviews on the safety of minibus taxis, aggressive driving behaviours, the Frustration and Aggression Theory (F-A) applied to aggressive driving, responses to aggressive driving and the bullying and victimisation theory, driving anger (DA) and its measures, driving anger expression (DAX), and aggressive driving behaviours. The third chapter outlines the study methodology. It starts by describing the selected study areas. It details methods and techniques used to classify minibus taxi aggressive driving behaviours and

to determine response behaviours performed by drivers of other vehicles in order to overcome frustrating situations. It concludes by explaining methods used in data processing and analysis. The fourth chapter presents results, analyses and discussion. Finally, the fifth chapter concludes the study and suggests recommendations to the research problem.

1.8 Definition of key terms

The definitions used in this study are borrowed from different authors as referenced below:

1.8.1 Minibus Taxi

Minibus Taxi refers to a public transport vehicle designed to carry more than nine persons but not more than sixteen passengers including the driver (National Road Traffic Acts 93, 1996). Minibus taxis offer unscheduled services to passengers and they operate for hire and reward in South Africa.

1.8.2 Frustration

The term frustration refers to an obstruction or a barrier to the occurrence of an intended goal at its proper time. It is an emotional reaction to the situations and it is followed by dissatisfaction as one was prevented from reaching his or her envisaged objective (Dollard, Miller, Doob, Mowrer & Sears, 1939).

1.8.3 Anger

The term anger makes reference to the strong emotion that you feel when you think someone has behaved in an unfair, cruel, or unacceptable way. It is an emotional state that varies in intensity and that could be conceptualised as state anger and trait anger (Spielberger, Reheiser & Sydeman, 1995:207). The state anger is a psychobiological state of individual feelings that vary in intensity and that is induced by annoying conditions. It is described as a measure of feeling angry (Spielberger, Reheiser & Sydeman, 1995:207). Trait anger refers to an individual tendency to experience state anger more frequently and intensely (Deffenbacher, 1992:177).

1.8.4 Driving Anger

Driving Anger refers to the frequency and intensity of feeling anger while behind the steering wheel. Even if it is defined as a personality trait which is associated with trait anger, it is more situation-context bound (Deffenbacher, Getting & Lynch, 1994:83).

1.8.5 Aggression

The term aggression refers to any form of behaviour that is intended to injure someone either physically or mentally (Berkowitz, 1993; Dollard, Miller, Doob, Mowrer & Sears, 1939). Researchers believe that

illegal and deliberate imposed barriers to one's goal achievement instigate more aggressive responses than barriers which seem to be socially justified (Pastore, 1952:728).

1.8.6 Aggressive driving

Aggressive driving is defined as any driving behaviour intended to physically or mentally harm another road user i.e. pedestrian, cyclist, and motorist and which is associated with feelings of frustration and anger (Dula & Geller, 2003:559). It is any deliberate on-road behaviour which increases the risk of a crash and instigated by anger and/or an attempt to save time (Tasca, 2000).

Chapter 2 LITERATURE REVIEW

2.1 A general overview of minibus taxi drivers' behaviour

Across developing countries, the number of road traffic accidents and injuries continue to grow due to the high rate of motorisation on the one hand and to the lack of adequate road traffic safety measures on the other. Pedestrians and cyclists (i.e. vulnerable road users and passengers in public transportation buses and minibuses) are more regularly exposed to road traffic collisions than other road users. Throughout Africa, minibus taxis represent one of the dominant forms of transport and the form that is most commonly associated with crashes and injuries. Across the continent, this dominance has grown significantly over the past three decades. In Ghana for example, between 1994 and 1998, the number of road traffic crashes increased from 6,850 to 10,715 whereas those of traffic injuries and fatalities grew from 7,663 to 11,405 and 824 to 1362 respectively. In that same period, the number of pedestrians killed represented about forty six per cent (46 %) of the total deaths reported (Afukaar, Antwi & Ofosu-Amaah, 2003:69). Between 1965 and 1998, the number of annual road traffic crashes increased from 3,562 to 14,342 and that of people killed moved from 552 to 2972. In that period, an annual estimate of eighty per cent (80%) of people killed was traveling in either public buses or taxis (Odero, Khayesi & Heda, 2003:53).

The public transport sector is ruled by minibus taxis and buses in most of African urban cities (Muhlrad & Lassarre, 2005:52). The increase of minibus taxi fleets in Africa is facilitated by these minibus taxi fleets being commonly purchased second-hand from abroad (Kumar & Barrett, 2008). Moreover, traffic crashes in urban areas are directly or indirectly due to the uncontrolled driving behaviours of minibus taxi drivers in most developing countries (La, Lee, Meuleners & Van Duong, 2013:451). In Nairobi, minibus taxis "known as "matatus" overload passengers and travel over the prescribed speed limit to make more trips in rush time periods (Khayesi, 1999; Turnbridge, 1998:54). They stop in the middle of the road and in front of the traffic to pull out passengers, drive over the curbs instead of the road when they overtake other vehicles or when they race with other minibus taxis and buses to make more trips. Minibus taxis drivers violate traffic road signs and signals at junctions and overtake on hills and curves where there is insufficient sight distance. They behave as if they have their own highway codes when they transport passengers mostly in rush time hours (Khayesi, 1999; Turnbridge, 1998:54). In a study performed at urban T-intersections in Nairobi, minibus taxis initiated more conflicts than any other type of vehicle (Maranga, 1989). The main factors associated with the increase of road traffic related crashes in Kenya included careless driving, non-roadworthy vehicles on roads, and the poor riding quality of pavements. Minibus taxis remain the cheapest mode of public transport for long and short trips inside and outside of Nairobi (Chitere & Kibua, 2004).

In Singapore, a study to assess the safety of minibus taxi drivers was conducted on 41,465 traffic injuries reported between 2001 and 2006. Detailed results revealed that in 8,015 accidents i.e. (19.3%) which involved minibus taxis, taxi drivers were responsible in 5,010 accidents (12.1%). This number was high as minibus taxis represented only 2.8% of all registered vehicles during the study period (Chin & Huang, 2009:47). Between 2006 and 2009, another study on the prevalence and factors related to road traffic crashes among minibus taxi drivers was conducted in Vietnam. A sample of 1,214 minibus taxi drivers was surveyed and 276 minibus taxi drivers (i.e. overall crash prevalence of 22.7%) were found to be involved at least in one crash. Among the crashed group, 50 minibus taxi drivers (18.1%) were involved in two to four crashes. About 55.7% of taxi crashes occurred on local roads, 23.3 % at intersections, 3% on bay and 18.2% on highways (La, Lee, Meuleners & Van Duong, 2013:451).

Lam LT (2004) considered driving at late night and driving without any passengers to be the two major factors related to the increase of minibus taxi crashes. In his study on environmental factors associated with crash mortality and injury among minibus taxi drivers, he explained that minibus taxi drivers travel long distances in unfamiliar areas as part of their work nature. He reported that they are more cautious when they carry passengers than when they run without passengers. Female minibus taxi drivers were found to be involved in crashes at a rate of about 2.5 times more than male drivers (Lam, 2004:905). Chin and Huang (2009) used two binomial logistic models to analyse factors that contributed to the occurrence of minibus taxi crashes in Singapore. The ten major factors suggested by their models included: age of the driver, time of day and day of week, type of road, horizontal element, posted speed limit, vehicle occupancy, road surface, and collision type. Their models firstly displayed factors linked to the minibus taxi drivers' behavioural problems and secondly, outlined factors related to the minibus taxi operations problems. The factors associated with minibus taxi driving behaviours i.e. increasing age, driving with no passengers in vehicle, and excessive speed overlapped those in accordance with minibus taxi operation such as driving on straight roads, driving on wet road surfaces, and multivehicle collision. Night time driving, operating at intersections, and no expressway situations were found to be associated with both driver behaviour and minibus taxi operations (Chin & Huang, 2009:47; La, Lee, Meuleners & Van Duong, 2013:451). The seven leading causes of minibus taxi crashes as identified in their two designed models were; failing to keep a proper lookout, failing to give way, disobeying traffic signs and signals, turning and changing lanes without due care, and tailgating (Chin & Huang, 2009:47).

Over the remainder of this chapter, a brief theoretical background on the minibus taxi industry in South Africa will be given. Furthermore, minibus taxis implication in road traffic related crashes and the general threat for road safety will be raised. In addition, the Frustration and Aggression Theory (F-A) of aggressive driving and the classification of aggressive driving manoeuvres will be discussed.

The response to aggressive driving behaviours and the bullying and victimisation theory will be discussed. Human and situational factors which tend to influence aggressive driving behaviours will be

explored. Lastly, literature findings on measurement scales of driving anger, driving anger expression, aggressive driving, and responses to aggressive driving behaviours will be presented. A conclusion regarding which measurement scale appropriately fits for the present study will be offered.

2.2 The minibus taxi industry in South Africa

2.2.1 Background

The 16-seater minibus taxis or so called "kombi" started to operate legally as public passenger transport vehicles after the 1987 White Paper on Transport Policy along with the Transport Deregulation Act of 1988 in South Africa (Khosa, 1994; Sekhonyane & Dugard, 2004). The minibus taxi industry grew quickly to take the place of the government owned trains after their deterioration and the boycotts of subsidised public buses which served black people for work trip purposes. This began in the 1980s while the Apartheid government was still in power (Ahmed, 2004; Barrett, 2003). Khosa (1994) attributed the rapid growth of minibus taxis in South Africa to three factors. Firstly, many black businessmen and commercial businesses in urban centres started to be inspired and attracted by minibus taxi services, Secondly, finance capital began to penetrate in the black community, and thirdly, vast numbers of black South Africans started to operate their own minibus taxis (Khosa, 1994). This excessive growth of minibus taxis in the country frustrated the apartheid government in the sense that it was seen as a new empowerment sector for black communities on one hand and as an opposing alternative to the government supported public buses and subsidised trains on the other (Khosa, 1994).

The minibus taxi industry has been characterised by violent wars after its rapid deregulation. Because of these wars, minibus taxi associations were created and operating routes were assigned to each minibus taxi association. The so called "*Taxi wars"* occurred when minibus taxis operators from one route violated local operating rules by leaving its assigned route to transport passengers on other routes. Secondly, smaller minibus taxi associations could break with their affiliates and join the more violent and financially stable minibus taxi associations (Sekhonyane & Dugard, 2004). Figure 3 shows numbers of deaths and injured people resulting from taxi wars and violence from 1991 to 1999 (Dugard, 2001).

Figure 3 Deaths and injuries of minibus taxi violence 1991-1999 (Dugard, 2001)

Minibus taxis operators are grouped into associations and they transport passengers according to the assigned routes. Both the South African Transport and Allied Workers' Union (SATAWU) and the National Taxi Drivers' Organization (NATDO), have an estimated membership of between 35,000 and 40,000 owners excluding drivers, queue marshals, car washers and fare collectors. In September 2001, the South African Department of Transport initiated the SANTACO (South African National Transport Council) after combining minibus taxi operator organisations. Through this unified body, authorities managed to build relationships with taxi operators and to engage with their representatives (Barrett, 2003). To date, minibus taxis operate in different associations and their operations are still in the hands of their owners. The government's strategy to stabilize the minibus taxi industry was to replace the old taxi fleets with new buses and to form one reliable, safer, and strong minibus taxi industry.

The recapitalization program envisaged by the government was designed to combine all the existing minibus taxi fleets into one minibus taxi industry capable of coping with the challenges that taxis experience to date and helping the whole industry to move forward to the development and other opportunities. However, minibus taxi owners rejected this idea of formalizing taxi fleets as they believed that they would lose direct control over their vehicles after recapitalization (Browning, 2001).

Minibus taxis form part of the informal economy in the Republic of South Africa. It is difficult to estimate their turnover as many of them continue operating illegally. According to the International Labour Organization (ILO, 2002), the number of unregistered minibus taxis reported in Gauteng Province was estimated at 16,000 in 2002. In the same year, an annual turnover of R12 billion was estimated taking into account the number of commuters only. In order to improve the quality of public transport in the country, the government continues to financially invest in formalising the minibus taxi industry, introduce the Bus Rapid Transport System (BRT), and to search for further solutions. In 2010,

Trans-Africa Consortium highlighted some of the reforms suggested by the South African government to improve the level of public transport services in both urban and rural areas. On the side of minibus taxis, they proposed to:

- Replace old 16-seater minibus taxis with new safe and reliable minibus vehicles
- Construct adequate minibus taxi rank facilities to improve their operations
- Formalise and democratize minibus taxi operations
- Improve working conditions of minibus taxi drivers
- Limit the number of minibus taxis operating per route and hence increase route turnover

2.2.2 Minibus taxis and threats for road safety

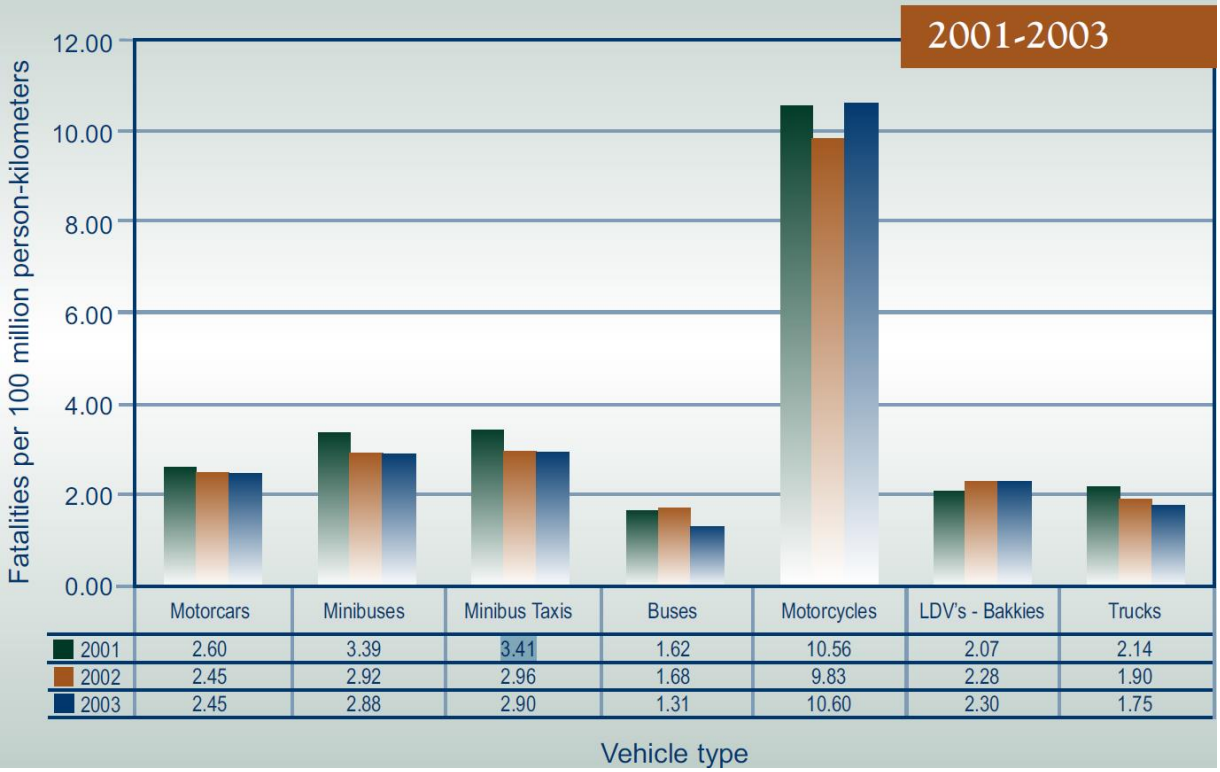
In South Africa, minibus taxis lead other modes of passenger transportation by carrying around 65 percent of daily commuters. However, careless driving behaviours of minibus taxi drivers and the dangers they cause to other road users continue to characterize this mode of public transport. A study conducted by the National Household Travel Survey (NHTS, 2003) among passengers revealed that minibus taxis offer the worst services compared to rail and to the former public subsidised buses (Department of Transport, 2004). In 2000, nearly ninety percent (90%) of all South African minibus taxi fleets had an average age of 10 years. These old fleets with an average age close to their lifespan doubled their accident rates between 1984 and 1994. In 1994, about 60,000 minibus taxi accidents were reported and the number of fatalities tripled to 1,000 whereas that of major injuries tripled to 6,000. In the same year, minibus taxis alone contributed fifteen per cent (15%) of all traffic related fatalities. A third of all crashes that involved minibus taxis were said to have resulted from worn tyres whereas seventeen percent (17%) of them resulted from overloading passengers (Barrett, 2003).

In 2000, a study to assess the causes of passenger transport vehicle accidents and to analyse their trends was conducted on crash data collected between 1991 and 1998 in South Africa. Table 1 displays accident fatalities and injuries findings collected on urban and rural roads.

Table 1 Shares of buses and minibuses accidents and casualties (Ribbens, Botha & Khumalo, 2000)

Accidents/ Casualties		Buses	Minibuses
Accidents	Urban	7095	48696
	Rural	1910	15471
Deaths	Urban	122	492
	Rural	164	1178
Serious injuries	Urban	423	3854
	Rural	415	4563
Slight injuries	Urban	843	8707
	Rural	710	6415
Total injuries	Urban	1388	13053
	Rural	1289	12156

More fatalities and casualties were recorded on rural roads than urban roads for the two types of passenger transport vehicles. The lack of emergency services and high driving speeds attained by passenger transport vehicles on rural roads were the two possible major causes of fatalities and casualties on rural roads. Around one-third of the registered buses (9,000 buses out of a total of 27,000 buses) were involved in road crashes and 65,000 minibus taxis out of a total of 126,000 minibus taxis registered in the same period were involved in road crashes. Detailed statistical analysis revealed that minibus taxis had the highest accident rate (above than 900 accidents per 100 million kilometers travelled) and the highest fatality rate (between 15 and 20 fatalities per 100 million vehicle kilometres travelled) when compared to buses and freight vehicles. On average, passenger transport vehicles were involved in road crashes at a rate of about 3.5 times higher than that of freight vehicles. Factors like overloading passengers, driving over the prescribed speed limit, reckless driving, driving under influence of alcohol and drugs, fatigue, age and health of the driver, pavement conditions and worn tyre were highlighted as the major causes of accidents that involved both buses and minibuses (Ribbens, Botha & Khumalo, 2000). Between 2001 and 2003, the number of fatalities per 100 million population kilometres travelled in minibus taxis (Figure 4) decreased from 3.42 to 2.9. From 2009 to 2011, the number of minibus taxis involved in accidents decreased from 1827 to 1408 in South Africa (Road Traffic Report, 2011).



	Motorcars	Minibuses	Minibus Taxis	Buses	Motorcycles	LDV's - Bakkies	Trucks
2001	2.60	3.39	3.41	1.62	10.56	2.07	2.14
2002	2.45	2.92	2.96	1.68	9.83	2.28	1.90
2003	2.45	2.88	2.90	1.31	10.60	2.30	1.75

Figure 4 Number of vehicle occupant fatalities per 100 million person-km (Boudreaux, 2006)

In the Pietersburg area (Polokwane), a study on superstition as a cultural related factor that contributes to minibus taxi road traffic accidents was conducted. A sample of 130 South African minibus taxi professional drivers was selected and interviewed on the basis of a superstition, risk-taking and perceived causes of road traffic accidents in urban areas. The study revealed high degree of superstitious attitudes towards minibus taxi driver accidents with superstitious items like; un-cleansed previous deaths, protection medicine, witchcraft, violating customs and fate, seeing an owl, black cat crossing and punishment from someone. Being raised superstitious attitude as courses for accidents was associated with minibus taxi drivers' self-reported accidents and the accidents they witnessed on one hand and inversely correlated to both risk-taking and accident causes on the other hand. No statistical relationship between superstition and risk-taking and perceived causes of minibus taxi accidents was found. The effect of formal education to minibus taxi accidents was negligible (Peltzer & Renner, 2003:619).

In Stanger, KwaZulu-Natal twelve people were killed when a minibus taxi collided with an oncoming car in rainy weather. Police reported excessive speed and overloading passengers to be the two causes of crash as the taxi had 20 passengers instead of 16 passengers at the time of incident. Further investigation on the crash causes revealed that varying thread depths on the front and rear axles, imbalanced load distribution on vehicle's rear and front axles due to some seating positions occupied by larger and heavy passengers, and the decrease of lateral friction of worn tyres on rear axle of the

minibus taxi constituted were the major causes to that crash. The road sight distance and the riding quality of the pavement were in good conditions (Govender & Allopi, 2006).

Between October 2009 and November 2010, the number of minibus taxis involved in fatal road traffic crashes decreased from 1,827 in October, 2009 to 1,408. Only Limpopo and the Northern Cape Province experienced an increase in minibus taxis fatal related road traffic crashes from 163 to 176 and 11 to 15 respectively. The number of all vehicles registered within the period of 1st April, 2010 to 31st March, 2011 increased from 9,678,989 to 9,945,021. In the same period, minibus taxis increased from 282,793 to 285,858. The total number of fatalities reported from 1st April, 2010 to 31st March, 2013 decreased from 10,948 to 10,845 when all vehicle types were considered. However, on provincial basis an increase of 238 i.e. a move from 1,069 to 1,307 fatalities was observed in Eastern Cape. A decrease in fatal road traffic crashes was observed in Gauteng Province where it decreased from 2153 to 2008 and in the Western Cape Province where it decreased from 1085 to 1026 (Road Traffic Report, 2011).

2.3 Driving behaviours

2.3.1 Introduction

The Highway Capacity Manual (HCM) defines driving as a complex task involving a variety of skills. The driver has to take in and process information, and make quick decisions based on that information. The driver's tasks while driving may be grouped into three main categories: control, guidance, and navigation. Control in driving refers to the driver's interaction with the vehicle in terms of speed and direction. Guidance refers to keeping a safe path and maintaining the vehicle in the proper lane. Navigation in driving means planning and executing a trip (HCM, 2000).

The performance of a driver refers to the driver's perceptual and physical skills or what the driver can do whereas driver behaviour refers to what the driver in fact does (Evans, 1991). The performance of a diver is based on his or her aptitudes and skills to control a vehicle at a given speed, and to react to encountered hazards. The performance of a driver is studied through various methods among which are laboratory tests, simulator experiments, tests using instrumented vehicles, and on-road observations of actual traffic. The driver behaviour on the other hand cannot be studied in laboratory tests, simulators or instrumental vehicles (Evans, 1991). It is mainly determined by what he or she expects another road user to do. The expectations of other drivers' future behaviours depend on the basic knowledge of formal traffic rules, road layout, and the state of other drivers. However, the driver's expectations can be wrong and result in road crashes (Björklund & Åberg, 2005:239).

Road users share roads with a great number of other fellow road users every day. They always negotiate with the traffic environment which includes cars, buses, cyclists and pedestrians. This task is only possible if every road user takes into consideration the intentions and behaviours of other road users.

The formal traffic rules which suggest the proper way to behave in different situations on the road are important for individual road users. On a daily basis, about 6 million licensed drivers together with 6.7 million registered vehicles interact with physical environment as well as with other fellow road users in South Africa (DoT, 2002). Media and road safety experts confirm that aggression on the roads continues to increase but there are no available hard statistical evidences to support this fact. There is no defined systematic way to collect driving behavioural data at the spot studies. Due to how unclearly aggressive driving has been defined in the previous literatures, it is difficult to measure how much aggressive driving is taking place on roads (Tasca, 2000).

2.3.2 Definition of aggressive driving

In 1980, Hauber defined aggressive driving as an intended driving behaviour performed by a driver with the intention to physically or mentally harm another driver. His definition was incomplete as it did not specify which driving behaviours to consider as aggressive and which ones to take as non-aggressive (Hauber, 1980:461). Mizell (1997) described aggressive driving in the same thought as Hauber (1980) as an event in which an angry road user i.e. pedestrian, cyclist or motorist harms intentionally another road user. His definition included driving behaviours intending to physically injure or to kill another road user. This definition reflects a severe form of on-road aggressive behaviours i.e. "Road rage" (Mizell, Joint & Connell, 1997). The National Highway and Traffic Safety Administration (NHTSA) and the American Automobile Association (AAA) defined aggressive driving as the operation of a motor vehicle in a manner which endangers or is likely to endanger people or property (U.S. House of Representatives, 1997). The NHTSA and AAA definition of aggressive driving includes behaviours such as; speeding, tailgating other drivers, failing to yield, weaving in and out of traffic, improper passing, unsafe lane changing, running stop signs and red lights, making hand and facial gestures, hooting and flashing lights (Goehring, 2000). This definition differs from that of Mizell (1997) as it did not include on-road behaviours related to Road rage. According to the NHTSA and AAA, Road rage is a rare phenomenon on roadways in the United States and driving behaviours associated with it fall under the purview of the criminal law (Connell & Joint, 1996). In Britain, a study conducted on road fatalities revealed that only six fatalities resulted from road rage in 1996. The likelihood of a British driver to be killed in a road rage incident was closer to one in 9.5 million fatalities whereas that of being killed in a motor vehicle collision was estimated to one in 15,686 vehicles (Elliott, 1999).

Several studies in the context of aggressive driving behaviours focused on categorising which types of driving behaviours are aggressive and which ones are non-aggressive (Dula & Geller, 2003:559). However, these studies are incomplete as they did not define one precise and common definition of aggressive driving behaviour to guide all road safety experts and safety researchers. Tasca (2000) studied 21 available publications on traffic safety and psychology that are linked to aggressive driving with the aim to propose a precised definition of aggressive driving. She reviewed various definitions

proposed by previous researchers and formulated her definition taking into consideration three important guiding principles. Firstly, the definition of aggressive driving should not be too general (Shinar, 1998:137). It should detail specific driving behaviours to consider as aggressive driving. Secondly, it should not include driving behaviours linked to road rage (Elliott, 1999). Thirdly, it should include deliberate driving behaviours which do not envisage causing either psychological or physical danger to other road users. Those driving behaviours should be instigated by annoyance, and/or attempts to save time. They are likely to intimidate other road users, irritate or force them to take evasive actions. The formal definition of aggressive driving by Tasca (2000) is stated as follows:

"*A driving behaviour is aggressive if it is deliberate, likely to increase the risk of collision and is motivated by impatience, annoyance, hostility and/or an attempt to save time*".

This definition includes driving behaviours such as cutting in too close in front of other drivers, weaving in and out of traffic, improper passing and passing on the road shoulder, cutting in too close in front of other vehicles, improper lane changes, failure to yield the right of way to other road users, obstructing other drivers from passing, refusal to accommodate motorists unable to merge or to change lanes due to traffic conditions, driving over the posted speed limit, frequent and abrupt lane changes, and red lights running. Dula and Ballard (2002) defined the three aspects of driving behaviours i.e. negative emotions behind the steering wheel (frustration and anger), intentional acts of physical or mental aggression towards other road users (obscene gestures and verbal abuse), and dangerous driving behaviours showed by drivers not with the aim to harm other drivers but to save time as on-road aggressive driving behaviours.

2.3.3 The Frustration and Aggression Theory of aggressive driving

The Frustration and Aggression Theory (F-A) also known as the Dominant Theory of Aggression (DTA) in Psychology defined aggression as a behaviour directed to a person with the intention to physically or mentally harm that person (Shinar, 1998:137). The F-A theory maintains the idea that frustration always results in aggression (Dollard, Miller, Doob, Mowrer & Sears, 1939). The Frustration and Aggression Model confirms that the extent to which a person is subjected to a frustrating event or situation defines how aggressive s/he will be (Shinar, 1998:137). However, Berkowitz in his reformulation of the F-A theory suggested that frustration only results in aggression when the victim is unpleasant enough to provoke anger (Berkowitz, 1993).

Further researches in this context agreed that the amount of anger accumulated by the victim exposed to a frustrating situation alone does not necessarily result in aggressive behavioural response. Both the way the individual interprets the frustrating situation and the characteristics of the situation itself add to the expression of aggressive behavioural response (Lajunen, Parker & Summala, 1999:225; Shinar, 1998:137). The frustrating on-road situations such as traffic congestions, delays, and time pressure

quantified in terms of duration of traffic signal, time of day and day of week have contributed to aggressive responses (Shinar, 1998:137).

In the road traffic context, the level of aggression will depend on the level of frustration suffered by the driver. It will also depend on the expected negative consequences for aggression as well as on the extent to which the frustration is deemed unfair (Shinar, 1998:137). From the F-A Model, two categories of aggressive behaviours were defined: hostile aggression and instrumental aggression. Shinar defined *hostile aggression* as an aggression characterized by strong emotion and includes behaviours intending to make the offender feel good. The primary goal in hostile aggression is to do harm. For instance, a driver who decides to follow a vehicle that cut him off abruptly on the roadway is an example of hostile aggression. *Instrumental aggression* refers to aggressive behaviour demonstrated by the victim with the intention to overcome frustrating events. It is not characterized by anger or annoyance directed to a particular individual. It stops as soon as the source of frustration has been removed. A driver who decides to weave in and out of the traffic because he or she is late for a meeting for example is a good illustration of instrumental aggression (Shinar, 1998:137).

To Shinar (1998) aggressive driving is an instrumental behaviour resulting from irritation with other drivers or deliberate dangerous driving to save time at the expense of other road users. Driving behaviours which include: ignoring traffic signals and signs, tailgating other drivers, obstructing other vehicles from passing, weaving in and out of the traffic, and flashing lights and horn-honking form part of his definition. The concept of the F-A Model for a driver stopping behind another vehicle at a signalized intersection when the red light is on is illustrated in Figure 5. As soon as the light changes to green and the lead car fails to immediately advance, the driver behind has then a disposition to hoot at the leader vehicle (Shinar, 1998:137).

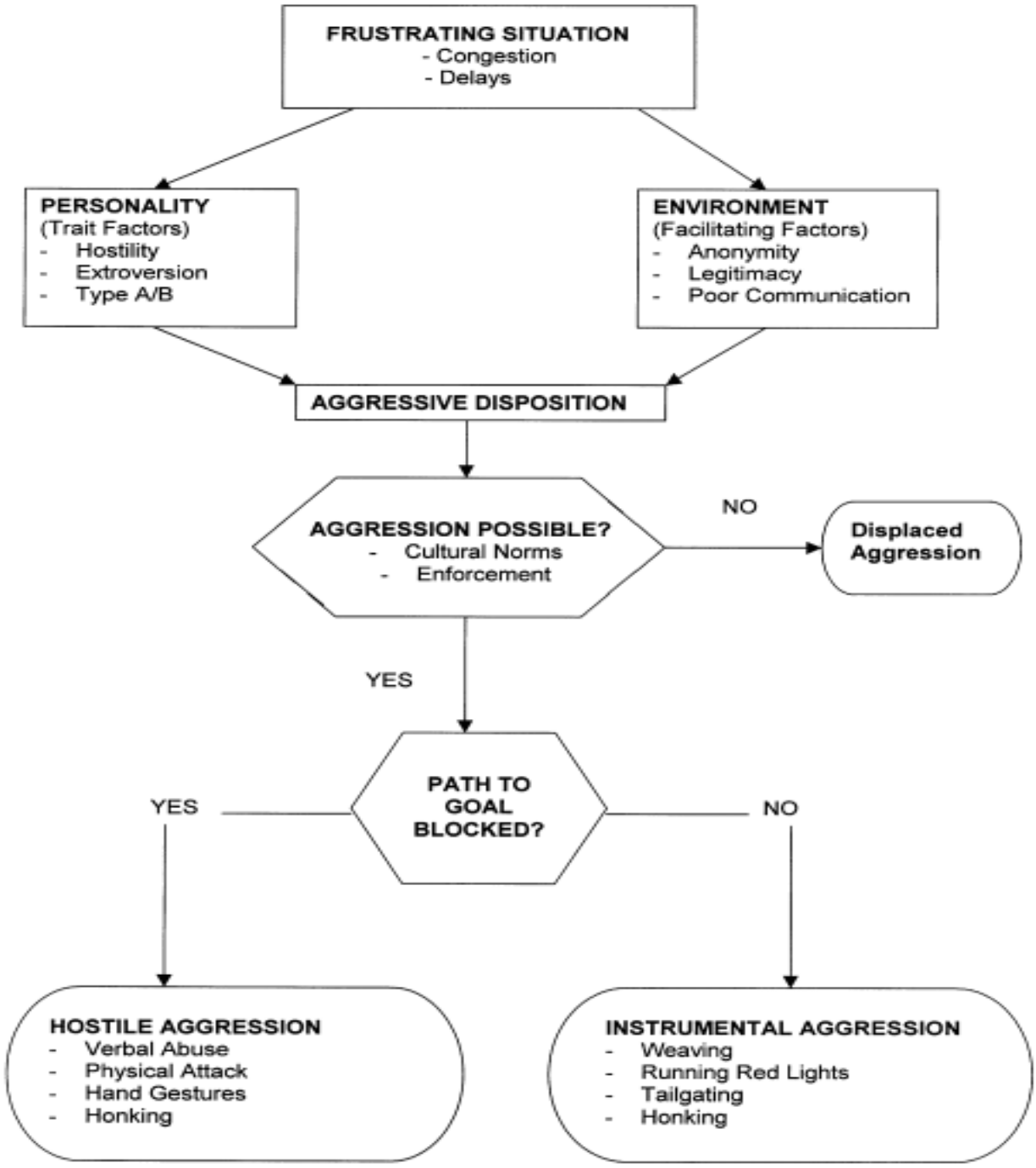


Figure 5 Frustration-Aggression Model of Aggressive Driving (Shinar, 1998:137)

However, Shinar's definition of aggressive driving differs from the definition proposed by the NHTSA and the AAA since he excluded speeding from his list of aggressive behaviours. Shinar admitted that speeding is a dangerous and purposeful behaviour but believed that it does not result from frustration or obstruction (Shinar, 1998:137). Others agree that in most cases, aggressive driving behaviours are connected. For instance, for a driver to weave or to tailgate other drivers within the same traffic s/he needs to increase the speed (Goehring, 2000). In a nationwide survey of drivers' views of speeding within the context of aggressive driving conducted in Canada, two-thirds of the participants agreed that

driving at twenty kilometres per hour (20km/h) above the prescribed speed limit is aggressive driving behaviour. Table 2 details driving behaviours identified by 1,008 participants as aggressive in Canada (Canada Safety Council, 2000).

Table 2 Aggressive driving behaviours (Steel Alliance - Canada Safety Council, 2000)

On-road aggressive behaviours	Percentage answering ("Yes")
Driving too closely behind other vehicles	93
Passing on the hard shoulders of the road	87
Making rude gestures	87
Pulling into a parking space someone else is waiting for	82
Changing lanes without indicating	73
Flashing high beams at the vehicle in front of you	72
Red light running	69
Waiting until the last second to merge with traffic on highway	66
Driving 20 km per hour over the prescribed speed limit	65

Driver behaviour on roads varies significantly as a result of traffic conditions. Most of the time, aggressive driving behaviours will include: tailgating other drivers, weaving in and out of traffic, improper passing, cutting in too close in front of vehicle being overtaken, passing on the road shoulder, changing lane without indicating, failure to yield the right of way to other road users, obstructing other drivers from passing, refusal to accommodate other fellow motorists unable to merge or change lanes due to traffic conditions, driving over the prescribed speed limit, frequent stops and abrupt lane changes, and red light running and traffic signs violation (Tasca, 2000). However, deliberate driving behaviours that fit into Tasca's description seem to be dangerous to other road users as they intimidate, irritate, and/or force them to take evasive actions. In addition to deliberate and risky driving behaviours, flashing headlights, horn honking, glaring at another driver to show dissatisfaction, gesturing, and yelling at other drivers are considered as aggressive driving (Tasca, 2000). The risky driving behaviours associated with: overtaking, heavy braking, low headways, conflicting movements, large speed differentials, and near misses were defined as on-road aggressive driving (Bonsall, Liu & Young, 2005:425). Researchers pointed out factors that are likely to increase the aggressive behaviours. Some of those factors are personal related factors i.e. age, gender, anger, and underestimation of the driver himself/herself in terms of driving skills. On-road situational factors include; privacy or anonymity of the driver, traffic conditions, and road types (Tasca, 2000).

2.3.4 Prevalence of aggressive driving behaviours

2.3.4.1 International studies

Between 1990 and 1996 in the US, the American Automobile Association Foundation for Traffic Safety studied 10,037 cases of aggressive driving incidents reported by the police and which were printed in newspapers and insurance reports. Findings from the study revealed 218 deaths and 12,610 injuries in all incidents recorded in that period resulted from aggressive driving (Mizell, Joint & Connell, 1997). In the Australian State of Victoria, a study on on-road aggression and violence associated with vehicle use was conducted on 800 drivers by the Victorian Community Council Against Violence (VCCAV). Findings from this study indicated that ninety one per cent (91%) of drivers who experienced extreme on-road aggressive behaviours i.e. road rage was not reported to the authorities. Again, forty one per cent (41%) of the participants were reported to have been involved in a form of road rage in the last 12 months (Victorian Community Council Against Violence, (VCCAV), 1999). In 2000, an on-road observational study to assess the most road safety issues related to aggressive driving was conducted in Canada. In a sample of 1,207 Canadian drivers studied by the Traffic Injury Research Foundation, sixty-five percent (65%) of respondents viewed on-road aggressive driving behaviours as a serious road safety concern. In this study, the aggressive behaviours observed to be most common used include driving over the speed limit, tailgating vehicles in front and driving slowly, weaving in and out of the traffic, red light running, late use of indicators, and failure to yield right of way on other fellow road users at junctions (Beirness, Simpson & Desmond, 2002). In 2002, another study to assess the prevalence of on-road aggressive driving behaviours was conducted in the United States. During the study, sixty two per cent (62%) of 6,000 drivers surveyed by the National Highway Traffic Safety Administration (NHTSA) reported to have been upset by other drivers' aggressive behaviours in the past 12 months. The most prevalent aggressive driving suffered by participants included tailgating, cutting in one or more lanes in front of other drivers, and traveling beyond the posted speed limits (NHTSA, 1998b).

2.3.4.2 South Africa

Research findings on aggressive driving in South Africa revealed that aggressive driving behaviours constitute an important road traffic safety problem (Sukhai, Seedat, Jordaan & Jackson, 2005:244). In eThekwini Metropolitan Area in South Africa, a study aimed to assess the nature and the prevalence of on- road aggressive behaviours was conducted in 2005. In this study, a sample of 1,006 motorists was interviewed on the nature and the occurrence of aggressive diving behaviours. Table 3 illustrates the results of victimisation and perpetration of the on-road aggressive behaviours from Level 1 to Level 4. The *Level 1 aggressive road behaviour* included behaviours related to the expression of irritation but non-threatening expression of anger. The *Level 2 aggressive road behaviour* referred to behaviours related to the expressions of anger on the road. The *Level 3 aggressive road behaviour* referred to the

direct threatening on-road behaviours. *The* Level *4 aggressive road behaviour* referred to the direct confrontational on-road behaviours. Table 3 summarises factor analysis results of predictor variables of the on-road aggressive behaviours identified (Sukhai, Seedat, Jordaan & Jackson, 2005:244).

Table 3 Prevalence and frequency of experiencing and perpetrating Level 1 to Level 4 road behaviours (Sukhai, Seedat, Jordaan & Jackson, 2005:244)

	Victimisation n (%)	Perpetration n (%)
Level 1 behaviours		
1.1 Say bad things to oneself or passenger		812 (84.9%)
1.2 Yell at oneself or passenger		780 (81.9%)
Level 2 behaviours		
2.1 Give another driver dirty looks	749 (74.8%)	462 (46.9%)
2.2 Hoot/yell at another driver	818 (83.8%)	519 (53.6%)
2.3 Make obscene gestures at another driver	630 (64.3%)	196 (20.0%)
Level 3 behaviours		
3.1 Preventing another driver from entering lane	789 (80.1%)	261 (26.4%)
3.2 Preventing another driver from passing	687 (69.5%)	241 (24.5%)
3.3 Tailgating another driver	777 (78.6%)	280 (28.5%)
3.4 Try to cut another driver off the road	330 (34.3%)	47 (4.9%)
3.5 Follow or chase another driver	89 (9.5%)	35 (3.6%)
Level 4 behaviours		
4.1 Get out of car and argue with another driver	174 (17.8%)	71 (7.2%)
4.2 Get out of car to hurt another driver	49 (5.1%)	29 (2.9%)
4.3 Deliberately collide with/damage another car	90 (9.2%)	18 (1.8%)
4.4 Point a gun or shoot at another car	57 (5.9%)	3 (0.3%)

In Table 3, offenders of aggressive on-road behaviours agreed to have been engaged in Level 1 on-road behaviours (82% - 85%) than in Level 2, 3, and 4 behaviours where offenders express their anger, directly intimidate the victims or engage physically with them (0.3 – 7.2%). However, victims of aggressive behaviours reported to suffer Level 2 and Level 3 behaviours (64 % - 84 %) and (10 % - 81 %) where offenders openly intimidate them and use their vehicles to express anger than in Level 1 and Level 4 on-road behaviours. The factor analysis in Table 4 revealed that among all the speed related on-road aggressive behaviours i.e. driving over the speed limit, red light running, tailgating, and weaving in and out of the traffic, only weaving in traffic was a predictor of Level 2, 3, and 4 on-road aggressive behaviours for victims. For perpetration, all levels of aggressive on-road behaviours were predicted by at least two speed related behaviours. For instance, driving over the posted speed limit

predicted aggressive on-road behaviour Level 3 and Level 4 in the factor analysis and weaving in traffic was a predictor of Level 2 and Level 4 on-road aggressive behaviours. Level 1 on-road aggressive behaviour was not applicable (Sukhai, Seedat, Jordaan & Jackson, 2005:244).

Table 4 Predictor variables for victimisation and perpetration of Level 1 to Level 4 behaviours

	Level 1 Behaviour		Level 2 Behaviour		Level 3 Behaviour		Level 4 Behaviour	
	victim	perp.	victim	perp.	victim	perp.	victim	perp.
Speeding					x	x		x
Red light running		x	x	x	x			x
Weaving in and out of traffic			x	x	x	x	x	
Tailgating other vehicles		x				x		
Drink and drive				x	x		x	x
Carry weapon while driving			x				x	x
Received fine over 10 years							x	
Age (young drivers)				x				
Gender (male)			x					
Drive almost every day		x						

2.3.5 Precursors to aggressive road behaviours

In Figure 6 several factors that influence on-road driving behaviours are indicated. In this context, the potentiality of those factors differs with respect to their abilities to produce on-road aggressive behaviours (REASON, 1991). The potential factors which contribute to aggressive driving can be divided into two main categories: person-related factors and state related factors. In terms of person-related characteristics, age and gender of drivers are the two of the contributory factors most often tackled by researchers in literatures (Shinar, 1998:137). For instance, in a study of the contributions of drivers and situation on aggressive driving by Shinar (1998), results revealed that as the age of the driver increases, his or her aggressiveness on the road decreases. In the same study, male drivers displayed more aggressive behaviours mainly those which seem to be more severe than female drivers (Shinar, 1998:137). As compared to the available readings on person-related factors to aggressive driving, little is known about the influence of situational factors on on-road aggressive driving.

owever, the three factors that contribute to aggressive driving i.e. time pressure, traffic congestion, and perceived delays were highlighted by some researchers to influence feelings of anger elicited by the victim and hence to increase the probability of the same driver to display a more severe behavioural responses (Lajunen, Parker & Stradling, 1998:107; Shinar, 1998:137).

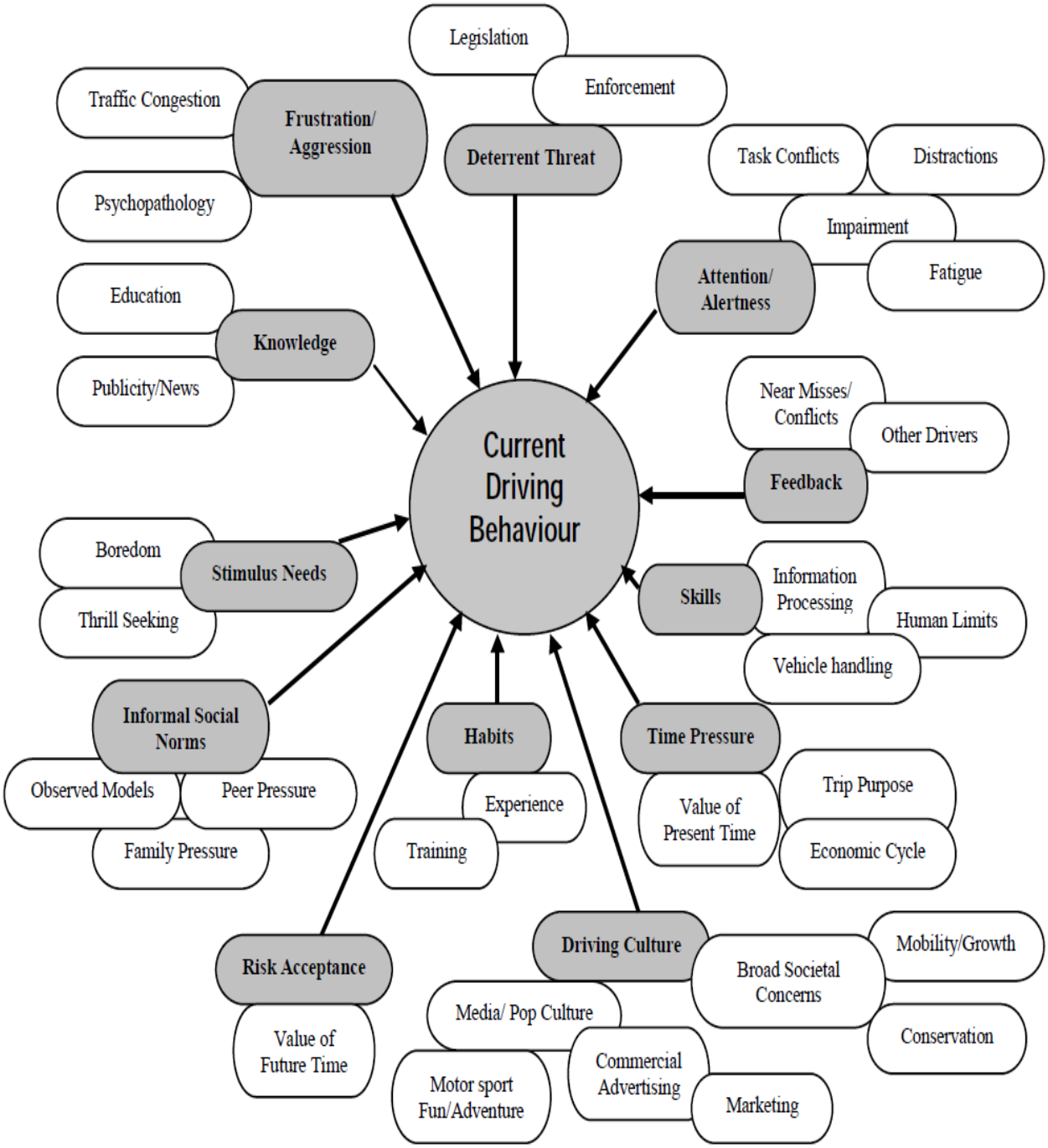


Figure 6 Situational factors influencing aggressive driving (Lonero & Clinton, 1998)

2.3.5.1 Person-related factors

Previous studies in the field of aggressive driving behaviour considered that driver's age and gender affect not only the individual experience of anger when exposed to a frustrating situation but also the associated behavioural responses. In a study to examine the relationships between self-reported driver anger and aggressive driving behaviours instigated by situational factors, the amount of anger experienced by male drivers and the severity of their corresponding behavioural responses was reported to decrease with increase of age (Lajunen, Parker & Stradling, 1998:107). In a survey of police records of reported aggressive driving incidents in New South Wales (Australia), results revealed that the percentage of young male drivers engaged in aggressive incidents overlapped those of female and elder divers (Harding, Morgan, Indermaur, Ferrante & Blagg, 1998:221). In another study that used anger-instigating scenarios to assess the effects of situational factors on aggressive driving, victims displayed more severe aggressive behavioural responses towards young offender drivers than elderly offender drivers (O'Brien, Tay & Watson, 2004:101). For instance when time pressure was absent, the average score for aggressive responses towards young female offenders was 18.6 whereas the corresponding score for elderly female offenders was 17.5. The average anger score produced in the participants by male offenders (2.99) was higher than that elicited by female offenders (2.90). There was no difference in severity of behavioural responses displayed by the participants. However, the amount of anger experienced by victims and their aggressive responses varied significantly in the same pairs of scenarios considered above when time pressure was considered. For instance the average anger score increased from 2.98 to 3.72 while aggressive behavioural response increased from 19.1 to 20.1. In Israel, a sample of 181 university students was selected to explore gender and age related differences in traffic law violations. Female drivers displayed a strong sense of obligation to respect traffic signs and signals. They complied with traffic laws even where the risk of non-compliance was very low. For instance, female drivers increased the travelling speed only where it was safe to do so. Male drivers on the other hand overestimated their driving skills and engaged in risky driving behaviours. Young male drivers placed more confidence in traffic laws compliance and underestimated the risks that they may account from violating traffic laws. Male drivers evaluated traffic laws in negative way compared to female drivers (Yagil, 2001:119).

2.3.5.2 Situational factors

Even though aggressive driving behaviours may occur on all types of roadways, more incidents are likely to occur on urban roads and arterials. Many papers on the effects of roads on aggressive driving focused on urban roads since within build-up areas, major roads and freeways experience higher levels of congestion generally in peak hours. This increases the likelihood of aggressive driving behaviours on urban roads (Elliott, 1999).

In a study to investigate the casual factors associated with anger and its possible consequences while driving, participants were asked to fill in a diary with near accidents and the feelings of anger they experienced with a period of two weeks. Results from this study revealed a strong relation between the number of near accidents reported and the feelings of anger experienced by participants. In this study, a strong correlation was established between anger feelings experienced by participants and frustrating situations. However this study did not confirm whether drivers who experienced higher levels of traffic congestion displayed more anger or not (Underwood, Chapman, Wright & Crundall, 1999:55). In another study, the frequent exposure to traffic congestion was assumed to increase the aggression on the road. Results revealed a weak relationship between exposure rates and traffic congestion. Only high intensity of vehicles on the road was observed in peak hours when people have to move to and from their workplaces (Lajunen, Parker & Summala, 1999:225). Traffic congestion cannot be taken as predictor of the on-road aggressive driving behaviours as it does not affect the driving behaviour of a given driver. Only the observed increase in numbers of aggressive driving behaviours observed in high density traffic is assigned to the increase of the number of vehicles on the road (Shinar & Compton, 2004:429).

To evaluate the influence of the time of observation on aggressive driving behaviours, Shinar and Compton (2004) used an exposure sample of 207,720 vehicles (99,000 vehicles in the weekday rush hours, 68,000 vehicles in the weekday non-rush hours, and 40,440 vehicle in the weekends) and compare the average of aggressive driving behaviours observed with the relative number of vehicles recorded in same periods. In terms of relative risk, results from the study revealed a higher relative risk of aggressive driving during weekday rush hours than weekday non-rush hours and weekends. The relative risk of aggression in weekday rush hours was 1.1 whereas during weekday non-rush hours and weekends was 1.0 and 0.7 respectively (Shinar & Compton, 2004:429). On urban signalized intersections, Shinar (1998) partially associated both the red light running behaviour and horn-honking on other drivers with the perceived duration of the red and green phases. In his study of the contributions of the drivers and situational factors on aggressive behaviours, drivers tended to run red lights as the length of the red phase increases. Drivers were disposed to start honking on the leading vehicle when they failed to proceed quickly through the junctions after the light has changed to green (Shinar, 1998:137).

Situations that confer anonymity and unfamiliarity of drivers to the traffic situation contribute to the on-road aggressive behaviours (Parkinson, 2001:507). For instance, on highways and during the night, offending drivers express more aggressive driving behaviours than during the day as they cannot be easily identified by other drivers or fined by traffic police. The same situation may be evidenced in traffic jams where flagrant incidents occur due to stressful circumstances. Putting this aside, Ellison et al. (1995) studied aggressive honking behaviour expression anonymous drivers and identifiable drivers.

They hypothesised that anonymous drivers stuck behind a car that does not progress quickly when the light changes to green will honk very sooner and for longer duration than drivers in identifiable conditions. Results from the study revealed a significant difference between driver condition and hooting behaviour. Unidentified drivers were seen to hoot more quickly and for longer durations each than identifiable drivers. However, no significant differences were found between vehicle type, location and number of persons in vehicle, use of sunglasses, age, gender of the driver and the hooting behaviours. In the next section, a discussion on various types of aggressive driving manoeuvres is given.

2.3.6 Aggressive driving manoeuvres

There is a difference between aggressive driving behaviours and aggressive drivers. According to Shinar (1998), aggressive drivers is defined as a group of drivers exhibiting aggressive driving behaviours every day whereas aggressive driving behaviours refers to driving behaviours demonstrated by a big number of drivers less frequently (Shinar, 1998:137). In the next section, the most common types of driving behaviours exhibited by many drivers are detailed

2.3.6.1 Improper passing and overtaking

An overtaking manoeuvre may be split into three phases i.e. diverting from the original lane, driving straight in the adjacent lane, and returning to the original lane (Wewerinke, 1996:2558). These three parts of overtaking manoeuvre as illustrated in Figure 7 can be simply stated as: lane changing, overtaking, and returning to the original lane. In almost all cases, the overtaking process includes lane changing. An overtaking manoeuvre starts when the front right wheel of the overtaking vehicle crosses the centreline between the original lane and the adjacent lane and finishes when its right rear wheel crosses the centreline from the adjacent lane (Mahdi, 1991). It is one of the most complex tasks that drivers face on roadways as it includes traffic observation, information processing, decision making, and manoeuvring (Wewerinke, 1996:2558).

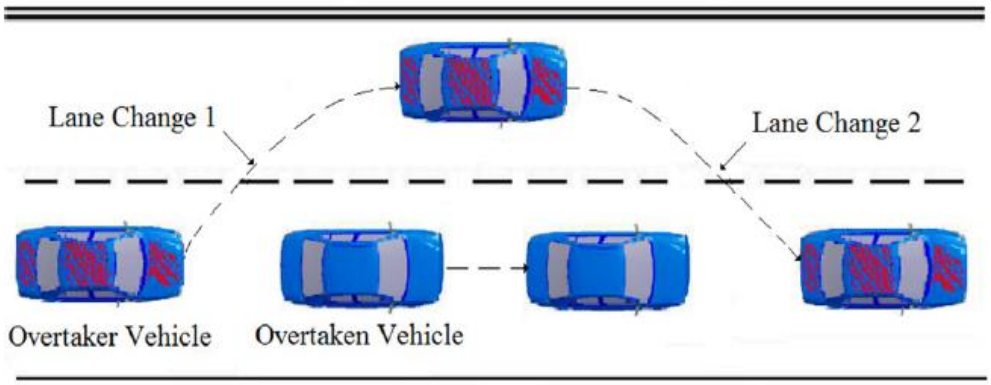


Figure 7 Overtaking manoeuvre stages (Ghaffari, Khodayari, Alimardani & Sadati, 2011)

There are various methods used to investigate vehicle overtaking behaviours on roadways. Among those methods are accident analysis, driving simulator, test track observations, and observation along the road

(Hegeman, Hoogendoorn & Brookhuis, 2005:505). In all cases, the important parameters of an overtaking manoeuvre that needed to be observed and studied to get a better insight of the real situation on the road include:

- The distance between the passing vehicle and the overtaken vehicle prior to and after the overtaking manoeuvre.
- Indicator use before and after overtaking manoeuvre
- The estimated time of the total overtaking manoeuvre
- The estimated speed of the overtaken vehicle
- The gap time between the overtaking vehicle after it completes the manoeuvre and the first oncoming vehicle in case of two-lane roads. It is called time to collision (TTC).

An overtaking manoeuvre is a risky task to engage in and it becomes more dangerous and difficult on two-lane two-way rural roads. This is due to the fact that the overtaking driver has to take into consideration both the movement of the lead vehicle to overtake in front and the oncoming traffic with high speed in most of the cases. The differential speeds among vehicles results in more overtaking manoeuvres and tends to increase the number of crashes (Mocsári, 2009). Previous studies estimated the lane changing crashes involving overtaking and merging manoeuvres at four to ten per cent (4% to 10%) of all crashes (Wang & Knipling, 1994). In the Netherlands, about three per cent (3%) i.e. 26 road users were killed in 2003 due to overtaking failures (Hegeman, Hoogendoorn & Brookhuis, 2005:505).

In the case of England, Wilson and Best (1982) conducted an on-the-road observational study to assess the drivers' different overtaking strategies on a two-lane two-way road. In their study, over 400 overtaking manoeuvers were observed and grouped into four overtaking strategies: normal or accelerative overtaking, flying overtaking, and piggy-backers, and multiple overtaking.

The multiple overtaking type of overtaking strategies reflects the case where the overtaking driver has to pass more than one vehicle behind the leading vehicle. In addition to the four overtaking strategies, three other undesired overtaking strategies were identified these being: lane sharing, cutting in, and braking to follow. *Lane sharing* is the overtaking strategy where the overtaking vehicle has to partially drive in both the original lane and the adjacent lanes whereas *cutting in* refers to quick return to the original lane. During the study, the first two types of undesired overtaking increased in situations where drivers accepted small gaps i.e. less than 400 m to start their overtaking manoeuvres (Wilson & Best, 1982:179).

In the Netherlands, Hegeman et al. (2005) analysed overtaking strategies of drivers using overtaking behaviour video observations on roads with opposing traffic and defined the four strategies of overtaking manoeuvres. The *Normal* or *accelerative overtaking* refers to the situation where the overtaking vehicle approaches the lead vehicle and waits for an overtaking opportunity to present. Behind the lead vehicle, the overtaking vehicle keeps on adjusting the speed to the speed of the leader

and accelerates to overtake when a sufficient gap is presented. The *Flying or continuous overtaking* occurs when the overtaking vehicle does not adjust his or her speed behind the lead vehicle and continues with his or her current speed during the overtaking process. The *Piggy backing* means that the overtaking vehicle follows another overtaking vehicle and stays behind the preceding vehicle until they both overtake the leading vehicle. Lastly, the *2+ or multiple overtaking* is when the overtaking vehicle overtakes one or more vehicles behind the leading vehicle and in the same move; it also overtakes the lead vehicle. In this case, the minimum number of overtaken vehicles is 2 and the complete overtaking time depends on the number of vehicles to be overtaken (Hegeman, Hoogendoorn & Brookhuis, 2005:505).

Mocsári (2009) observed and analysed 230 cases of overtaking manoeuvres collected by means of observation. From 230 cases studied, 127 cases (55%) were of accelerative or normal overtaking types whereas 46 cases (20%) were of continuous or flying overtaking types. The speed of the overtaking vehicle was higher in flying or continuous overtaking than in accelerative overtaking. In accelerative overtaking the differential speed between the overtaking vehicle and the overtaken vehicle was estimated at 15.4 km/h whereas in continuous overtaking this difference was 26.4 km/h (Mocsári, 2009). On two-lane roads, a driver preparing for overtaking starts by estimating the distance and speed of oncoming traffic. He or she slightly inclines to the right lane of the road and starts looking far to see if there is an oncoming vehicle approaching. Studies showed that many drivers do not watch oncoming traffic before they start overtaking. Sometimes they start their overtaking manoeuvres with their head-motions without checking whether there is another car behind that has started the overtaking manoeuvre (Mocsári, 2009).

2.3.6.2 Speeding and Tailgating

Speeding refers to exceeding the prescribed speed limit or driving at a speed not suitable to the prevailing road and traffic conditions (arrivealive.co.za, 2012). Speeding increases the likelihood of crash and severity of crash by reducing the driver's ability to perceive and react to dangerous situations (arrivealive.co.za, 2012). Finch et al. (1994) noted that an increase of 1 km/hr in average travelling speed augments the risk of injury crashes by three (3%) and fatality crashes by four to five (4-5%) (Finch, Kompfner, Lockwood & Maycock, 1994). From principles of physics, the energy dissipated in collision is proportional to the square of the speed (Ogden, 1996).

On roadways, travelling speeds are limited to minimise traffic accidents by allowing smooth and efficient passage for all types of vehicles (Wium & Ribbens, 1986). In South Africa, the general speed limits according to The South African National Road Traffic Act of 1989 are as follows: Urban roads (60 km/h), public roads outside urban areas (100km/h), and motorways or freeways (120km/h). There is a high correlation between accident rate and vehicles exceeding the speed limits. In South Africa,

minibus taxi drivers do not comply with speed limits. In a study to determine the effectiveness of different speed limits for different classes of vehicles, eighty five percent (85%) of the drivers of light vehicles and buses respected their speed limits whereas minibus taxi drivers and drivers of heavy vehicles appeared to exceed their speed limits to a large extent. The speeds of buses, minibus taxis, light and heavy vehicles were measured on 12 sections of two, four and six-lane roads selected in the Eastern and Western Cape Provinces. The speed limit for all light vehicles on those sections was 120 km/h (Bester & Marais, 2012).

In the United States, speeding was found to be a contributory factor in thirty one per cent (31%) of all traffic accidents reported (NHTSA, 2003). In South Africa, excessive speed was a cause of about thirty per cent (30%) of all crashes reported (DoT, 2002). Sukhai et al. (2005) studied aggressive on-road behaviours in Durban and more than half of respondents (53%) reported driving above the posted speed limit. In their study, the frequency of speeding for drivers interviewed was equal to half of the times the chance to speed was presented. However, previous researchers did not define speeding as aggressive driving behaviours. Shinar (1998) excluded speeding in his list of aggressive driving behaviours as he believed that it is a dangerous and purposeful behaviour not instigated by frustrating situations or driving behaviours of other motorists. The NHTSA on the other hand included speeding in their list of aggressive driving behaviours because some driving behaviours are interrelated. For instance tailgating or driving too close behind other vehicles results in speeding (Goehring, 2000).

Tailgating refers to driving too closely behind another vehicle. It has been included in the list of specific aggressive driving behaviours by several researchers (Mizell, Joint & Connell, 1997; Tasca, 2000).

Postans and Wilson (1983) distinguished between provoked, unprovoked, and unnecessary tailgating. In provoked tailgating, a slower moving vehicle chooses to remain in the centre lane instead of moving into a clear inside lane. In unprovoked tailgating, a slower moving vehicle remains in the centre lane, but access to the inside lane is blocked by another vehicle. Unnecessary tailgating involves a vehicle following too closely despite the availability of a clear outside lane (Postans & Wilson, 1983:317). In their observational study, they found that forty three per cent (43%) of the tailgating crashes occurred with a clear outside lane and twenty three per cent (23%) of drivers in the centre lane of the M1 motorway followed a vehicle with gaps of less than one-half second of stopping time. Large vehicles involved in tailgating incidents had a greater potential for serious injury or death in the event of a collision (Postans & Wilson, 1983:317).

There is always a link between short-time headway and rear-end collisions. Traffic accidents are always associated with how persons drive. The time headway of two seconds i.e. " so called the 2- second rule" has been recommended by previous researchers as the possible minimum time headway between successive vehicles in the traffic stream for safe following (Michael, Leeming & Dwyer, 2000:55). In the traffic stream, drivers who follow with headways less than 2 seconds are more likely to be involved

in accidents than accident-free drivers (Evans & Wasielewski, 1982:57). Tailgating is the major cause of rear-end collisions on urban roads (Winsum & Heino, 1996:579). In 1997, 169,000 road crashes were analysed in Tennessee. Of the 169,000 crashes studied, 46,000 were found to be rear end collisions. Up 44.1 per cent of the rear-end crashes observed in the study occurred on urban streets and following closely was the major cause of crashes (Michael, Leeming & Dwyer, 2000:55).

2.3.6.3 Red Light Running

Driving behaviours at signalized junctions are governed not only by the rules of priority but also the geometry as well as behaviours of other road users (Björklund & Åberg, 2005:239). Driver's behaviour at signalised intersections is determined by traffic signals and signs compliance, which depend on the whole setting of the intersection. The failure to obey traffic signals can lead to intersection violations and eventually to near-collisions or collisions. To assess the safety of signalised intersections, a set of factors which include the layout of junction, traffic volumes at the intersection approaches, the phasing and the time settings of the traffic signals and of course the driver's characteristics (Parker, West, Stradling & Manstead, 1995:571) were identified. The primary cause of signalized intersection accidents is when a motorist enters an intersection when the red light is displayed, and collides with another motorist, bicyclist, pedestrian, who is legally within the intersection (Björklund & Åberg, 2005:239). In 2008, the Traffic Safety Facts Report by the National Highway Traffic Safety Administration, 762 deaths and 165,000 persons injured by red light running were reported (FHWA, 2013). Between 16 and 20 per cent of all intersection crashes are red light running related crashes (FHWA, 2013).

To date, a form of aggressive driving behaviour that is associated with non-compliance of traffic code is displayed by many drivers. For signalised intersections, aggressive driving is evaluated in terms of approaching with a speed higher than the design speed and red light running. This behaviour reduces road safety levels (Bonsall, Liu & Young, 2005:425). Some of the factors that contribute to intersection red light running include poor intersection design, distraction and inattention of drivers approaching signalised intersections (Björklund & Åberg, 2005:239). Previous researchers have developed models to predict accidents at signalized intersections. However, those models do not explain more than thirty five per cent (35%) of the variance. This is due to the fact that seventy five per cent (75%) of other factors that contribute to intersection accidents are not included in those models. Those other factors are generally linked to the driver's characteristics include gender, age, attitude and behaviours. Road conditions, weather, and time of the day contribute to intersection accidents. Papaioannou (2007) developed a model to predict accidents with and without pedestrians on urban signalized intersection in Thessaloniki, Greece. Results from the model revealed a great correlation between illegal movements and accident occurrences. He suggested more focus on driver's behaviour when studying the safety of intersections (Papaioannou, 2007:147).

Furthermore, Shinar (1998) assessed the effects of frustrating situations on drivers' aggressive driving behaviours. He used red light running behaviour as a measure of aggressive driving and checked whether there is a correlation between the time delays spend at intersection while waiting for the light to change from red to green and the tendency of the drivers to the red light running behaviours. He hypothesised that the shorter the green phase, the more likely the drivers will be to run through the red light. During the study, drivers drove through 10 signalized intersections in Tel-Aviv in peak hours and a total of 100 signal changes observations were made at each intersections. Results in Figure 8 show a moderate inverse relationship between the duration of green phase and the number of red light runners. The study concluded that the number of drivers tending to run red light per 100 cycles observed decreased as the duration of the green phase increase (Shinar, 1998:137).

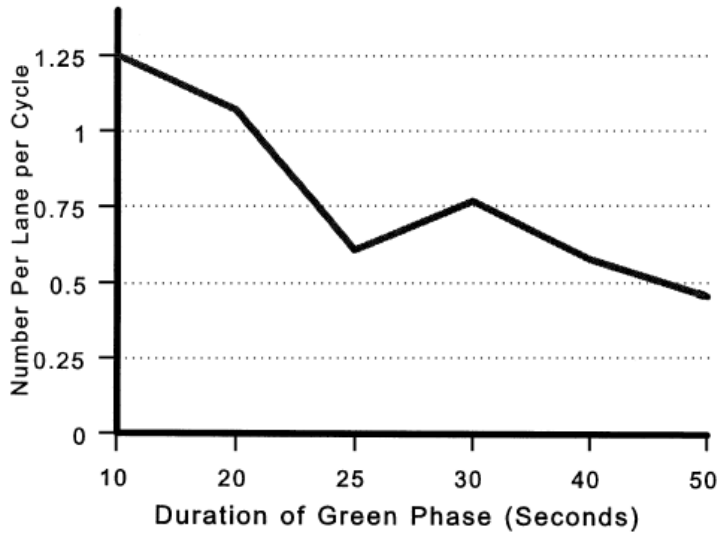


Figure 8 Red light running vs green phase duration (Shinar, 1998:137)

To investigate the psychological and physical variables associated with the Red Light Running, Shinar (1998) extended the previous study of 10 urban intersections to 40 urban signalized intersections. In the previous study, the dependent variable was the number of drivers running red lights per 100 cycle observations. The independent variables in this study were cycle length, average waiting time for cars approaching intersections, and the perception of traffic congestion. Experimenters partially hidden from the view of approaching vehicles recorded 226 aggressive drivers who entered intersections after the red light came on. Further analysis revealed that eighty per cent (80%) of the aggressive drivers recorded were males and their age ranged between 30 and 40 years. The frequency of red light running behaviours was correlated to the estimated waiting time at intersections ($r = 0.60$) in Figure 9, complete cycle length, and perception of traffic congestion ($r = 0.75$) in Figure 10 (0.32) (Shinar, 1998:137).

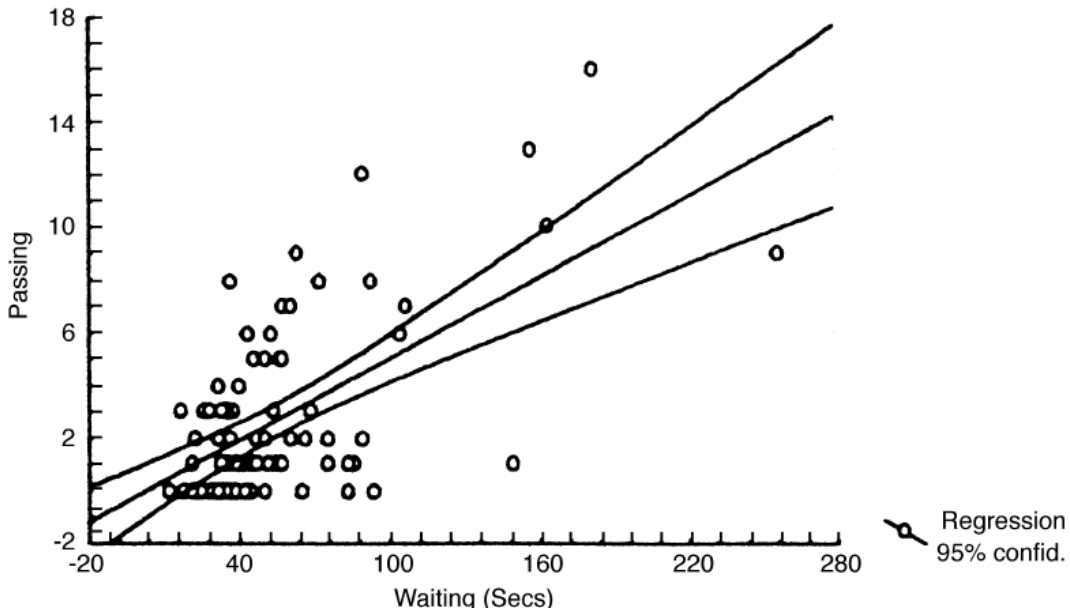


Figure 9 Red light running vs intersection waiting time (Shinar, 1998:137)

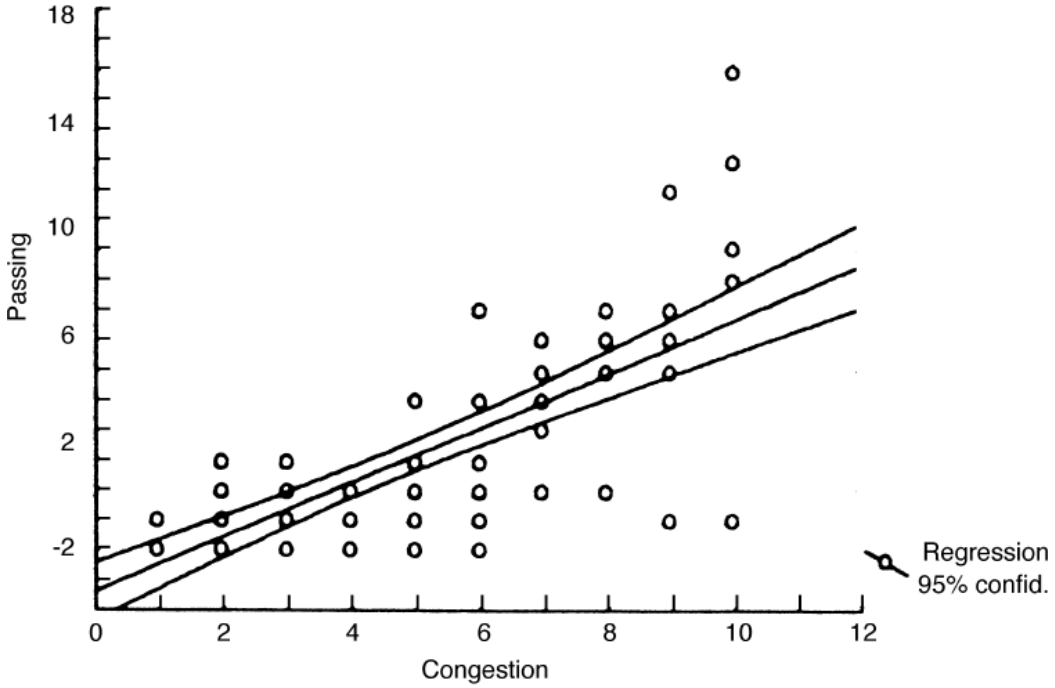


Figure 10 Red light running vs perceived congestion (Shinar, 1998:137)

On high-speed intersections (speed limits ≥ 60 km/hr.), two types of driving situations exist for drivers faced with a yellow indication on the approach to a signalized intersection. Those driving situations called "Dilemma Zones" refer to the highway zones or a length of pavement in advance of the intersection where some drivers may prefer to proceed through an intersection while others may prefer to stop at the onset of a yellow phase.

A driver's poor decisions at the onset of a yellow phase can lead to rear-end collisions if s/he decides to stop when s/he should have proceeded or to right-angle collisions with side-street vehicles in case s/he decides to proceed when s/he should have stopped. The driver's decision within a dilemma zone at the onset of a yellow phase is influenced by his or her perception-reaction time, acceptable deceleration rate, driver age and gender, and the time to intersection (Chandler, Myers, Atkinson, et al., 2013; Rakha, El-Shawarby & Setti, 2007:630).

Previous research has established two types of dilemma zones at signalized intersection approach. In Figure 11, Figure 12, and Figure 13, X_s represents the minimum distance from the stop line at which a driver can recognize the yellow indication, decide and execute the appropriate action, and stop the vehicle by applying comfortable brake. X_c in the same way describes the maximum distance from the stop line at which vehicles can clear the intersection prior to the red phase. The type I dilemma zone or yellow time dilemma zone describes the possibility that a motorist approaching a signalized intersection when a yellow light is displayed will not be able to clear the intersection safely or to stop prior to the stop line (Gazis, Herman & Maradudin, 1960:112). In another word, the type I Dilemma Zone occurs when X_c is smaller than X_s (ITE, 1991). The type II Dilemma Zone also known as Option Zone (OZ) refers to the region of pavement starting at the position on the approach to a signalized intersection where most drivers decide to stop their vehicles when presented with the yellow phase and ends at the position where most drivers decide to proceed through the intersection. Inside this region, drivers presented with a yellow light can clear the intersection width without accelerating or stop before the Stop bar without violating traffic signals (Parsonson, Roseveare & Thomas Jr, 1974). The type II dilemma zone occurs when X_s is larger than X_c and it is associated with driver's behaviour (Kell, Fullerton & Mills, 1990). The third possibility occurs when the minimum stopping distance (X_c) equals the minimum clearing distance (X_c). In this case, neither the option zone nor dilemma zone exists because drivers present themselves with varied acceleration rate and perception reaction times (ITE, 1991).

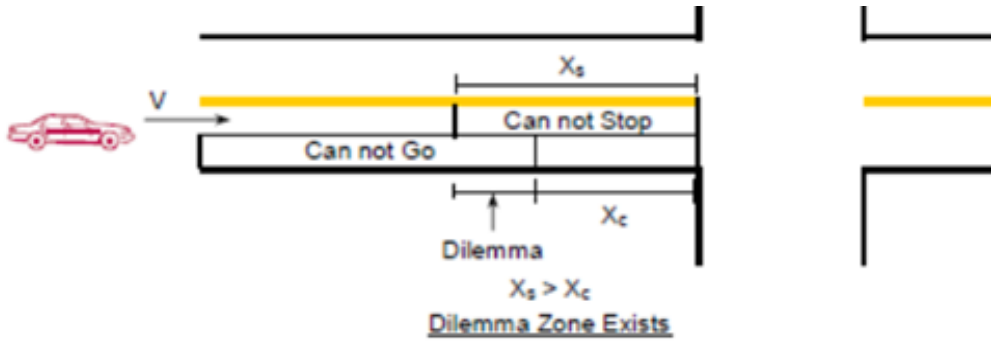


Figure 11 Type I Dilemma Zone Diagram

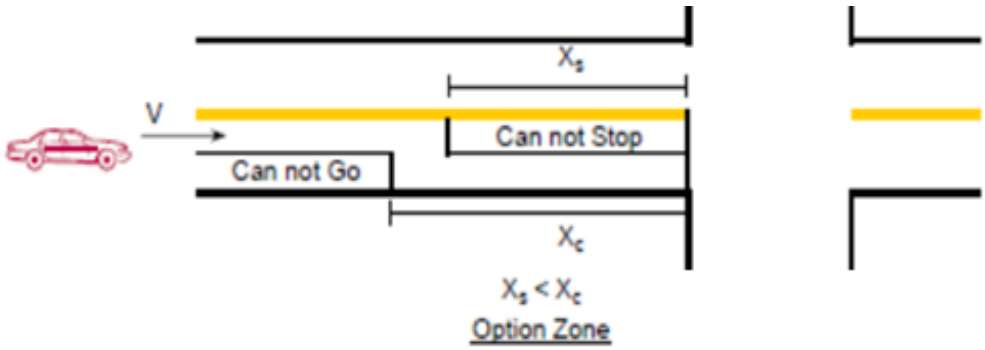


Figure 12 Type II Dilemma Zone or Option Zone Diagram

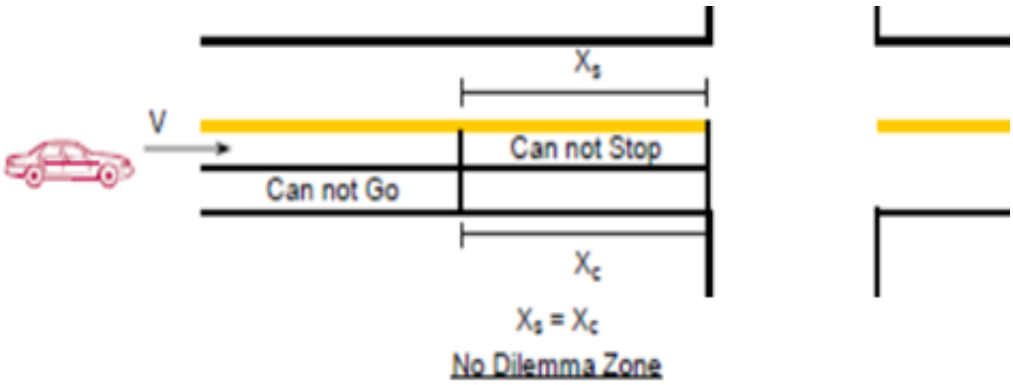


Figure 13 No Dilemma Zone

Previous studies tried to locate the type II dilemma zone boundaries at signalized intersection approaches. In terms of decision making, Zegeer (1978) situated the beginning of the type II dilemma zone at the position where 90 per cent of drivers stopped and the end of the dilemma zone where only 10 per cent of the drivers stopped (Zegeer, 1978). In 1985, Chang et al. (1985) defined dilemma zone boundaries in terms of travel time to the stop line. In their study, eighty five per cent (85%) of drivers stopped if they were 3 seconds or more back from the stop bar and almost all drivers who proceed through the intersection were 2 seconds or less from the stop bar at the onset of yellow phase (Chang, Messer & Santiago, 1985). The Type II Dilemma Zone in Figure 14 was located in areas where the travel time to the stop bar is between 5.5 and 2.5 (Chang, Messer & Santiago, 1985).

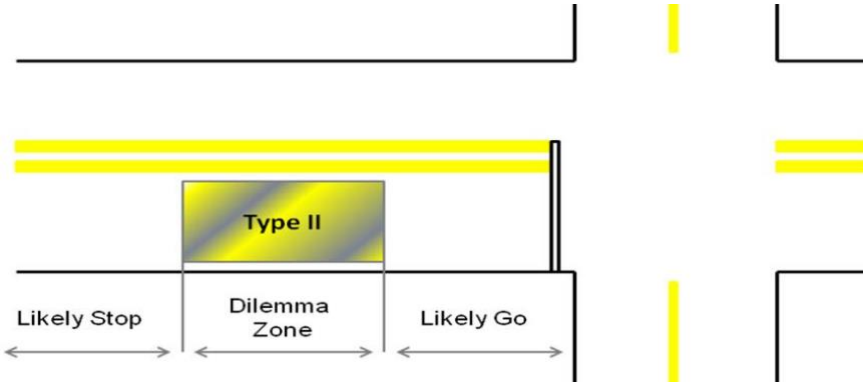


Figure 14 Dilemma Zone (DZ) boundaries

Frequent rear-end and right-angle crashes affect the operational capacity and the safety of high speed signalized intersections. The two crash situations in relation to dilemma zones are abrupt stops which lead to rear-end collisions and Red-Light Running (RLR) which result in right-angle crashes. The location of DZ on high-speed intersections depends on the vehicle's approaching speed, size and weight of vehicle. To date, reduction in speed limits, signal timing, detectors, and warning systems are being opted to reduce the effects of dilemma zone at high speed intersections (Knodler Jr & Hurwitz, 2009).

2.3.6.4 Traffic obstructions and hooting behaviours

A driver obstructed from passing by another driver who fails to directly progress through a signalized intersection after the light has changed to green may hoot his hoot to activate the frustrating driver or to emotionally reduce tension. In both cases, the hooting behaviour is seen as aggressive especially if the obstructed driver hoots with the intention to make the offender feel uncomfortable (Doob & Gross, 1968:213). Shinar (1998) studied the effects of the situational factors (traffic signal duration and time pressure) and characteristics of drivers (age and gender) on aggressive hooting behaviour. Behaviours of the subjects stopped behind an experimental vehicle that does not quickly move after the light has changed to green were observed from two signalized intersections of different green phase duration in Israel. In this experiment, a helper hidden at a signalised intersection recorded the time difference between the onset of a green phase and the time the subject behind the experimental car starts honking. In addition, age and gender of the hooting driver behind the experimental car were noted. Analysis of Variances (ANOVA) conducted on 72 trials revealed a shorter average honking delay at short green phase intersection than at the long green phase intersection [$F(1.61) = 5.32$, $p < 0.01$]. In weekday peak hours, subjects' mean honking delay was shorter than in weekends [$F(1.68) = 9.4$, $p < 0.01$]. The mean honking delay for male drivers was 2. 89 seconds whereas female drivers honked at an average of 3.94 seconds. No strong correlation between honking delay and age of the drivers was found (Shinar, 1998:137).

In a similar study by (Doob & Gross, 1968:213), the driver in an experimental vehicle was instructed to remain stopped at the onset of the green phase and move after 15 seconds or after the subject had honked twice. Hooting behaviours of 82 drivers (26 females and 56 males) whose progress was blocked by experimental vehicles (high status experimental car was a black 1966 Chrysler Crown Imperial hardtop and low status experimental cars were: a rusty 1954 Ford station wagon and an unobtrusive gray 1961 Rambler sedan) at six signalized intersections in California were studied. The experiment started when experimental cars stopped first at the red light and an assistant hidden at the intersection recorded both the latency of each honk and its estimated length. In addition, the model of the subject's car, age, gender, and the number of cars behind the experimental vehicle were recorded. The findings revealed that 84 percent of the drivers blocked behind low status experimental cars honked at least once whereas only 50 percent of drivers blocked behind high status experimental vehicles hooted.

Taking one hoot as a polite sign to alert the frustrator in front about the light change, two honks were considered as aggression and further analysis were conducted. Results again showed that 47 percent of the subjects blocked low status experimental cars honked twice and only 19 percent of drivers behind high status experimental cars hooted twice. First hoot latencies were approximately the same for both situations and male drivers tended to honk faster than female drivers. This study concluded that horn-honking behaviour is a predictor of aggressive response to low-status drivers who prevent traffic from moving at signalised intersections ($F = 4.49$, $p < 0.05$) (Doob & Gross, 1968:213).

As mentioned previously, situations that confer anonymity and unfamiliarity of drivers to the traffic situation contribute to on-road aggressive behaviours (Parkinson, 2001:507). Ellison et al. (1995) studied aggressive hooting behaviour expression by anonymous drivers and identifiable drivers. He hypothesised that anonymous drivers stuck behind a car that does not progress quickly when the light changes to green will honk very sooner and for longer duration than drivers in identifiable conditions. Results from the study revealed a significant difference between driver conditions and hooting behaviours. Unidentified drivers were see to hoot very quickly and for longer durations each than identifiable drivers. However, no significant differences were found between vehicle type, location or number of persons in vehicle, use of sunglasses, age, gender of the driver and the horn-honking behaviours (Ellison, Govern, Petri & Figler, 1995).

2.3.7 Measures of aggressive driving behaviours

Considerable number of motorists report having been subjected to on-road aggressive driving behaviours, traffic violations, and reckless driving from other drivers on the public roads (Lajunen, Parker & Stradling, 1998:107). In this context, aggressive motorists blame their fellow road users as have been the cause of their poor driving behaviours. Driver survey statistics show that between 47 percent and 75 percent of drivers report to have been the victims of mild forms of on-road aggression such as hooting, verbal abuse, and rude gestures from other drivers and only 7.5 percent to 35 percent report to have been subject to the more severe forms of driving aggression such as being closely followed by vehicle directly behind, cut off or chased off the road by other drivers (Victorian Community Council Against Violence, (VCCAV), 1999). These inconsiderate on-road aggressive behaviours constitute a threat to the safety of both motorists and non-motorists since a clear relationship between aggressive driving behaviours and increases in the risk of road traffic accidents has been evidenced by researchers (Underwood, Chapman, Wright & Crundall, 1999:55). Recent studies tried to identify factors associated with aggressive driving behaviours, traffic rule violations, and the effects of those behaviours to safety of road users (Lajunen, Parker & Summala, 2004:231; Underwood, Chapman, Wright & Crundall, 1999:55).

Previous studies based on surveys have developed measurement instruments to assess various factors associated with aggressive driving behaviours. The questionnaires developed measure the driver's physical aggression, verbal aggression, anger, and hostility (Buss & Perry, 1992:452). Among the questionnaire forms are the Manchester Driver Behaviour Questionnaire (DBQ) (Reason et al., 1990), the Driver Anger Scale (DAS) (Deffenbecher et al., 1994), and the Driving Skill Inventory (DSI) (Lajunen, Parker & Stradling, 1998:107). The Manchester DBQ, which initially focused on driving errors and violations, has recently become one of the most commonly used measuring scales to assess self-reported driving behaviours (Reason, Manstead, Stradling, Baxter & Campbell, 1990:1315). In this context, driving errors such as failure or misjudgement of driving situations refer to unintentional or accidental behaviours whereas driving violations behaviours such as exceeding speed limit or following too closely vehicles in front reflect cautious deviations from safe driving practices (Lajunen, Parker & Summala, 2004:231). In addition, the DBQ has been used in several road safety studies as a measuring tool to assess driving behaviours and effects of age, genetics of driving behavioural studies, and the association between driver behaviours and crashes involvement (Bianchi & Summala, 2004:655; Dobson, Brown, Ball, Powers & McFadden, 1999:525; Parker, West, Stradling & Manstead, 1995:571; Reason, Manstead, Stradling, Baxter & Campbell, 1990:1315). In almost all studies where the DBQ is used, participants fill in 5-point Likert Scale (1 = never, 2 = seldom, 3 = sometimes, 4 = very often, and 5 = always) how often they perform each item of aggressive driving described in each of the subscales (Eugenia Gras, Sullman, Cunill, Planes, Aymerich & Font-Mayolas, 2006:129).

Lawton et al. (1997) modified the original scale of Driver Behaviour Questionnaire (DBQ) and included new items in order to investigate further contributory factors to driver violations. This new measuring scale distinguished two types of driving violations i.e. aggressive violation and ordinary violation (Lajunen, Parker & Summala, 2004:231; Lawton, Parker, Manstead & Stradling, 1997:1258). Ordinary violations also called Highway Code violations which include behaviours such as disregarding traffic signs and signals (Red Lights Running) and driving above the speed limits are deliberate driving behaviours not aimed to harm other road users. Interpersonal also known as aggressive violations with behaviours such as horn-honking or cutting off another driver when frustrated constitute deliberate behaviours instigated by impatience and anger and are aimed to physically or psychologically harm other road users (Lawton, Parker, Manstead & Stradling, 1997:1258).

Hitherto, available versions of the DBQ appear with either three subscales i.e. errors, lapses, and violations (Parker et al, 1995) or four subclasses of driving behaviours i.e. errors, lapses, violations, and aggressive violations (Eugenia Gras, Sullman, Cunill, Planes, Aymerich & Font-Mayolas, 2006:129).

In addition to errors and violations factors, Lajunen et al. (2004) added lapses or behaviours associated with distraction or memory problems while driving to the list of factors that influence on-road driver's aggressive behaviours. However, both the original DBQ scale with three factors and the extended

violations scale with four subscales have been found to have acceptable internal reliability among subscales over time (Parker, West, Stradling & Manstead, 1995:571). In a study of reliability of the three subscales of the DBQ i.e. errors, violations, and lapses, Westerman and Haigney (2000) found Cronbach's alpha coefficients of 0.74 for the violations scale, 0.74 for the lapses scale, and 0.76 for the errors scale. Lajunen et al. (1998) found Cronbach's alpha coefficients of 0.76 for the ordinary violations scale and 0.70 for the interpersonal or aggressive violations scale in their study of internal reliability of extended violations. Reason et al. (1990) called 80 respondents to complete the DBQ twice in seven months period to check the consistency of the DBQ subscales. Results from the completed two sets of questionnaires which were in a period of seven months apart revealed high correlations of, 0.81 for the violations subscale, 0.75 for the lapses subscale, and 0.69 for the errors subscale (Reason, Manstead, Stradling, Baxter & Campbell, 1990:1315).

In Spain, a 28-item version of the Manchester Driver Behaviour Questionnaire (Lawton et al., 1997) was generalised on a sample of Spanish drivers. In this study, the consistency of the four assumed subscales of the reduced version of the original DBQ i.e. errors, lapses, violations, and aggressive violations was checked by assessing how often participants perform each of the aberrant driving behaviours detailed in a 28-item English version of the DBQ. The measuring tool consisted of eight driving errors, eight lapses, six violations, and six aggressive violations. The first three types of violations reported by most of the drivers were; exceeding the speed limit on highways (violations), inappropriate hooting at other road users (aggressive violations), and violating the speed limit in residential roads (violations). Most drivers failed to yield to pedestrians crossing into side streets when they turn from major roads to minor streets (errors) and forgot where they parked their cars (lapses). Misreading traffic signs and exiting roundabout from wrong road (lapses) and aggressive violation behaviour such as becoming very angry and cut off or chase another driver from the road were reported by few participants. The failure to read signs (lapse) was reported by few people and hence it was excluded in the factor structure. The error factor with seven errors and four lapses had good internal consistency with an alpha coefficient of 0.82. This factor explained around 22 percent of the variance. The violation factor included all six violations, three aggressive violations, and one remaining error. This factor explained around 10 percent of the variance with an internal reliability coefficient of 0.81. The interpersonal or aggressive violation factor consisted of three aggressive violation items had an internal coefficient of reliability of 0.59. This factor explained up to 6 percent of variance. The last factor i.e. lapse contained three lapses and accounted for about 5 percent of variance. This factor was very weak. In the next section, a discussion on driving anger, measures of driving anger and anger expression are discussed. A conclusion regarding which measurement scale fits well to the present study will be drawn.

2.4 Responses to aggressive driving behaviours

2.4.1 Introduction

In traffic, not much is known about how frustrated drivers respond to aggressive driving situations. In order to understand how victims of aggressive driving behaviours respond to the frustrating driving situations, a distinction between types of victims is needed. The available studies that looked at how frustrated drivers behave, listed seven different ways that angered drivers use to react to the angering situations (Lajunen, Parker & Summala, 1999:225). However, this study did not distinguish types of the victims of on-road aggressive behaviours. To date, there is no available literature that details types of the victims with respect to how they react as they encountered aggressive driving situations. In an attempt to understand how victims of on-road aggressive behaviours respond, the concept of bullying as defined and detailed in the field of psychology is introduced in the next section.

2.4.2 Definition of bullying

The concept of bullying (also known as mobbing in many European countries) was first defined and operationalised in Scandinavia in the 1980s (Leymann, 1996:165). Bullying is a dysfunctional form of relationship between individuals, involving the assertion of interpersonal power though aggression. It involves power differential where bullies have more power than the victims. Bullying includes negative physical or verbal actions that have hostile intents and that cause distress to the victims (Einarsen & Raknes, 1997:247).

The term bullying is synonymously used with the terms harassment or victimisation in literature (Einarsen, 2000:379). However, there is a difference between bullying and what people call teasing. The difference between these two terms lies in the relationship of the bully and victim on one hand and in the intent of the interaction on the other. While bullying is deliberate, one-sided, intended to hurt a person, and last long, teasing is usually a form of fun between two or more friends, and it does stop when someone is hurt (Einarsen, Hoel, Zapf & Cooper, 2010). Initially, the problem of workplace bullying was largely examined from a psychological point of view and later on diverged to many other fields of study such as sociology, communication theory, medicine, law, and industrial relations (Einarsen & Raknes, 1997:247).

In Scandinavia, between 1 percent and 5 percent of the workers had experienced some form of workplace bullying (Zapf, Escartín, Einarsen, Hoel & Vartia, 2011:75). Between 10 percent and 30 percent of the workers in the UK and USA reported having been victims of workplace bullying (Hoel, Cooper & Faragher, 2001:443). In South Africa, a recent study on the prevalence of the workplace bullying revealed that 31.1 percent of the workers had experienced workplace bullying (Cunniff & Mostert, 2012:1). Previous researchers affirm that higher levels of bullying may be found in the health

and public sectors than in other working industries (Niedhammer, David & Degioanni, 2007:346). In an international study of adolescent health related behaviours, the prevalence of being bullied at least once was between 15 percent and 20 percent in some countries and 70 percent in others (King, 1996).

Ross (1996) divided bullying behaviours into two categories: direct and indirect bullying. Direct bullying is overt and includes physical aggression, direct verbal aggression, and non-verbal aggression (including threating or intimidatory body language). Indirect bullying behaviours can be physical (using someone to attack someone else), verbal (spreading rumours), non-verbal (excluding someone from a group, cyberbullying) (Einarsen, Hoel & Notelaers, 2009:24; Ross, 1996). Indirect bullying aims to hurt people on an emotional level (Einarsen, Hoel & Notelaers, 2009:24; Escartín, Rodríguez-Carballeira, Zapf, Porrúa & Martin-Pena, 2009:191).

Research into bullying among children indicates that boys as well as girls bully others either directly or indirectly. Boys are more likely to use physical types of bullying behaviours whereas girls preferred verbal and non-verbal forms of bullying such as spreading rumours or isolating someone from a group. In a study conducted among 23 schools in Britain, direct verbal aggression was the most common form of bullying among both boys and girls whereas the direct physical aggression form of bullying was common among boys (Rivers & Smith, 1994:359). In another study conducted in Roma, the most common types of bullying reported by boys were threats and physical harm whereas girls reported name-calling, teasing, and telling rumours more frequently (Baldry, 1998:361).

2.4.3 Responses of the victims of bullying behaviours

There are several different forms of bullying, all of which have negative consequences on bullies as well as on the victims. Bullying mostly occurs in the school environment and children in elementary school are more likely victims (Nansel, Overpeck, Pilla, Ruan, Simons-Morton & Scheidt, 2001:2094). Salmivalli et al. (1996) and Olweus (1994) found that the frequency of children reporting to have been severely bullied by their peers in the middle schools was approximately equal to 10 percent. In a similar study, Boulton and Underwood (1994) reported that about 20 percent of school children in the middle schools, aged between 8 and 9 years and between 11 and 12 years, had been bullied sometimes (Boulton & Smith, 1994:315). In another study, 600 pupils were selected from middle and secondary schools in order to assess the prevalence of bullying at schools. The frequency of children reporting to have been victims of bullying sometimes was close 20.0 percent (Whitney & Smith, 1993:3).

Literature distinguishes two types of victims of bullying, i.e. passive and provocative victims. Passive victims are those with anxious personality and physical weakness whereas provocative victims are those characterised by both anxious and aggressive behaviour patterns (Olweus, 1994). Provocative victims enjoy aggressive situations whereas passive victims tend to resolve conflicts in a constructive manner (Stephenson & Smith, 1989:45), or avoid it altogether. In a study of 158 school children aged between

8 and 9 years, Boulton and Smith (1992:73) found that around 26 percent of the victims were provocative whereas 43 percent were identified as disrupting or passive victims. In their sample, boys were more frequently identified as bullies than as victims of bullying. Girls were more likely to be victims of bullying whereas boys were likely to be bullies (Boulton & Underwood, 1992:73). In addition to passive and provocative types of victims of bullying, literature refers further to school children who bully others and are bullied themselves as bully/victims. Boulton and Smith (1992) found that 4.4 percent of the school children were designated as bullies by 50 percent of the participants and victims of bullying by 33 percent of the participants. Salmivalli et al. (1995) found out that 3 percent of the girl victims and 8 percent of the boy victims behaved as bullies when they were harassed. In the above two samples, the frequency of bully/victims was relatively small in the samples when compared with passive and provocative victims.

Coie et al. (1991) studied possible ways that school boys used to respond to bullying behaviours. In their study, the five ways of responding to bullying identified among boys aged between 7 and 9 years were as follows:

- Escalating the level of bullying,
- Defending oneself,
- Trying to resolving the conflicts in a constructive manner,
- Ignoring aggressors or bullies, and
- Submitting to others' aggressive behaviours i.e. bullies

In Coie's study, submission to others' aggressive behaviours i.e. to bullies appeared to increase the level of bullying behaviours among school boys. The second more frequent response behaviours identified among school boys was defending oneself (32.1%) whereas the least common response was escalating the level of bullying or encouraging aggression (9.2%) (Coie, Dodge, Terry & Wright, 1991:812).

Salmivalli et al. (1996) used both peer - and self - evaluation methods to describe the responses of victims of bullying. In addition, their study looked at the responses on the side of the victims which seemed to either escalate level of bullying among school children or to put an end to it. In a sample of 573 sixth-grade children selected from 23 Finnish schools, 33 girls (11%) and 34 (11.8%) boys were identified as victims of bullying by their peers. Children were asked to evaluate the response behaviours observed from the victims on a 29-item measurement scale with three subscales (Counter-aggression, helplessness, and nonchalance) and to indicate on a three point scale (never, sometimes, often) how often victims exhibit each of the specific types of response behaviours.

The counter-aggression subscale included response behaviours which generally escalate or encourage bullying. These include behaviours such as attacking or speaking out to the bully, starting to harass someone else, name calling, trying to make the others hate the bully, etc. The helplessness subscale

included response behaviours such as giving up; crying and running away, missing or avoiding school, and telling his or her parents. The nonchalance subscale generally included response behaviours where victims acted as if they don't care about the bullies. Based on peer-estimated behaviours of the victims in bullying situations, three types of victims i.e. counter-aggressive, helpless, and nonchalant were defined. Results again revealed that helpless and nonchalance responses to bullying were more frequent among girl victims than boy victims. Boy victims tended to adopt counter-aggressive or nonchalant types of response behaviours. Helpless responses in the case of girl victims and counter-aggressive responses in the case of both girl and boy victims appeared to encourage or intensify the level of bullying among children. The absence of helplessness in the case of girl victims, and nonchalance as well as the absence of counter-aggression in the case of boy victims seemed to diminish bullying or to put an end on it. The self-evaluation method also supported these views (Salmivalli, Karhunen & Lagerspetz, 1996:99).

A study that examined the emotional reactions of victims of bullying was conducted in Malta in 1998. In this study, 6,282 pupils obtained from 50 state primary and secondary schools responded to self-administered questionnaires. The five emotional feelings or reactions consolidated from open-ended feelings associated with bullying reported by the victims were as follows: vengeful, angry, self-pity, indifferent, and helpless. The most prevalent forms of emotional feelings identified among pupils were; vengeful feelings (38.3%), angry feelings (37.1%), and self-pity feelings (36.5%). Boy and girl victims reported feeling angry, indifferent, and helpless in the same way. A statistical significant gender difference was only found for vengeful and self-pity feelings. More boy victims felt vengeful than girl victims ($z = - 6.509$, $p < 0.001$) whereas more girl victims felt self-pity than boy victims ($z = 11.162$, $p < 0.001$). The number of secondary school victims who reported feeling vengeful and angry was higher than that of primary school victims. More primary school victims reported feeling unhappy and helpless than secondary school victims. No statistical significant difference was found for both primary school and secondary school victims and the frequency of felling indifferent. Emotional reactions of self-reported bullies were also consolidated as feeling sorry for the victims, indifferent, and felling satisfied. Results revealed that, feeling sorry for victims, was the most frequent emotional feeling among bullies (49.8%) and that more girl bullies felt sorry for victims than boy bullies (52.7% girls against 47.8% boys). More primary school bullies reported feeling sorry (66.1% against 40.2%), whereas more secondary school reported feeling satisfied and indifferent (25.2% against 13.6%; 46.8% against 29.9% respectively). Only 20% of bullies reported feeling satisfied after the bullying incident (Borg, 1998:433).

In addition to the examination of emotional feelings after the bullying incident, behavioural reactions of the victims were investigated. Two types of behavioural reactions i.e. doing nothing or seeking help from others were identified among victims of bullying. More girl victims reported seeking help from friends, teachers, head of school, and parents whereas more boy victims reported doing nothing to the

bullies. There was a statistical significant difference between school level of and frequency of reporting different types of behavioural reactions. More secondary school victims reported doing nothing to the bullies while more primary school victims sought for help from friends, teachers, head of schools, and parents (Borg, 1998:433).

In conclusion, three types of victims of bullying behaviours were identified in literatures. The first type is counter-aggressive or provocative victims. These victims defend themselves with behaviours which encourage bullies to continue aggression or escalate the level of bullying among peers. The second type is helpless victims. Helpless victims are passive victims characterised by physical weakness. They are unable to do or to say anything to the bullies and always seek help from others. The third type is nonchalant victims. These are indifferent victims characterised by ignoring aggressors' behaviours. They tend to adopt constructive measures and do not take bullying seriously. More girl victims tend to seek help whereas more boy victims defended themselves against the bullies. The counter-aggressive or provocative behaviour was also a function of school level among peers. Primary school victims were more helpless whereas more secondary school victims were provocative and indifferent.

2.5 Driving anger and aggressive driving

2.5.1 Introduction

Media reports and research both suggest that driver anger and road rage behaviours constitute one of the prevalent factors of road accidents. Though road rage is rare and refers to the extreme form of anger expression on road, drivers behind the wheel are generating more anger in the today's society. In the United States, between 1990 and 1995, road rage on roads increased by 7percent and resulted in deaths of around 200 people and 12000 injuries in that period (AAA, 1997). There is a relationship between anger experienced while driving and aggressive driving behaviours (Deffenbacher, Petrilli, Lynch, Oetting & Swaim, 2003:383). Parker et al. (1998) investigated driver anger and aggression on road in a sample of 270 drivers. In this study, 89 percent of respondents confirmed engaging in aggressive driving behaviours such as chasing or cutting other drivers off the road, hostile behaviours, and aggressive hooting to indicate their annoyance to other road users. In a similar study, Underwood et al. (1999) used a diary to record driver anger instigated by frustrating road events in a period of two weeks. In a sample of 100 drivers surveyed, 85 percent of drivers involved in aggressive driving behaviours reported to have been experiencing anger while driving (Underwood, Chapman, Wright & Crundall, 1999:55).

Personality and emotional disposition influence driver anger and aggression while driving. In anger-instigating situations such as traffic jam or impeded progress some angry drivers behave aggressively whereas others do not display their anger towards other fellow road users (Shinar, 1998:137). Highly angry drivers tend to engage in highly risky driving behaviours such as flashing headlights, speeding,

and tailgating more than less angry drivers (Deffenbacher, Petrilli, Lynch, Oetting & Swaim, 2003:383). Male drivers differ from female drivers not only in the way they perceive and interpret frustrating situations but also in the way they react to those situations. Studies on gender differences, driver anger, and aggressive driving revealed that frustrated male drivers get angry very quickly and tend to engage in more overt forms of aggression such as obscene gestures whereas female drivers show adaptive /constructive or more covert forms of aggression such as swearing (Galovski & Blanchard, 2004:105). In a study by Lonczak et al. (2007), frustrated female drivers tend to avoid observable forms of anger expression and drive less aggressively than male drivers (Lonczak, Neighbors & Donovan, 2007:536). In a study of angry thoughts when driving, male divers reported more frequent opinions of revenge and physical aggression than female drivers (Deffenbacher, Petrilli, Lynch, Oetting & Swaim, 2003:383).

2.5.2 Driving Anger

The State-Trait Anger Theory (STA) defines anger as an emotional state that changes in magnitude and distinguishes two modes of anger i.e. State Anger (SA) and Trait Anger (TA) (Spielberger, Reheiser & Sydeman, 1995:207). In this theory, SA is defined as a psychobiological state of personal feelings that changes in amount and that is instigated by frustrating events such as being treated in unfair way or being attacked. It refers to how a person feels anger at a particular time (Spielberger, 1988). The TA on the other hand refers to a chronic trait expressing the tendency of experiencing state anger more repeatedly and intensely. Generally, the TA refers to one's tendency to perceive situations in ways that elicit state anger (Deffenbacher, GETTING & Lynch, 1994:83). High trait anger people are more likely to become angered than low trait anger people when they encounter same anger eliciting situation (Spielberger, 1988).

In order to evaluate the intensity of anger experienced by subjects at particular time, Spielberger et al. (1983) developed a measurement scale in the light of the state-trait anger theory. The State-Trait Anger Scale (STAS) designed with 30 items (15 items for state anger and 15 items for trait anger) has been used to assess general trait anger among people. Later, the STAS scale was combined with the Anger Expression Scale (AX) proposed by Spielberger et al. (1985) and the State-Trait Anger Expression Inventory (STAX) was developed.

This measurement tool was used in many studies to assess different ways people use to express their anger when exposed to frustrating situations (Spielberger, 1988). In addition to three classic subscales of anger expression forms i.e. anger-in, anger-out, and anger control, the STAX questionnaire had 44 items divided into 10-item subscale for state anger measurement and 10-item subscale for trait anger assessment. The inclination to suppress one's anger is known as anger-in and the tendency to express anger either physically or verbally refers to anger-out. The anger control on the other hand refers to

one's tendency to control anger or annoyance using adaptive methods such as ignoring what is happening and concentrate on safe driving behaviours (Spielberger, 1988).

Deffenbacher et al. (1994) extended Spielberger et al.'s STA Theory by adding driving anger to the former state anger and trait anger in order to assess levels of anger elicited by drivers while behind the steering wheel. In this context, driving anger was defined as the intensity and frequency of feeling angry while driving. It is more situation-context bound or state anger than trait anger (Deffenbacher, Getting & Lynch, 1994:83). Deffenbacher et al. (1994) proposed the first Driver Anger Scale (DAS) to measure levels of anger elicited by drivers subjected to driving anger related situations. Questionnaire forms composed of 53 items describing driving anger-related situations were presented to 1500 college students and a 33-item self-reported scale was developed. These 33 items of the DAS are grouped into six reliable factors or subscales of anger related driving situations i.e. (1) discourtesy on road, (2) slow driving, (3) illegal driving, (4) impeded traffic, (5) hostile gestures, and (6) police presence. It has been used in several driving behaviour studies as a tool to assess the driving anger proneness as separate to trait anger (Deffenbacher, GETTING & Lynch, 1994:83).

Lajunen et al. (1998) studied a sample of 280 drivers in UK and came up with a new Driver Anger Scale composed of 21 items grouped into three factors. This New UK DAS with three factors i.e. direct hostile, impeded progress, and reckless driving differs from the original DAS designed by Deffenbacher et al. (1994) in the sense that it does not consider items in which none motorists provoke anger among drivers. It does focus only on situations where a driver was the principal premotor of anger and excludes anger-instigating situations such as road works and police presence. In many studies where self-report scales are used to assess driving anger, participants rate the extent to which they feel annoyed on a 5-point Likert Scale (1 = not at all angry, 2 = a little angry, 3 = fairly angry, 4 = very angry, 5 = extremely angry) when they are exposed to driving situations that provoke anger (Lajunen, Parker & Stradling, 1998:107).

In addition to self-report scales, researchers used several methods such as laboratory simulations, driving logs and diaries, presenting driving scenarios that instigated anger among subjects and observational-based studies to assess driving anger. These methods have the advantage of reporting driving anger experienced among subjects in a short time and with maximum precision in contrast with self-reported measures.

Deffenbacher et al. (2003) used both filed study diaries and DAS to record drivers' trips, anger experienced, aggression, and risk driving behaviours in a three days experiment. In this trial, high anger drivers reported more frequent and intense anger in diaries when compared with results in the self-reported questionnaires. The likelihood of drivers to respond more aggressively to anger-instigating situations encountered and the likelihood to engage in high risk driving behaviours were higher in

driving diaries than in self-reported questionnaires (Deffenbacher, Lynch, Filetti, Dahlen & Oetting, 2003:333).

Recent literature on driving behaviours has few studies where field observation was used as the main tool (Appel, Blomkvist, Persson & SJóBERG, 1980:605; Turner, Layton & Simons, 1975:1098). The majority of these observation-based studies focused primarily on the effects of situational factors, driver characteristics, road condition, and state and social status of studied subjects on the mild forms of aggression on road such as obscene gestures and inappropriate and excessive use of horn and lights. These studies showed no interest in driving anger though it continues to become more prominent in recent literature (Diekmann, Jungbauer-Gans, Krassnig & Lorenz, 1996:761; Ellison, Govern, Petri & Figler, 1995). Observational methods are uncommon in the study of driving anger due to the high costs associated with training and using observers, infrequent incidence of events that provoke anger among drivers, and the incapability of a human being to observe inner cause of aggressive driving behaviour (Diekmann, Jungbauer-Gans, Krassnig & Lorenz, 1996:761; Ellison, Govern, Petri & Figler, 1995).

Laboratory simulators have been used in several studies in attempts to assess driving behaviours. However, only a few of these tried to assess driving anger (Deffenbacher, Lynch, Filetti, Dahlen & Oetting, 2003:333; Ellison-Potter, Bell & Deffenbacher, 2001:431; Stephens & Groeger, 2006:49). Deffenbacher et al. (2003) studied driving behaviours of high and low anger drivers in a driving simulator. In their study, artificial driving environments which arouse driving anger such as impeded progress, slow drivers ahead, and pedestrians crossing the road were simulated. High trait anger drivers reported more frequent and intense driving anger in driving simulator than low anger drivers. In driving situations which elicited anger, high trait anger drivers were more inclined to aggressive driving behaviours than low trait anger drivers. These results confirmed with what had been found before using field study diaries and self-report forms (Deffenbacher, Lynch, Filetti, Dahlen & Oetting, 2003:333).

Stephens and Groeger (2006) examined the relationship between driving anger, anonymity, and aggressive driving behaviours using a driving simulator. Participants rated their emotions when they encountered driving situations that interrupt their journeys such as pedestrian crossing and slow traffic. Results revealed no interaction between driving anger and driving anger-instigating situations.
However, drivers tended to increase their anger when they were forced to reduce their speeds due to crossing pedestrians or slowing vehicles ahead. In another study where a larger sample was used, no significant relationship between trait driving anger and aggressive driving was identified. Subjects tended to engage in more severe form of aggressive driving behaviours when they were unidentified and exposed to aggressive stimuli in a driving simulator than when they were identified (Ellison-Potter, Bell & Deffenbacher, 2001:431).

2.5.3 Driver Anger Expression

People behind the steering wheel feel angry from time to time. However, people differ in the ways they react to frustrating situations that they may come across during their journeys. The former STAX Inventory by Spielberger (1999) has been used in many studies as a tool to assess general trait anger expression among subjects. To date, literature findings on anger expression do not provide a specific method to measure driving anger expression on the road. This is due to the fact that the driving situation is a unique environment and drivers express their anger in relation to their actual state or mood and to the driving environment. Previous researchers affirm that high anger drivers tend to engage in more severe form of aggressive responses whereas low anger drivers remain calm regardless of the frequency and intensity of the frustrating situation (Deffenbacher, Lynch, Filetti, Dahlen & Oetting, 2003:333).

In an attempt to examine different ways that people used to express their anger while behind the steering wheel, Deffenbacher et al. (2002) studied a sample of 290 people. In this study, the Driver Anger Expression Inventory (DAX), which is a tool to measure various forms of driving anger expressions, was developed. The DAX tool, initially consisted of 62-items grouped into four subscales i.e. Verbal Aggressive Expression, Personal Physical Aggressive Expression, Use of Vehicle to Express Anger, and Constructive or Adaptive Expression of driving anger, has been adopted in many studies to assess driving anger. The Verbal Aggressive Expression Subscale designed with 12 items refers to showing driving anger through behaviours such as cursing, insults, and yelling at another driver. The Personal Physical Aggressive Expression Subscale consisted of 11 items includes behaviours such as giving another driver the finger and getting out of your vehicle ready to physically engage with the frustrator. The Use of Vehicle to Express Anger Subscale contains behaviours such as traffic obstruction, cutting off other drivers, flashing headlights, speeding and tailgating. It constitutes the more severe form of driving anger expression on the road. The Positive or Constructive Expression Subscale of driving anger refers to calming down or trying to find positive solutions regardless of the situation and focus on safe driving behaviours (Deffenbacher, Lynch, Oetting & Swaim, 2002:717).

Lajunen et al. (1999) assessed driving anger among drivers in various driving situations and the number of drivers likely to respond aggressively to those situations. This study used 2500 people who were selected from three countries: UK, Netherlands, and Finland to find out different ways that people use to express their anger on the road. In addition to driving anger assessment and aggressive reactions, this study investigated individual and cultural differences in terms of feeling angry and reacting aggressively to anger-instigating situations. Results revealed seven alternative reactions to anger-instigating situations starting from no reaction (item 1 in the list) to getting out of a car, prepared to physically engage with the other road user (item 7 in the list). The other 5 items are: (2) beep horn or flash headlights, (3) gesture at the other driver, (4) verbal abuse of the other driver, (5) driving aggressively towards another driver i.e. driving very close to vehicles in front of you, changing lanes without

signaling, and swerving in the traffic, (6) stop your vehicle and get out, ready to argue. This studied identified no differences in terms of driving situations that generate anger and various ways of anger expression in these three countries (Lajunen, Parker & Summala, 1999:225).

In conclusion, self-reported questionnaires were preferred in this study to investigate both levels of driving anger aroused and the corresponding likely responses behaviours to anger-instigating situations. This method was preferred due to the inefficiency of both observational and laboratory simulator methods in assessing the inner cause or motives to aggressive driving behaviours. Due to infrequent incidence of events that provoke anger and to the high costs involved in training and using observers, observational method and laboratory simulator methods of driving anger assessment were found inefficient. The observational method of behaviours was used to examine the nature and frequency of minibus taxis drivers' aggressive driving behaviours since it allowed events to continually occur as in the real world.

Chapter 3 METHODOLOGY

3.1 Introduction

Tasca (2000) proposed a precise definition of aggressive driving to assist road safety experts and researchers. She divided the 21 traffic safety and psychology research findings related to aggression on road into two categories: surveys of the driving public and field experiment studies. According to Tasca (2000), survey studies provide estimates of self-reported and not actual on-road aggressive driving whereas field experiments involve a small number of drivers and are designed most of the time to create situations that instigate aggressive driving behaviours. She advised direct systematic observational studies of the actual on-road aggressive behaviours in order to get better insight of the nature, prevalence, and causes of aggressive driving behaviours (Tasca, 2000).

In this study, both qualitative and quantitative data were collected to investigate the nature and the prevalence of the most common types of minibus taxi drivers' aggressive behaviours as well as the corresponding behavioural responses of other drivers to those behaviours. The observational study was possible partly through the video footage supplied by the Traffic Management Center (TMC in Cape Town) from its Closed Circuit Television cameras (CCTV) mounted on the roads. In addition to the CCTV camera footage, a high definition video camera (GoPro Hero3) was used to supplement video recordings. A total of 48 hour video recordings, collected in the months of March and June 2014 from Monday to Saturday in peak periods from three different sites, were watched and manually coded. Surveys to supplement observational studies were conducted by the researcher at the sites. The effects of socio-demographic variables such as age and gender of drivers on the minibus taxi drivers' aggressive driving behaviours, levels of anger expressed by drivers of other vehicles when exposed to the minibus taxi frustrating situations, and on the various forms of responses to those behaviours were assessed in surveys through the use of questionnaires. This chapter outlines the methods and techniques used in conducting this study.

3.2 Research design

The flowchart in Figure 15 outlines the main tasks and procedures followed in carrying out this study. The research problem definition, objectives, data required, and data collection methods were established based on previous literature. Statistical analysis was used to evaluate both videotaped data collected from the footage and survey data obtained from printed survey sheets.

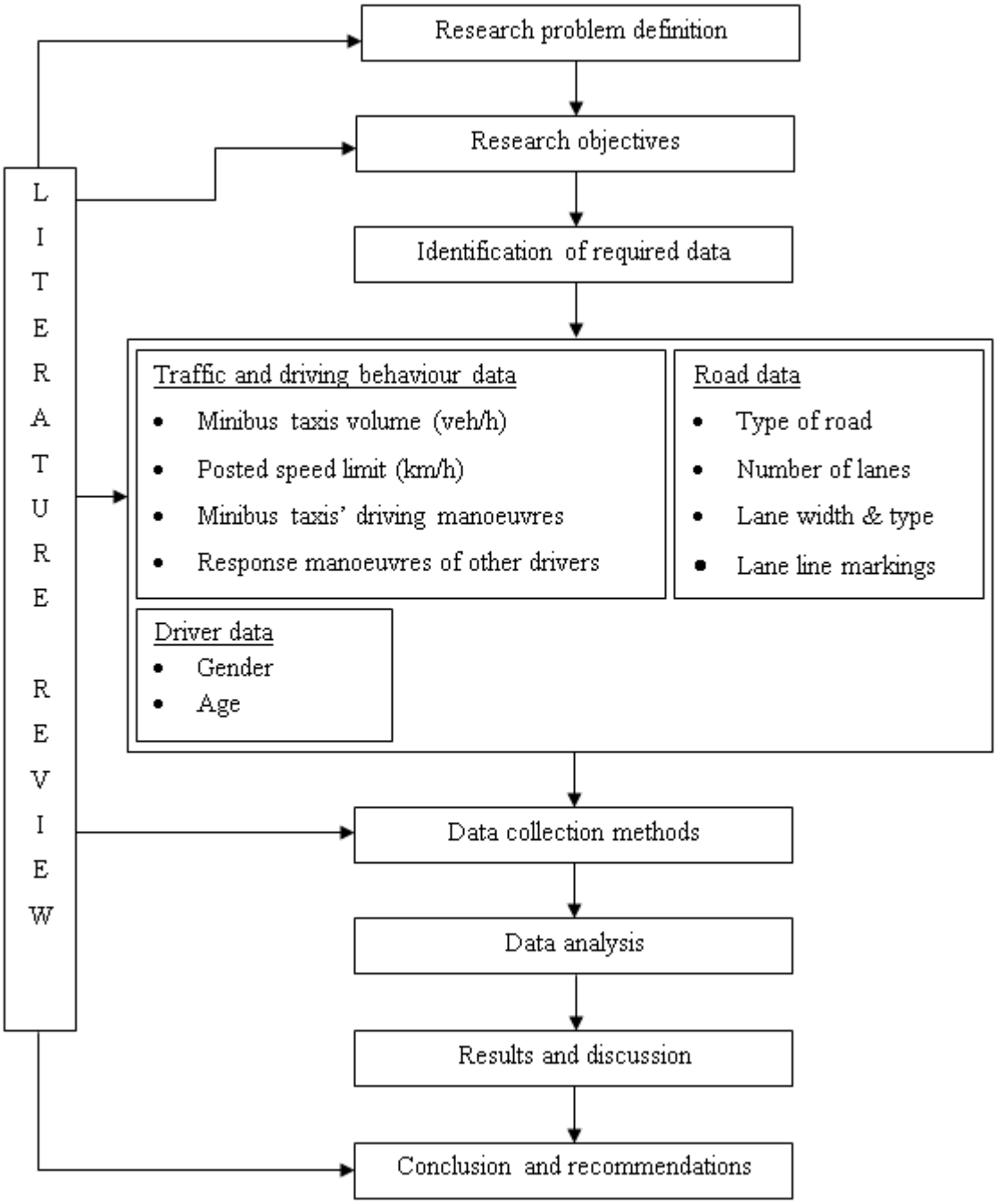


Figure 15 Research Design

3.3 Data collection methods

In general, research data are divided into two types, i.e. primary data and secondary data. The primary data referes to the first data collected by the researcher to meet the main goals of his or her study. The

secondary data, on the other hand, includes data obtained from exising research findings. In the present study, the primary data included:

- **Traffic and driving behavioural data**

The traffic and driving behavioural data comprise; volume of minibus taxis observed moving towards signalised intersections, minibus taxi driving manoeuvres, and response manoeuvres of drivers of other vehicles. Each intersection leg was observed in a perod of 15 minutes and the number of minibus taxis passing through was recorded at the same time. For the rest of the study, minibus taxi driving manoevres, response manoevres of drivers of other vehicles, and volume of minibus taxis observed in 15 minutes from each of intersection approaches were summed to get an hourly estimation.

- **Driver characteristic data**

The driver characteristic data such as age and gender of both minibus taxi drivers and drivers of other vehicles were obtained from questionnaire surveys. It was impossible to estimate the age of the driver and to identify the driver's gender from the video footage.

- **Road condition data**

Road condition data such as road type, number of driving lanes, speed limit, and lane width were collected manually by the researcher on site during the time of data collection.

3.3.1 Observational technique

The real incidence of unsafe driving is measured through direct systematic observation. In this study, aggressive driving behaviours by minibus taxi drivers and the corresponding response behaviours of drivers of other vehicles were systematically observed and recorded. Camera recorders usually used as tools for behavioural studies in road traffic were used to observe and record traffic volume, vehicle type, aggressive driving manoeuvres of minibus taxi drivers, and the response manoeuvres performed by other road users to avoid potential danger. In comparison with the former roadside observational method, video cameras offer many advantages in behavioural observation studies as they lower interference with the traffic processes and offer possibilities to make long observational periods. In addition, the use of video cameras in traffic behavioural studies helps to store and to review some of the important events and permit more exact measurements. Direct systematic observation has an advantage that another researcher can go back and check what the first researcher studied or even extend his or her study by including behaviours which were not considered important in the original study. The problem with the direct systematic observation occurs when the subject being observed knows about the study or the experiment being conducted. This may lead to subject change in normal behaviours and hence result in significant study bias (Salvia, Ysseldyke & Bolt, 2009). The CCTV from the TMC

mounted on the roads were turned at the strategic points of the selected study sites to record the minibus taxis movements and various types of responses performed by other drivers i.e. swerving, lane changing, or braking (red light) to avoid crashes on a stretch of road. In addition, a high-definition video camera (GoPro Hero3) was used to supplement the video footage collection. In the observational study, traffic flow, vehicle type, minibus taxi drivers' aggressive driving behaviours, and response manoeuvres performed by other drivers were observed and recorded.

3.3.2 Questionnaire surveys

In this part of the study, quantitative and qualitative data were collected through the use of both self-reporting and self-administered questionnaires. To get better insight into different levels of anger aroused by drivers of normal vehicles when exposed to the minibus taxi drivers' aggressive driving behaviours, a Driver Anger Scale (DAS) was applied. Participants were requested to rate their anger when exposed to the six minibus taxi anger-instigating situations highlighted in the Pilot Study I on a scale of 1 to 5 (1 = not at all angry and 5 = extremely angry). The reduced versions of the Driver Anger Scale (DAS) by (Deffenbacher, GETTING & Lynch, 1994:83) and the Driver Anger Expression Inventory (DAX) by (Deffenbacher, Lynch, Oetting & Swaim, 2002:717) were applied to develop a tool to assess the intense of anger experienced by other drivers and their likely behavioural responses when exposed to frustrating driving situations. The final tool directed to other drivers included questions on the types of minibus taxi on-road aggressive behaviours they suffered in the last 12 months, intensity of anger experienced, and their likely behavioural reactions to those behaviours. Respondents were asked to identify different areas in Cape Town where they think minibus taxi drivers are more aggressive. On the side of minibus taxi drivers, the Driver Aggression Questionnaire (DAQ) with subscales to measure verbal and physical aggression, anger, and hostility was consulted (Buss & Perry, 1992:452). The instrument to assess the effects of age and gender of minibus taxi drivers on the self-reported frequency of certain types of on-road aggressive behaviours was adapted from the Driver Aggression Questionnaire (DAQ) (Buss & Perry, 1992:452).

The final DAQ used for minibus taxi drivers contained questions on accident history, time of exposure in terms of number of hours driven per day, and the general awareness of road safety. The hand-out/assisted method as one of the three methods of collecting written information was preferred in this study. The reason was because the hand-out and hand-back method of written information collection allows the researcher to keep direct control on his forms distributed among respondents during survey. The two additional methods of collecting written information i.e. the hand-out and mail-back and the mail-out and mail-back methods (Schroeder & Rouphail, 2010:129) were inappropriate for the purpose of this study as the researcher had to meet participants at the fields and talk to them there. One version of the survey form / English was available to respondents.

3.4 Site selection

To gather the required data to achieve the goals of this study, an overall investigation in selection of study sites was conducted in Cape Town. Three study sites were selected as being the most suitable for the purpose of this study. The selection criterion considered in the site selection were that there would be sufficient congestion and high density of minibus taxis during weekday peak hours to promote more minibus taxis' aggressive driving behaviours and various response manoeuvres of other drivers. The three sites selected in this study had high density of minibus taxis (Simpler form of classification of manual traffic conducted in Appendix 3, Appendix 4, and Appendix 5) and two of them are located close to the train station, taxi rank, shopping malls, and hospital. The traffic data which include traffic flow, minibus taxi drivers' aggressive behaviours, and the response behaviours of other drivers were collected in the month of June 2014 during daylight hours. The three sites are located on multi-lane urban highways (Belrail and M10 Intersection), urban arterial road (Main Road and Station Road intersection), and freeways (Hospital Bend interchange on the N2). Basing on the criteria defined above, the three study sites shown in Figures 16, 17, and 18 were selected.

Figure 16 Site location 1 (Intersection of Main Road and Station Road in Observatory)

Figure 17 Site location 2 (Intersection of M10 and Belrail Road in Bellville)

Figure 18 Site location 3 (Hospital Bend on the N2 in Cape Town)

3.5 Research methodology

3.5.1 Pilot study I: Minibus taxi drivers' aggressive driving behaviours

Prior to the main study, a pilot survey was conducted on thirty drivers of normal passenger cars (10 male and 20 female) randomly selected near the central taxi rank in Stellenbosch. The aim of this pilot study was to identify nature or types of minibus taxis' driving behaviours which commonly bother or irritate drivers of other vehicles on roads. In a very short questionnaire (Appendix 1), participants were asked to list the types of minibus taxi driving behaviours that frustrate them while driving. Table 5 illustrates the 20 minibus taxi drivers' unsafe behaviours as highlighted by participants in the Pilot Study.

Table 5 Twenty minibus types of minibus taxi drivers' irritating behaviours (Primary data, 2014)

No	Minibus taxi drivers' unsafe driving behaviours	Frequency (fi)	Percentage (%)
1	Pull out / load passengers in front of other vehicles	13	43.3
2	Improper passing and overtaking manoeuvres	12	40.0
3	Driving over the prescribed speed limit	12	40.0
4	Sudden stops in the road	10	33.3
5	Changing lane without indicating	8	26.7
6	Beep horn inappropriately	8	26.7
7	Cutting in one or more lanes in front of me	7	23.3
8	Red Light Running [RLR] at robots	6	20.0
9	Traffic rules and signs violation	6	20.0
10	Pushing through on hard shoulders	4	13.3
11	Not yielding to other traffic	3	10.0
12	Do not care about the safety of commuters in taxis	3	10.0
13	Driving in the yellow lane to pass vehicles in front	3	10.0
14	Not respecting right of way (ROW) at junctions	2	6.7
15	Tailgating drivers in front	2	6.7
16	Do not stop at designated area / pedestrian crossings	2	6.7
17	Swerving on the road	1	3.3
18	Drink driving and playing music loudly	1	3.3
19	Acting as if they own the road	1	3.3
20	Forced merging	1	3.3

In Figure 19, the twenty items highlighted by respondents are summarised into six groups of minibus taxis' unsafe driving behaviours as follows:

- Lane change without signalling (waiving or swerving in traffic) 9 (30.0%).
- Traffic signs and signals violation (red light running and stop line violation) 14 (46.7%)
- Speeding and tailgating 14 (46.7%).
- Ignoring the rights of other drivers (failure to yield right of way at stop streets, hooting) 18 (60.0%).
- Improper passing behaviours (cutting in too close, pushing through on road shoulder or on yellow lanes) 20 (66.7%), and
- Traffic obstructions (blocking traffic in the road or outside bus stops) 23 (76.7%).

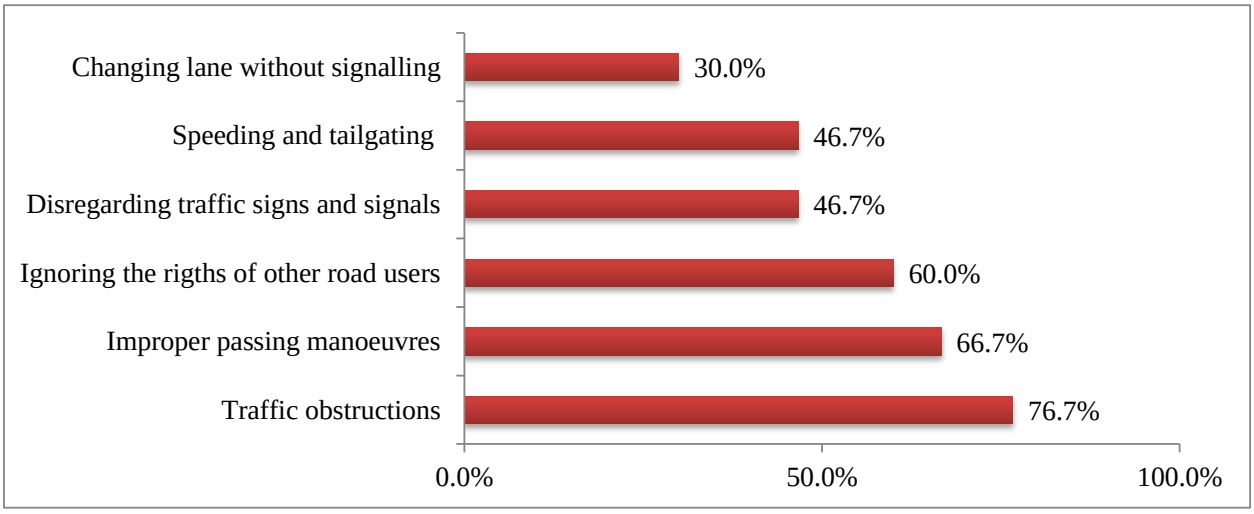


Figure 19 Unsafe on-road behaviours by minibus taxi drivers (Primary data, 2014)

These unsafe driving behaviours of minibus taxi drivers as defined by respondents in the pilot study fall into the list of aggressive driving behaviours defined in international literature (Dula & Geller, 2003:559; Tasca, 2000). Tasca (2000) defined aggressive driving as any driving behaviour which is deliberate, likely to increase the risk of crash and instigated by annoyance, anger and/or attempt to save time. Dula & Geller (2003) added to Tasca's definition and included all on-road behaviours manifested by a driver aiming to physically and/or mentally harm other road users (Dula & Geller, 2003:559). In the same line of thought as Shinar and Compton (2004), minibus taxi driving behaviours which interfere with the movement of other road users were defined as aggressive driving in this study. Again, following Dula & Geller (2003) definition of aggressive driving, on-road behaviours intending to harm other road users either physically or psychologically, such as making rude gestures and verbal abuses were considered as on-road aggressive behaviours in this study.

3.5.2 Instrumentation

Two main types of data i.e. videotaped data and survey data were required in this study. The videotaped data used to assess the nature and the frequency of the minibus taxis' aggressive driving behaviours as well as the response maneuvers performed by drivers of other vehicles to overcome frustrating situations were collected from the CCTV footage. To supplement videotaped data, the researcher used a GoPro Hero3 high resolution video camera. During self-recording data, the researcher equipped with a pole of 4.5 meters height with a camera fitted at the top, an umbrella, and a stop watch was positioned upstream of a signalized intersection between 30 and 90 meters. To store video recordings, an external hard drive (1T Seagate) was used. To assess the levels of anger expressed by drivers of other vehicles when exposed to the minibus taxis' frustrating situations, a Driver Anger Scale (DAS) questionnaire supported by printed photographs describing the minibus taxis' frustrating situations were used. Respondents were asked to rate their levels of anger expressed when they face some of the minibus taxis' anger-instigating situations described in the photographs and to indicate their likely behavioral responses on printed sheets.

3.5.3 Data collection procedures

3.5.3.1 Recorded data

In this study, two stretches of roads between three urban signalized intersections (Main Road and Station Road in Observatory and Belrail Road and M10 in Bellville) and one stretch of the N2 in Hospital Bend in Cape Town were selected for data collection. The observations were conducted on traffic approaching signalized intersections for 15 minutes in one direction and the next 15 minutes in the opposing direction. On Main Road, the stretch of the road studied lies between Station Road and Main Road whereas on the Robert Sobukwe Road the stretch of road studied was located between Belrail Road and the M10 (Robert Sobukwe Road). In weekdays, recording was conducted from Monday to Friday at different times. Over weekends, video recordings were collected on Saturday between 1:00 p.m. and 6:00 p.m. In total, 48 hour video recordings (17 hours on the M10 and Belrail Road in Bellville, 25 hours on the Main Road and Station Road in Observatory, and 6 hours on the N2 in Hospital Bend in Cape Town) from three different study sites were available for analysis. Traffic was recorded during peak and non-peak traffic conditions because aggressive driving behaviours of minibus taxi drivers as well as various response manoeuvres of drivers of other vehicles could occur at any time of the day independently of the traffic conditions. However, more video recordings were done in morning peak and evening peak since the researcher believed to observe more aggressive driving behaviours when roads are congested enough and drivers are under pressure. On the N2 (Hospital Bend in Cape Town), video recordings were only done during evening peak hours.

3.5.3.2 Survey data

Table 6 illustrates evaluation indices used to classify the nature and the frequency of the most common types of the minibus taxi drivers' aggressive driving behaviours. These indices were set based on the most frequent minibus taxi drivers' unsafe driving behaviours highlighted by participants in the pilot study (Figure 19). In addition, response manoeuvres of drivers of other vehicles to those aggressive driving behaviours of minibus taxi drivers were observed and recorded from the video footage.

In order to assess the effect of driver characteristics such as age and gender on both the on-road aggressive behaviours performed by minibus taxis drivers and the response manoeuvres showed by drivers of other vehicles, survey forms were used. For minibus taxi drivers, administered questionnaires were used whereas for drivers of normal passenger cars self-administered questionnaires and photographs describing minibus taxis' aggressive driving situations were used. On the side of the minibus taxi drivers, survey questionnaires examined the various forms of aggressive on-road behaviours they perform and how often they do that. On the side of drivers of other vehicles, survey questionnaires firstly studied the types of minibus taxis' on-road aggressive behaviours suffered in the last 12 months; secondly, assessed levels of anger aroused when subjected to those frustrating situations, and thirdly, identified the likely behavioural responses to those aggressive behaviours. The hand-out/assisted method was used to collect written answers from the respondents. Printed sheets were distributed among respondents and returned to the researcher after completion.

Table 6 Evaluation indices of the minibus taxi drivers' aggressive driving behaviours

Driving behaviours	Evaluation indices	Driver's measurable reactions / actions
1. Improper passing: - Cutting in too close - Inappropriate lane use - Driving on road shoulders to pass	- Indicator use before driving manoeuvre - Pass on road shoulder or Yellow Lane (YL) - Utilisation of through lane to turn - Utilization of turning lane to pass - Crossing continuous line to pass - Estimated minimum cutting distances ($S_{d1,2}$) - Estimated cross path angle (θ)	- Brake and stop (red light) - Swerve (steering angle) and change lane - Speed change: (a) accelerate (b) decelerate - Comments: Hooting and hand signs
2. Traffic obstruction: - Stopping in the road - Stopping outside bus stop - Crossing Red Line to stop	- Stopping inside or outside Red Line (RL) - Stopping in the road or outside bus stops - Indicator use before and after obstruction - Time delay of the obstructed vehicle (t_d)	- Stop and wait until the road is free to move - Swerve (steering angle) - Comments: Hooting and hand signs
3. Disregard of traffic signals /signs: - Red Light Running (RLR) - Violating Stop Line (SL)	- Time to intersection (TTI) - Speed change at the onset of Yellow Phase (a) accelerate (b) decelerate - Intersection approaching speed (S) - Crossing the Stop Line (SL)	- Decelerate and stop before the Stop Line (SL) - Accelerate and follow the Red Light Runner - Comments: Hooting and hand signs

Four sites were selected during the survey data collection. Three study sites selected for minibus taxi drivers' surveys are Somerset West Taxi rank, Bellville main Taxi Rank, and Stellenbosch Taxi rank. These sites were visited between 10:00 a.m. and 2:30 p.m. when minibus taxi drivers were least busy. The Eikestad Mall's main parking and PnP Mall's main parking in Stellenbosch were visited to target other drivers. Prior to questionnaire survey, two minibus taxi drivers and two drivers of normal passenger cars were selected and surveyed. On average, a survey time of 2 to 3 minutes was required for respondents to complete a survey form.

3.5.3.3 Evaluation indices

This section describes how different evaluation indices used to classify minibus taxi drivers' aggressive driving behaviours were determined. Evaluation indices which include indicator use, driving on road shoulders or on yellow lane, utilization of turning lanes as through lanes or vice versa, stopping in the road, and speed change at the onset of Yellow lights were distinguished on the video footage without difficulty. Indices like time delay of obstructed vehicles, time to intersection (TTI) of minibus taxi drivers at the onset of a Yellow Light, and the estimated minimum spacing between two following cars to accommodate a cutting minibus taxis were determined as follows:

- **Time delay (t_d)**

The time delay of the obstructed vehicle was computed as the time difference between the time when the road was free for moving traffic (**t_f**) and the time when the minibus taxi driver stopped to block the moving traffic behind (**t_s**). The time delay (**t_d**) was calculated in seconds as follows:

$$t_d = t_f - t_s \quad (1)$$

Where:

t_d : Time delay (seconds)

t_f : Time when the road was free (seconds)

t_s : Time when obstruction started (seconds)

To determine the arithmetic mean time delay and standard deviation of the obstructed vehicles, following statistical formulae were used.

$$X = \frac{\sum x_i * f_i}{\sum f_i} \quad (2)$$

$$S_{td} = \sqrt{\frac{\sum f_i(x_i - X)(x_i - X)}{N - 1}} \quad (3)$$

Where:

S_{td} : Standard deviation (seconds)

X : Arithmetic mean delay (seconds)

f_i : Frequency

x_i : Mid-point value

N : Number of observed values or observations

- **Distance from the Stop Line at the onset of yellow light (d)**

Prior to the determination of the time to intersection (TTI), the position (d) of each minibus taxi approaching a signalized intersection at the onset of Yellow Light was estimated. This position was measured by means of a scale drawn on the road shoulder with markings every five meters from the stop line of the intersection approach. Once the position was determined, the vehicle's approaching speed (S) was obtained by taking the distance to the stop line (SL) over the estimated time to intersection (TTI). Where it was not possible to draw markings on road shoulders, identifiable benchmarks were chosen and distances from the stop line to those benchmarks were determined. The minibus taxis' intersection approaching speed (S) was calculated in (km/h) as follows:

$$S = \frac{d}{TTI} \quad (4)$$

Where:

S : Intersection approaching speed (km/h)

d : Distance to the Stop Line at the onset of a Yellow Light (meters)

TTI : Time to Intersection (seconds)

- **Time to intersection (TTI)**

Drivers approaching signalized intersections with high speed (speed limits ≥ 60 km/h), face two types of driving situations. These two driving situations refer to the highway zones where some drivers prefer to proceed through the intersection while others may decide to stop at the onset of yellow lights. The first zone called Yellow Time Dilemma Zone (DZ) describes the option that a motorist approaching a signalized intersection when a yellow light is on will not be able to clear the intersection safely or to stop prior to the Stop Line (Gazis, Herman & Maradudin, 1960:112).

The second zone called Optional Zone (OZ), commonly occurs as differences in driver behaviours, refers to the pavement region starting where most drivers (90%) decide to stop their vehicles when presented with the Yellow Light and ends at the position where most drivers (90%) proceed through the intersection (Zegeer, 1978).

Chang et Al. (1985) defined dilemma zone boundaries in terms of travel time to the stop line. In their study, 85 percent of drivers stopped if they were 3.0 seconds or more back from the stop line and almost all drivers who proceed through the intersection were 2.0 seconds or less from the Stop Line at the onset of yellow light (Chang, Messer & Santiago, 1985). A driver's poor decision at the onset of a yellow light may lead to a rear-end crash if the driver decides to stop when he should have proceeded or to a right-angle crash with side-street vehicles in case he decides to proceed when he should have stopped. However, a driver's decision within dilemma zones at the onset of a yellow light depends on his or her perception-reaction time, acceptable deceleration rate, age and gender, and the estimated approaching speed (Chandler, Myers, Atkinson, et al., 2013; Rakha, El-Shawarby & Setti, 2007:630). This study was limited in the sense that it did not consider all factors that influence driver's decisions at the onset of a yellow light. The speed change behaviour at the onset of yellow light (accelerate or decelerate), intersection approaching speed (S), and time to intersection (TTI) of minibus taxis approaching signalised intersections were considered to decide whether or not the Red Light Running (RLR) or Stop Line (SL) violation option was aggressive.

The Yellow Time Dilemma zone (2.0 seconds and less back from the stop line) where the chance of the driver to clear the intersection safely or to halt before the stop line without violating is too small was removed in order not to penalise minibus taxi drivers. In this study, Red Light Running behaviour by minibus taxi drivers was studied from 2.5 to 5.5 seconds and more upstream of signalized intersections at the start of yellow light, since this region was defined as "Dilemma Zone or Indecision Zone" for drivers (Bonneson, Middleton, Zimmerman, Charara & Abbas, 2002). The TTI of minibus taxis approaching signalized intersections was measured as the time difference between the time to the Stop Line ($\mathbf{t_{SL}}$) and the time at the onset of a yellow light ($\mathbf{t_Y}$). The estimated TTI was calculated in seconds as follows:

$$TTI = t_{SL} - t_Y \quad (5)$$

Where:

TTI : Time to Intersection (seconds)

t_{SL} : Time to the stop line (seconds)

t_Y : Time at the onset of yellow light (seconds)

- **Minimum distance between two following cars to allow a cutting minibus taxi (S_d)**

There was an estimation of the minimum distance between two following cars (S_d) to accommodate a cutting minibus taxi. To evaluate whether a cutting manoeuvre performed by a minibus taxi driver amounted to aggressive driving or not, the estimated distance between two following cars (S_d) was compared with the distance observed from the video footage between two cars accommodating a cutting minibus taxi. Prior to the approximation of S_d, the estimated average travel speed (S), flow rate under saturated conditions (v), density (D), estimated spacing between cars in the traffic stream (H), and the distance between two following cars to allow a cutting minibus taxi were computed:

a. Estimated average travel speed (S)

Prior to the estimation of the average travel speed (S), the average travel time of vehicles passing through a known length was estimated. In Appendix 2, the estimated average travel time was measured from 96 vehicles passing through a road segment of 18 m length (Hospital Bend / N2 in Cape Town) in peak hours. The number of observations (n) was obtained from statistics assuming a confidence interval of 95% (Z =1.96), a tolerance in error (e) of ±1 m per hour of observation, and a standard deviation (S) of 5 meters per hour of observation (ITE, 2009). The formulae used to compute the required sample size (n) and estimated average travel speed (km/h) are defined below:

$$n \geq \frac{S^2 K^2}{e^2} \tag{6}$$

Where:

n : required sample size

S^2 : Standard deviation of sample

K : t-value for a confidence interval of 95%

e : tolerance in error (assumed ±1 m)

$$S = \frac{L}{T_{av}} \text{ x } 3.6 \tag{7}$$

Where:

S : Estimated average travel speed (km/h)

L : Length of the segment (m)

T_{av} : Estimated average travel time (seconds)

b. Estimated Flow rate (v)

The flow rate (v) under saturated conditions was estimated in the slow middle lane where the rate of cutting and unsafe passing manoeuvres of minibus taxi drivers was high. On the N2 (4lanes uninterrupted facility) at Hospital Bend, the average volume was measured from 4:00 pm to 5:00 pm over two different days (Tuesday 3rd June 2014 and Friday 13th June 2014). The flow rate (v) in Table 7 was estimated from a volume of vehicles observed in 15-minutes as an equivalent hourly volume if a sub-hourly flow was sustained for 60 minutes (HCM, 2010).

Table 7 Estimated saturation flow rate (v) on the N2, Hospital Bend (Primary data, 2014)

Date of observation	Time (hr/min)	Volume (veh/15min/ln)	Flow rate (veh/hr/ln)
June 3rd 2014	4:00 pm – 4:15 pm	390	1560
	4:15 pm – 4:30 pm	330	1320
	4:30 pm – 4:45 pm	356	1424
	4:45 pm – 5:00 pm	305	1220
June 13th 2014	4:00 pm – 4:15 pm	253	1012
	4:15 pm – 4:30 pm	208	832
	4:30 pm – 4:45 pm	293	1172
	4:45 pm – 5:00 pm	379	1516

c. Estimated density (D)

The estimated density (D) was computed from the average travel speed (S) and estimated flow rate (v). The following under-saturated equation for uninterrupted facilities was used:

$$D = \frac{v}{S} \tag{8}$$

Where:

v : Estimated flow rate (veh/h)

S : Estimated average travel speed (km/h)

D : Estimated density (veh/km)

d. Estimated spacing between vehicles (H)

In traffic engineering, density expresses the proximity of vehicles to one another and reflects the freedom to manoeuvre within the traffic stream (HCM, 2010). From the estimated density (D), the spacing (H) between two following cars in the traffic stream was estimated as follows:

$$H = \frac{1000}{D} \quad (9)$$

Where:

H : Estimated minimum spacing (meters)

D : Estimated density (veh/km)

e. Minimum spacing between two cars to allow a cutting minibus taxi (S_d)

The minimum spacing between two following vehicles in order to safely accommodate a cutting minibus taxi (S_{d1} and S_{d2}) was estimated based on the estimated spacing between vehicles (H) and the average length of vehicles in the traffic stream (V_l).

- **Mean vehicle length (V_l)**

Bester & da Silva (2011) revised old South African parking design standards which had last been updated in 1985 and proposed a New Design Vehicle Dimensions (Length, Width, Height, and Wheelbase) based on the recent vehicle Sales and Dimension data (2006-2010) of both passenger vehicles and Light commercial Vehicles (LCV). In their study, which aimed to determine a new set of parking bay dimensions suitable to the current vehicle sizes, LCV were included in the analysis because these types of vehicles are being used as daily vehicles in South Africa. Figure 20 displays a New Design Vehicle Length obtained from a combined analysis using both LCV and Passenger vehicles (Bester & da Silva et al, 2012).

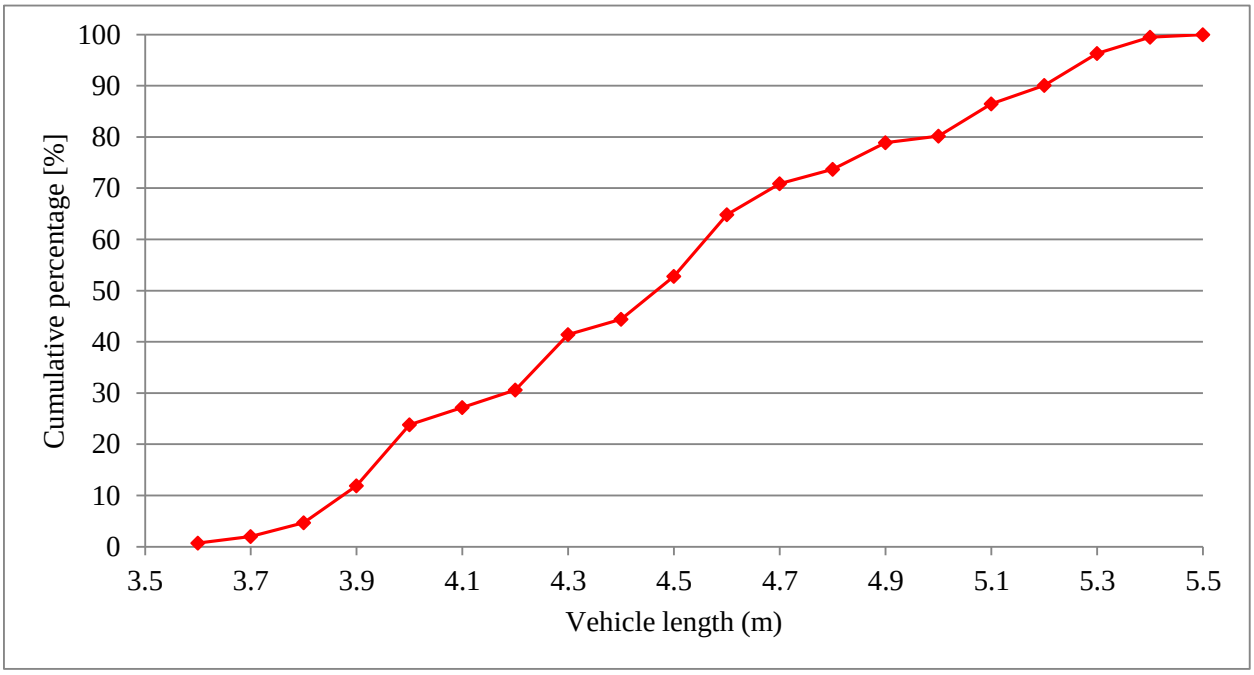


Figure 20 Combined LCV and Passenger vehicle length distribution (Bester & da Silva, 2012)

In Figure 20, 95th percentile of the surveyed vehicles had a length less than or equal to 5.3 meters. For the sake of this study, a length of 4.5 meters was estimated for minibus taxis in order to determine the minimum spacing between two following cars to allow cutting taxis as 5.3 meters seemed to be too long.

- **Minimum spacing between two following cars to allow cutting manoeuvre (S_d)**

The minimum spacing (S_{d1} and S_{d2}) between two following cars (vehicle 1 and 2 in the diagram) in order to accommodate a cutting minibus taxi from outside lane was measured considering a fictitious minibus taxi (3) with same length posed in between the two vehicles. Following are the results obtained from the above computation formulae:

- Estimated average flow rate v = 1257 veh/h (Table 7)
- Estimated average travel time T_{av} = 6.0 seconds (Appendix 2)
- Estimated average travel speed S_{av} = 10.8 km/h (Appendix 2)
- Density D = 117 veh/km (Equation 8)
- Estimated spacing between vehicles H = 8.5 m (Equation 9)
- Mean vehicle length V_l = 4.5 m (**Error! Reference source not found.**)
- Minimum spacing between two cars to allow a cutting taxi S_{d1} = 12.5 m, S_{d2} = 4.0 m (Figure 21)

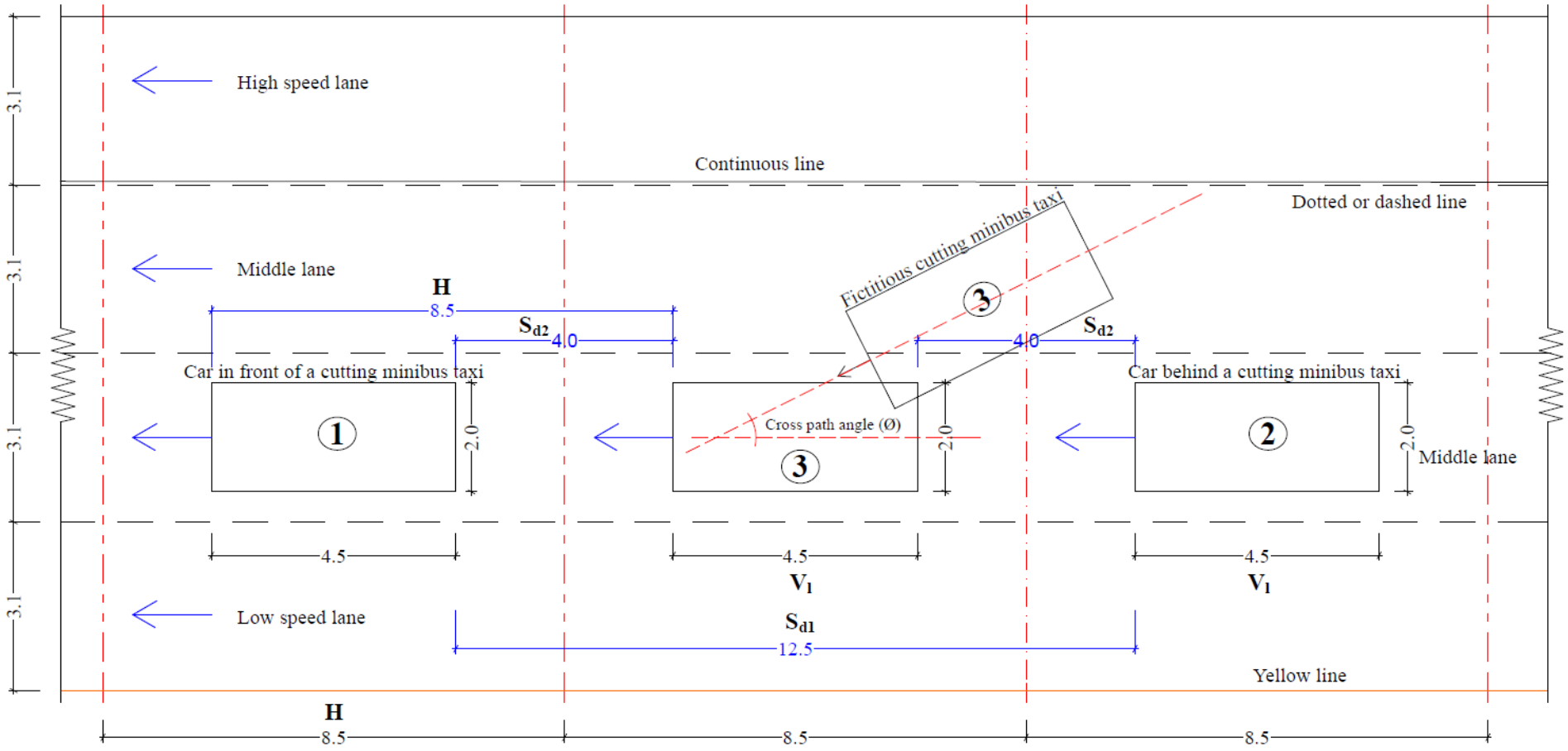


Figure 21 Minimum spacing between two cars to accommodate a cutting taxi (Primary data, 2014)

Note: The cross path angle (θ) between a cutting minibus taxi and a vehicle being overtaken was used to evaluate aggressive cutting manoeuvres where lane line markings on the road were obscured in the video footage. The cross path angle (θ) estimated on the computer screen by means of a protractor was used as a subjective index of aggressive minibus taxi driver's cutting manoeuvres and no detailed computations were performed.

- **Estimated distance between two following cars observed from video footage (K)**

Each time a minibus taxi performed a cutting manoeuvre, the distance between two following vehicles accommodating the cutting manoeuvre was estimated from the video footage based on the lane line markings. The standard lane line markings for urban roads (9 meters modules for broken line markings which means two gaps of 3.0 m and two Lines of 1.5 m in Figure 22) were used to estimate the distance between two following cars during the time a minibus taxi cutting manoeuvre was performed (SADC – RTSM, 2012). The cutting manoeuvre performed by a minibus taxi driver was judged as aggressive when the estimated distance between two cars (K) observed from the video footage was smaller than the estimated minimum spacing between two following vehicles (S_{d1} and S_{d2}).

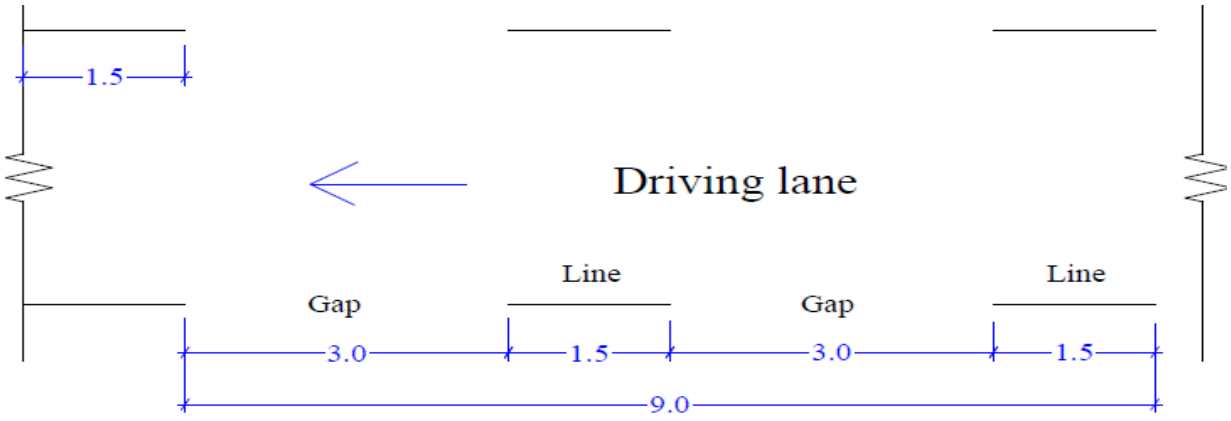


Figure 22 Standard modules for broken line markings / Urban (SADC - RTSM, 2012)

3.5.4 Measures of driver anger, anger expression, and aggressive driving behaviours

3.5.4.1 Driver anger and anger expression

Deffenbacher at al. (1994) designed the original Driver Anger Scale (DAS) to measure levels of anger aroused by drivers exposed to anger-instigating situations. This measuring tool contained 33 items describing different types of anger-instigating situations. These items were grouped into six subclasses named: (1) discourtesy on road, (2) slow driving, (3) illegal driving, (4) traffic obstructions, (5) hostile gestures, and (6) police presence (Deffenbacher, Getting & Lynch, 1994:83). The new UK Driver Anger Scale on the other hand contains 21 items divided into three categories i.e. direct hostile, impeded progress, and reckless driving.

The difference between the new UK DAS tool of driver anger and the initial DAS is that the latter includes items describing situations where no motorist provoked anger among drivers, such as road works and police presence. The new UK DAS with 21 items focuses on the situations where a driver is the principal promoter of anger. Participants rate the extent to which they feel annoyed on a 5-point Likert Scale (1 = not at all angry, 2 = a little angry, 3 = fairly angry, 4 = very angry, 5 = extremely angry) (Lajunen, Parker & Stradling, 1998:107). In this study, the new UK DAS with three factors; direct hostile, impeded progress, and reckless driving was adapted and a measuring tool of the amount of anger expressed by other drivers when exposed to the minibus taxi anger-instigating situations was developed. To avoid any ambiguity in responding, the student decided to combine item 2 (a little angry) and item 3 (fairly angry) into one item "a little angry" and remained with a 4-point Likert Scale instead of a 5-point Likert Scale used in the original DAS.

To measure the likely response behaviours of other drivers to the minibus taxi anger-instigating situations, the self-developed form of the Driver Anger Expression (Gonzalez-Iglesias, 2012) reduced from the original Driver Anger Expression Inventory (DAX) questionnaire by Deffenbacher et al. (2000) was consulted. This available tool of anger expression assessment comprises 18 items gathered in four subclasses such as verbal aggressive expression, personal physical aggressive expression, use of vehicle to express anger, and constructive or adaptive expression of anger. In this study, photographs describing the minibus taxi drivers' aggressive driving behaviors were printed and showed to other drivers. In a blank box, other drivers were asked to write their likely behavioral responses to each driving situation. The seven alternative reactions to anger instigating situations starting from 1 to 7 (1 = no reaction, 2 = beep horn/flash lights, 3 = gesture at the other driver, 4 = verbal abuse the other driver, 5 = drive aggressively towards another other driver i.e. drive very close to vehicles in front of you, changing lanes without signaling, and swerving in the traffic, 6 = stop your vehicle and get out, ready to argue, and 7 = get out of car, prepared to physically engage with the other road user) developed by (Lajunen, Parker & Summala, 1999:225) were consulted and behavioral responses of other drivers were ranged accordingly. The measurable actions and reactions of drivers were; swerving or deviating, right foot off accelerator, braking, hooting, flashing headlights, making signs, and verbal comments.

3.5.4.2 Aggressive driving behaviours

The Manchester Driver Behaviour Questionnaire (DBQ) initially designed to differentiate driving errors from driving violations, has been used by many researchers to examine associations between self-reported driving behaviours and accident involvements (Reason, Manstead, Stradling, Baxter & Campbell, 1990:1315). To date, the reduced versions of the DBQ appear with four subclasses of driving behaviours i.e. driving errors, lapses, violations and aggressive violations.

Driving violation is defined as deliberately deviating from safe driving codes whereas aggressive violation refers to showing hostility to other road users. Driving violation includes behaviours such as driving over the posted speed limit and following too closely another driver whereas aggressive driving deals with on road behaviours such as making impolite signs at other road users. Lapses in driving include inattention problems such as not recalling where you parked your car for example whereas driving errors refer to observational failures or misjudgement of driving situations. These two subscales of the DBQ are not deliberate and no related questions were included in the final measuring tool of aggressive driving behaviours (Lajunen, Parker & Summala, 2004:231; Mesken, Lajunen & Summala, 2002:469). In this study, driving violation and aggressive driving subscales alone were consulted to develop a measuring tool of minibus taxi drivers' aggressive driving behaviours. Participants were asked to fill in 5-point Likert Scale (1 = never, 2 = seldom, 3 = sometimes, 4 = very often, and 5 = always) how often they perform each type of aggressive driving behaviours.

Buss & Perry (1992) developed the Driver Aggression Questionnaire (DAQ) with scales to measure physical aggression, verbal aggression, anger, and hostility. The subscales measuring physical aggression were used in both observational and survey studies whereas the two other subscales which measure verbal and hostile aggression were consulted in surveys only. The six measures of minibus taxi drivers' aggressive driving behaviours used in this study were: (1) cutting in too close in front of other vehicles, (2) obstructing traffic from passing, (3) violating traffic signals and signs (red light running and violating stop line), (4) weaving in and out of traffic or changing lane without signalling, (5) ignoring the rights of other road users, and (6) driving fast or speeding for road conditions. The first three measures of minibus taxi drivers' aggressive driving behaviours were assessed in both observational and survey parts of this study. The last three measures of minibus taxi drivers' aggressive behaviours i.e. speeding; ignoring the rights of other road users, and weaving in and out of traffic were assessed only in the survey part of this study. Every time there was a minibus taxi aggressive driving behaviour in the video footage, the nature of aggressive driving was quickly identified and the response manoeuvre of the vehicle directly behind was recorded. The Freemake Video Converter Software helped to play, to stop and record, and to replay the video frame by frame until all the necessary measurements were captured. Hostile and verbal aggression measures included items such as obscene gestures; making negative comments about the other driver, and swearing at the other driver.

3.5.5 Data reduction

Recorded data were transferred from the video camera and stored in a Seagate External Hard Drive of 1T on the basis of the study location, time and date of recordings. Recorded data were displayed on a computer screen and coded. The necessary information was recorded on paper sheets and transferred to Microsoft Excel spreadsheets for further calculations and statistical analysis.

The survey data were transferred from handwritten sheets to SPSS. 16 data sheet for analysis. Each time a minibus taxi's aggressive driving behaviour was noticed, the film was slowed down and stopped until the necessary information such as type of aggressive driving behaviour and response manoeuvre of other driver were well watched and recorded. Though the GoPro Hero3 video camera used had the ability to provide a maximum recording rate of 60 frames per second, camera settings which allowed more recording time were selected since no detailed information other than minibus taxi volume, types of minibus taxi driving manoeuvres, position of minibus taxis at the onset of yellow light, and response manoeuvres of drivers of other vehicles were needed. The chosen settings (Resolution, RES = 1280 x 720, Frames per second, FPS = 30, Field of view, FOV = Wide) for the video camera allowed a recording time of 3 hours non-stop with a Scan Disk (SD) of 16 GB.

3.5.6 Sample size and selection technique

The accurate sample size depends on both the sample population and the intended research goals. It is chosen in relation to the number of categories required. A sample is defined as a portion of the population selected to achieve the research objectives (Kothari, 2004). In the survey part of this study, two samples i.e. one for minibus taxi drivers and one for other drivers were needed. For both samples, the stratified sampling method was used. With this method, the driver population was divided into two categories: minibus taxi drivers and drivers of other vehicles. For minibus taxi drivers, the stratified random sampling technique was used. In this method, respondents had an equal chance to participate in the study at the taxi ranks (Baker, 1988:489). For other drivers, the purposive sampling method was used. The purposive sampling method was preferred to sample other drivers in comparison with other methods of non-random sampling because it allows the researcher to use his or her own judgement to choose participants who meet the purposes of the study (Schroeder & Rouphail, 2010:129). The disadvantage of the non-random sampling method resides in the fact that its validity cannot be scientifically evidenced. Results obtained in the non-random sampling technique pose difficulties as they do not necessarily represent the population as a whole.

In July 2014, the total number of vehicles registered in the City of Cape Town was 1,195,686. The population of registered minibus taxis alone accounted for 24,318 (Western Cape Live Vehicle Population per Local Authority, 2014). To determine the required sample size for both categories, the formula below proposed by the research division of the National Education Association (NEA, 1960) for known population size was used (Kraft, HOMBURGER & Pline, 2009; Krejcie & Morgan, 1970:607). In the survey part of this study, 182 drivers of normal passenger cars were selected and interviewed. Only half of them i.e. 91 participants was selected and interviewed for minibus taxi drivers. The reason was that minibus taxi drivers were difficult to find and many of them were not willing to participate in the study.

$$n = \frac{\left(X^2 NP(1-P)\right)}{d^2(N-1) + X^2 P(1-P)} \quad (10)$$

Where:

- n : required sample size.
- X^2 : Table value of chi-square for 1 degree of freedom at the desired confidence level.
- N : Population size.
- P : Population proportion (assumed to be 0.50 to provide the maximum sample size).
- d_{ac} : Degree of accuracy expressed as a proportion (0.10).

With:

- N = 24,318 minibus taxi fleets (Live Vehicle Population Local Authority, 2014)
- X^2 = 2.71 at 90 % confidence level
- P = 0.50
- d = 0.10
- n = 182

In the observational part of this study, the direct systematic approach was used to observe the minibus taxi drivers' aggressive behaviours and the corresponding response behaviours of other drivers. Contrary to the naturalistic approach where the researcher observes a subject with no determined behaviours in mind, in the direct systematic approach the researcher starts observation with a set of predetermined behaviours (Salvia, Ysseldyke & Bolt, 2009). There are several methods of direct systematic approach to behavioural observations. Some of those methods applied to this study include; Time Sampling method (TS), Event-Based Sampling method (EBS) or Behaviour Sampling method (BS), Focal Sampling method (FS), and Scan Sampling method (SS) (Little, 2013). The TS method records what a person is doing at defined time intervals. It is a time-based sampling method mostly used to sample frequently occurring behaviours. The EBS method in contrast to the TS method allows the behaviours under study to continually occur as in real world. In the EBS, each instance of the behaviour is recorded and an estimate of how often it occurs can be drawn. The EBS is valid for both frequently occurring behaviours and non-frequently occurring behaviours. The SS method was preferred in comparison to the FS method because while the FS method selects one person and records his or her behaviours for a defined time interval, the SS method allows the researcher to observe individual's behaviours in more than one situation. In this method, the observer scans observational fields for possible behaviours for a defined period of time. Once a behaviour studied occurs it is directly recorded. However, in case spacing between scans is not adequate, the Behaviour Sampling method may not be able to give the true frequency of the behaviours studied (Pellegrini, 2001:861).

Salvia and Ysseldyke (2001) introduced the five characteristics of direct systematic approach to behavioural observations. Those five characteristics of the behaviours to study also known as the best five practices for direct systematic approach (Hintze, Volpe & Shapiro, 2002:993) are listed as follows:

(1) the behaviours to measure must be specific, (2) they have to be well defined, (3) they have to be recorded following standardized procedures, (4) times and places of observation must be selected and identified carefully, and (5) data scoring and coding have to be standardized and reliable to all observations made (Salvia, Ysseldyke & Bolt, 2009). In this part of the study, both the Event-Based Sampling and Scan Sampling methods were considered. The Event-Based Sampling method was used to record the minibus taxi drivers' aggressive behaviours and the response manoeuvres of other drivers since these behaviours were time-independent. To select suitable study sites for possible minibus taxi drivers' aggressive behaviours, the Scan Sampling method was used. Though the minibus taxi drivers' aggressive behaviours targeted in this study could happen anywhere and at any time, the Hospital Bend site (a stretch of the N2 in Cape Town) was scanned primarily for improper passing behaviours i.e. cutting in too close, passing on non-passing lanes, and lane changing without indicating. In the same manner, the Main Road site in Observatory and the Belrail site in Bellville were selected for the minibus taxi drivers' on-road aggressive behaviours like Red Light Running (RLR), obstructing traffic from passing by pulling out or loading passengers in the road, speeding, and ignoring the right of other road users. The videotape data used in this study were extracted from the CCTV cameras mounted on the roads. The researcher supplemented recorded data using a GoPro Hero3 camera. In total, 48 hour video recordings from three different study locations were available for analysis.

3.5.7 Data analysis

The analysis of video recorded data included the description of types and prevalence of minibus taxis drivers' aggressive driving behaviours as well as the corresponding behavioural responses performed by drivers of other vehicles. On a large computer screen, minibus taxi drivers' aggressive driving behaviours and response manoeuvres of drivers of other vehicles were identified, manually coded in excel spreadsheet, and statistically analysed. Information from the questionnaire surveys which included levels of anger expressed by drivers of other vehicles when subjected to the minibus taxi drivers' on-road aggressive situations, their likely behavioural responses, demographic variables of drivers such as age and gender, and the motivational factors for aggressive driving behaviours were processed with the statistical package SPSS version16.0

3.6 Ethical considerations

Recruiting participants for research studies requires ethical consideration. In every study, the researcher has the responsibility of protecting the participants involved from any harm that may result from using the information supplied in the study. In addition, he or she must ensure privacy to participants and gain consent from them before participation in the study (Binik, Mah & Kiesler, 1999:82). In this study, surveys were conducted following ethical standards which took into consideration issues such as voluntary participation, informed consent; privacy and ensuring that no harm was brought on

participants. Before the research questionnaires were distributed, participants were informed about the objectives of the study and thereafter consent was obtained. However, in the observational part of this study, no consent was attained from participants before video recordings since the video recordings were secondary data recorded and provided by the TMC in Cape Town. As such no agreement was required with motorists before these videos were recorded. Furthermore, the video data was used only in this study in order to comply with the requirements set by the TMC not to use the video footage outside of the boundaries of this study. After consent was gained from the traffic department, the researcher enhanced the data collection process by collecting additional video footage from the study sites. No potential risk to participants in the study was ascertained and the research study was approved by the ethics committee within the Civil Engineering Department of Stellenbosch University.

3.7 Limitations

Two research approaches were used in this study. The direct systematic behavioural observation approach was used to study the nature and the frequency of the on-road minibus taxi drivers' aggressive behaviours and the response behaviours of drivers of other vehicles to those behaviours. The TMC's CCTV cameras mounted on road and a high definition video camera were used to record video footage from three different locations. Questionnaires were used to assess levels of anger produced by other drivers when exposed to the minibus taxis' on-road aggressive behaviours as well as their likely behavioural responses to those behaviours. The effects of age and gender of both minibus taxi drivers and other drivers on the levels of anger produced and on the corresponding responses were only assessed through questionnaire surveys. The limitations associated with these two approaches were summarised in the following bullet points:

- **Recorded video footage**

This study was conducted in urban areas. The first challenge encountered by the researcher was to locate a suitable place to install the camera and start recording behaviours. This place had to be hidden from the targeted drivers in order not to alter their normal driving behaviours. The CCTV cameras, mounted on the road for other purposes than those of this study, have served in video recordings. These cameras were located close to intersections and interchanges and this constituted a limitation to this study as the researcher was constrained in selecting study sites close to intersections.

The minibus taxi drivers' aggressive behaviours which required long stretches of road to be observed to record such as weaving in and out of traffic and speeding were not examined in the video footage. The footage extracted from these CCTV cameras was not detailed enough for the purpose of this study, and so the researcher supplemented video recordings by using his own video camera. The problem with the video footage recorded by the researcher is that it was affected by weather changes (wind and sun). The researcher was holding a 4.5 metres pole during the recording time and this was difficult to maintain

under windy conditions or when there was excessive sun and heat for him to remain standing. The three study sites selected for the purpose of this study were located far from Stellenbosch. This constituted another challenge to the researcher. There was no specific video recording time as the minibus taxi drivers' aggressive behaviours were unpredictable. The recording time was also dependent on the train schedule as the researcher had to depart from Stellenbosch in the morning and return by train again in the evening. The researcher was unable to determine whether the behaviours reported in questionnaires by different respondents reflected what they really do on the roads as it was impossible for him to collect driver characteristics such as age and gender from the video footage. While one aggressive driving manoeuvre of a minibus taxi driver could affect the whole queue of the vehicles behind, this study was constrained only on the reaction of the vehicle directly behind the leading minibus taxi.

- **Evaluation indices**

With direct systematic observation approach of behavioural studies, the problem resides in defining indices to guide the researcher while classifying and coding behaviours. It is always difficult to judge from traffic observation whether or not a driver decides to brake, swerve, or to change lane because he or she feels uncomfortable of the driving behaviour of another driver. For traffic obstruction and Red Light Running (RLR) behaviours, the researcher found no major difficulties in estimating the time delay for obstructed vehicles or in judging whether a minibus taxi driver violated a red light willingly. However, imprecisions occurred when the researcher had to estimate both the minimum spacing between two following cars in order to allow a cutting minibus taxi with no difficulties and observe the distance between two cars from the video footage. The observed distance between two following cars in the video footage was estimated based on the standard lane line markings on the road. Here, inaccuracies occurred when the lane line markings were obscured by vehicles or when the camera shook due to the wind. The impressions in estimating the minimum spacing between two following cars on the road resulted from the estimation of traffic flow rate. The flow rate was estimated from a 15 minutes count conducted in two hours of two different days. Secondly, the average travel speed used to compute the density was estimated from the average travel time obtained from 96 vehicles observed completing a known segment length in Appendix 2.

The video footage supplied by the TMC for the purpose of this study had no sound. This constituted a limitation to this study as aggressive horn-honking behaviour was only coded in the video footage recorded by the researcher. Sometimes, the researcher experienced difficulties in coding hooting behaviours from both perspectives (drivers of other vehicles and offending minibus taxis drivers). In peak periods, it was difficult for the researcher to know whether the vehicle that hooted was directly behind the offending minibus taxi or not.

1. Survey data

Two hundred and seventy three participants (91 taxi drivers and 182 drivers of other vehicles) responded to survey questionnaires. The survey questionnaires were used to assess both the levels of anger expressed by drivers of other vehicles when exposed to the minibus taxi frustrating situations and the corresponding response behaviours. The researcher was not sure whether or not what the respondents reported was true or not due to the negative image or attributions they have for minibus taxi drivers. With minibus taxi drivers, the researcher experienced a language problem. Though almost all minibus taxi drivers surveyed were able to communicate in English, the researcher recruited two local people to accompany him as respondents sometimes preferred to interact in either Afrikaans or Xhosa. The reliability of the written answers was uncertain as minibus taxi drivers were potentially dishonest about their normal on-road driving behaviours.

Chapter 4 RESULTS PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter consolidates the findings on the most common forms of the minibus taxi drivers' on-road aggressive behaviours obtained from three sites (see Table 8). In the observation section, the results on the nature and prevalence of the minibus taxis' aggressive driving behaviours observed such as improper passing manoeuvres (cutting in too close in front of cars, pushing through on hard shoulder or yellow lane, inappropriate lane utilisation), traffic obstructions (blocking traffic in the road or outside bus stops), and disregarding traffic signs and signals (red light running and stop line violations) are presented. The response manoeuvres performed by drivers of other vehicles to overcome minibus taxis' frustrating situations, together with the factors that seem to influence those responses, are shown. The survey section presents results on how frequent minibus taxi drivers reported to engage in on-road aggressive behaviours and on the effect of age and gender on those aggressive behaviours. In addition to the behaviours observed in video footage, this part presents results on the minibus taxi drivers' on-road aggressive behaviours such as speeding, changing lane without signalling, and ignoring the rights of other road users highlighted in the pilot study. These behaviours were not seen in the video footage as they require long stretches of the road to be observed. The survey section continues by showing results on the levels of anger aroused by drivers exposed to the minibus taxis' frustrating situations and the likely response behaviours displayed.

Table 8 Site characteristics (Primary data, 2014)

No	Site and location	Speed limit [km/h]	Type of road	Legs	Number and type of lanes at each approaching leg		Traffic volume [veh/h]		Demand [taxis/h/ln]	Lane width [m]	Traffic signal control system	Observation time [hours]	Taxis observed
1	M4 and Station Road Observatory [Cape Town]	60	Multilane road	4	Leg 1	4 lanes: 2 Thro, 2 RT, and 1 LT	Leg 1	855	104	3.2	Actuated	25	3474
					Leg 2	4 lanes: 2 Thro, 2 RT, and 1 LT	Leg 2	847	146				
					Leg 3	2 lanes: 1 RT and 1 LT	Leg 3	n/a	n/a				
					Leg 4	2 lanes: 1 Thro, 1 RT, and 1 LT	Leg 4	n/a	n/a				
2	M10 and Belrail Road [Bellville]	60	Multilane road	4	Leg 1	4 lanes: 2 Thro, 2 RT, and 1 LT	Leg 1	768	532	3.2	Actuated	17	2082
					Leg 2	4 lanes: 2 Thro, 2 RT, and 1 LT	Leg 2	1627	568				
					Leg 3	4 lanes: 3 Thro, 1 RT, and 2 LT	Leg 3	1038	391				
					Leg 4	3 lanes: 2 Thro, 2 LT, and 1 RT	Leg 4	854	140				
3	Stretch of the N2 [Hospital Bend]	n/a	Freeway	1	4 Thro lanes		1368		225	3.5	n/a	6	1710

4.2 Observational study

In total, 7,266 minibus taxis were observed at three different sites over a period of 48 hours. Of these, 175 (2.4%) obstructed moving vehicles in the road, 242 (3.3%) approached signalised intersections as platoon leaders at the onset of yellow lights, and 600 (8.2%) were involved in improper passing manoeuvres. In the next section, characteristics and frequencies of the above three types of minibus taxis' driving manoeuvres observed will be presented. The decision on whether the driving manoeuvre was aggressive or not, response manoeuvres of drivers of the vehicles behind the offending minibus taxis, and possible factors that seem to influence decisions of the drivers directly behind minibus taxis are statistically summarised and graphically represented.

4.2.1 Traffic obstructions by minibus taxi drivers

4.2.1.1 Characterisation of obstructing minibus taxis

Figure 23 illustrates the numbers of minibus taxis that stopped in the road, outside bus stops, and those that crossed the red line to load or unload passengers. It can be seen that 105 (60%) of minibus taxis involved in traffic obstructions stopped in the road, 69 (39.5%) obstructed moving vehicles outside bus stops, and only 1 taxi (0.5%) crossed the red line and posed obstruction to vehicles behind it.

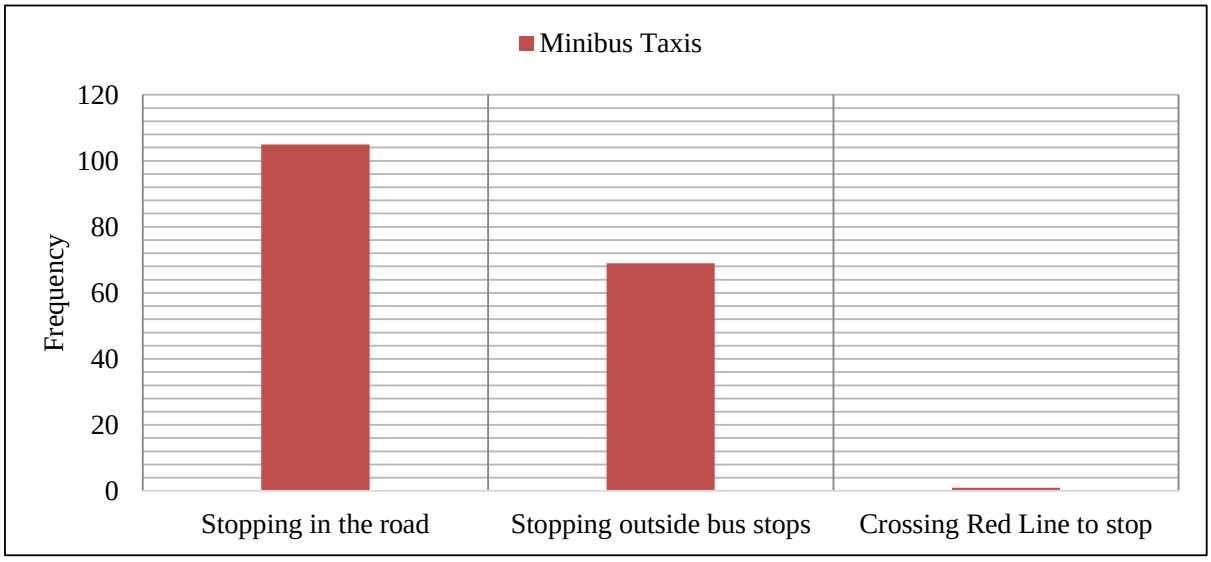


Figure 23 Traffic obstructions by minibus taxis drivers

4.2.1.2 Frequency of minibus taxi drivers' traffic obstructions

On average, 175 (100%) of minibus taxis involved in traffic obstructions in the study stopped aggressively. In Appendix 24, 65 (62%) of minibus taxis that stopped inside the road indicated to the vehicles behind before stopping. For minibus taxis that stopped outside bus stops and delayed traffic, only 28 (40.5%) indicated to the vehicles behind before stopping.

Minibus taxis that managed to indicate to the vehicles behind before stopping were coded as aggressive only if they stopped inside the road or outside bus stops.

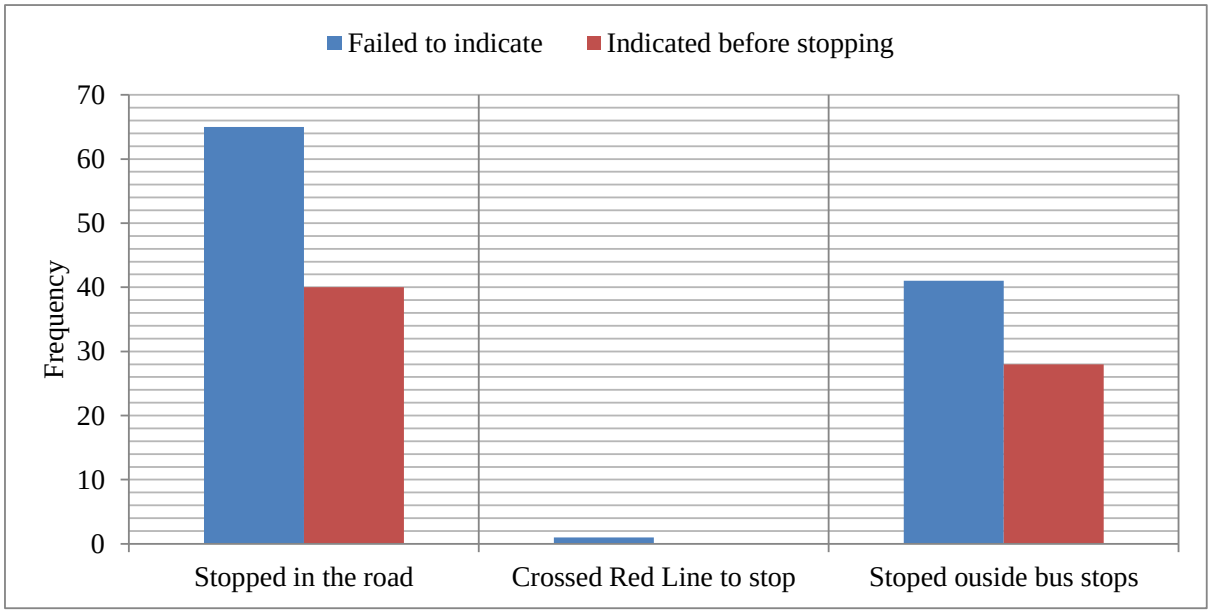


Figure 24 Minibus taxi drivers' aggressive stopping behaviours

4.2.1.3 Response behaviours to traffic obstructions by minibus taxi drivers

Prior to the assessment of the response manoeuvres of the drivers directly behind obstructing minibus taxis, the mean time delay and standard deviation of the obstructed vehicles were determined. The mean time delay and the standard deviation were computed from Equation 2 and 3 after grouping all time delay data sets into seven classes of 5 seconds intervals. The mean time delay computed for 175 vehicles blocked behind minibus taxis was 7.4 seconds and the standard deviation was equal to 2.86 seconds. Table 9 shows the time delay data set observed for 175 vehicles obstructed behind minibus taxis. The computation processes for mean time delay and standard deviation is also shown.

Table 9 Frequency distribution table for set of obstructed vehicles' time delay data

Delay class (sec)	Mid-point (xi)	(fi)	(fi*xi)	$(xi - X)^2$	Percent (%)	Cum. (%)
0 - 5	2.5	70	175	23.04	40.0	40.0
5 - 10	7.5	65	487.5	0.04	37.1	77.1
10 - 15	12.5	25	312.5	27.04	14.3	91.4
15 - 20	17.5	8	140	104.04	4.6	96.0
20 - 25	22.5	4	90	231.04	2.3	98.3
25 - 30	27.5	1	27.5	408.04	0.6	98.9
30 - 35	32.5	2	65	635.04	1.1	100.0
Total		175	1297.5	1428.28	100.0	100.0

The estimated maximum time delay for 175 targets of traffic obstructions by minibus taxi drivers was 34.0 seconds and the minimum time delay was 2.0 seconds. In Figure 25 below, more than 95 percent of drivers blocked behind minibus taxis experienced a delay of less than or equal to 20 seconds.

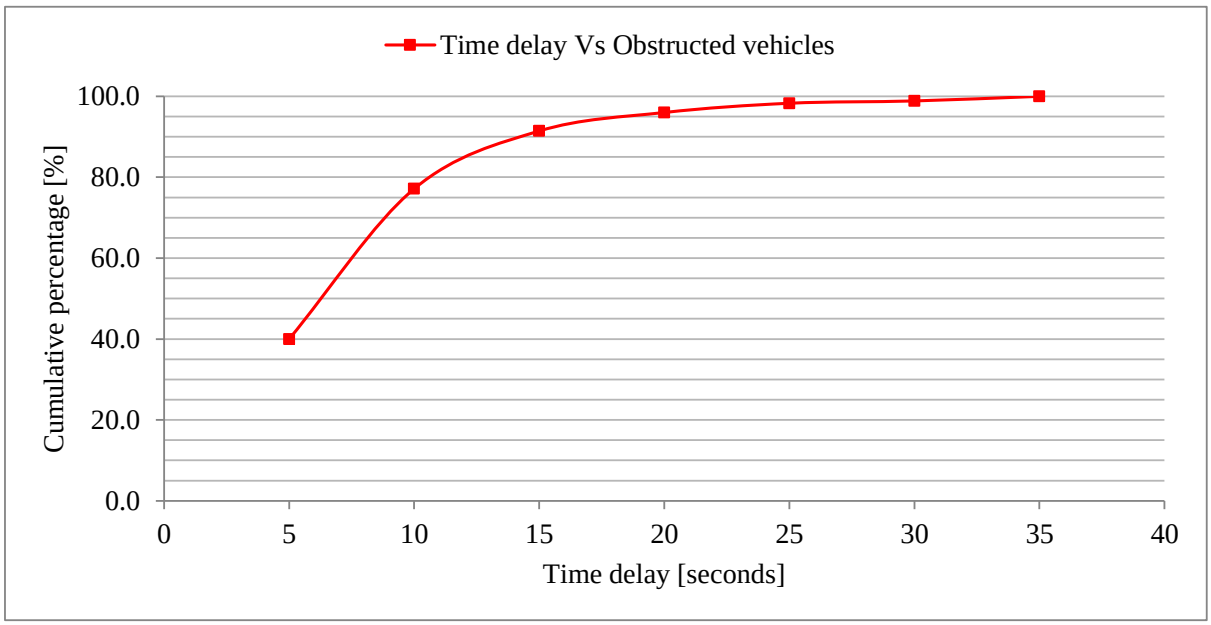


Figure 25 Cumulative distributions of obstructed vehicles' time delay

The driver of the vehicle behind stopping minibus taxis had two driving options. They either had to stop and wait for the minibus taxi until the road was free for them to move or to swerve to the next lane to find a way out and move on. In addition, these drivers could hoot at the minibus taxi drivers to express their anger or irritation. Table 10 illustrates response manoeuvres of drivers of the vehicles obstructed behind minibus taxis at three different stopping positions. In a sample of 105 vehicles blocked in the road, 54 (51.5%) of them swerved aggressively to the next lane whereas 22 (32%) of 69 vehicles blocked outside bus stops waited until the road was free for them to move. On average, 126 (72%) drivers of 175 victims of traffic obstructions by minibus taxis hooted to show frustration.

Table 10 Response manoeuvres of drivers of the obstructed vehicles

Traffic obstructions by minibus taxi drivers	Response behaviours to traffic obstructions			
	Stop & wait	Stop & swerve	Stop, wait & hoot	Stop, swerve, hoot
Cross Red Line to stop	1	0	1	0
Stop outside bus stops	22	47	17	29
Stop in the road	51	54	41	28
Total	74	101	59	57

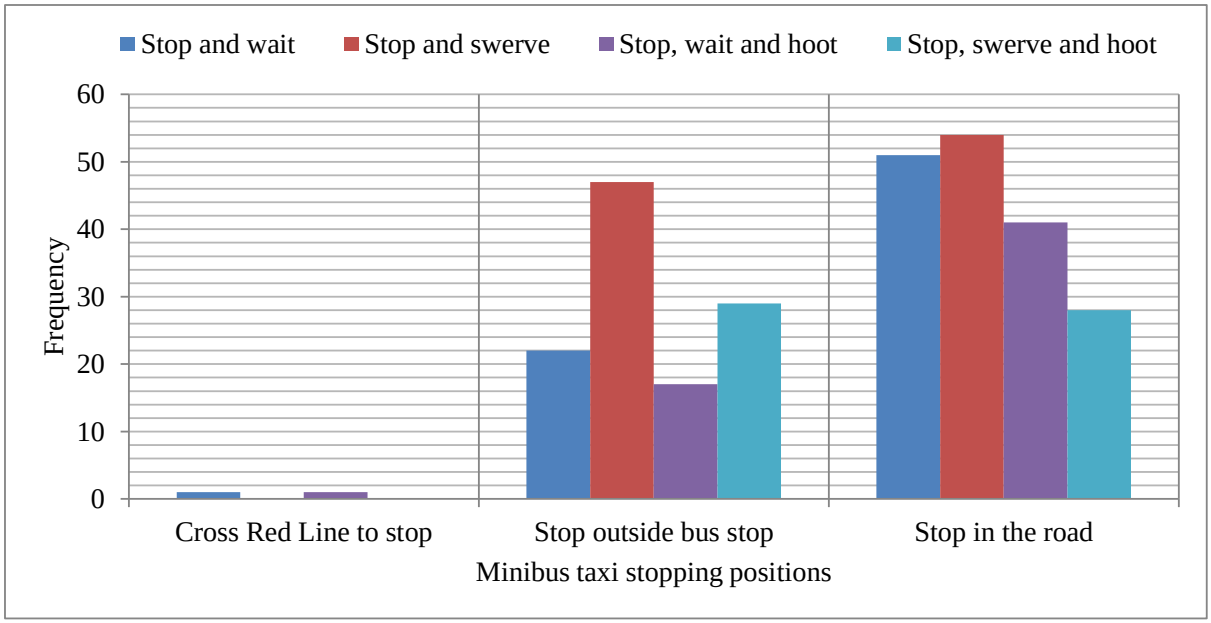


Figure 26 Response behaviours of obstructed drivers at stopping locations

Furthermore, the response behaviours of drivers of the obstructed vehicles were studied as a function of time delay experienced. The numbers of drivers that stopped and waited until the road was free to pass; those that stopped and swerved to the next lane to find a way out and move; those that stopped, waited and hooted, and finally those that stopped, swerved after some time and hooted at the minibus taxis are detailed in Table 11 and graphically represented in Figure 27. In addition, the weighted average for the delay for each of the four driver responses are presented.

Table 11 Frequency distribution table for set of obstructed drivers' time delay data

Delay class (sec)	Mid - values	Response behaviours of drivers of other vehicles against traffic obstructions by minibus taxi drivers															
		Stop and wait				Stop and swerve				Stop, wait, and hoot				Stop, swerve, and hoot			
		fi (n)	(%)	Cum. (%)	Weighted average (s)	fi (n)	(%)	Cum. (%)	Weighted Average (s)	fi (n)	(%)	Cum. (%)	Weighted average (s)	fi (n)	(%)	Cum. (%)	Weighted average (s)
0 - 5	2.5	21	28.4	28.4	0.7	49	48.5	48.5	1.2	13	22.0	22.0	0.6	25	43.9	43.9	1.1
5 - 10	7.5	24	32.4	60.8	2.4	41	40.6	89.1	3.0	18	30.5	52.5	2.3	25	43.9	87.7	3.3
10 - 15	12.5	19	25.7	86.5	3.2	6	5.9	95.0	0.7	18	30.5	83.1	3.8	4	7.0	94.7	0.9
15 - 20	17.5	7	9.5	95.9	1.7	1	1.0	96.0	0.2	7	11.9	94.9	2.1	0	0.0	94.7	0.0
20 - 25	22.5	1	1.4	97.3	0.3	3	3.0	99.0	0.7	1	1.7	96.6	0.4	2	3.5	98.2	0.8
25 - 30	27.5	1	1.4	98.6	0.4	0	0.0	99.0	0.0	1	1.7	98.3	0.5	0	0.0	98.2	0.0
30 - 35	32.5	1	1.4	100	0.5	1	1.0	100	0.3	1	1.7	100	0.6	1	1.8	100	0.6
Total		74	100	100	9.2	101	100	100	6.2	59	100	100	10.1	57	100	100	6.6

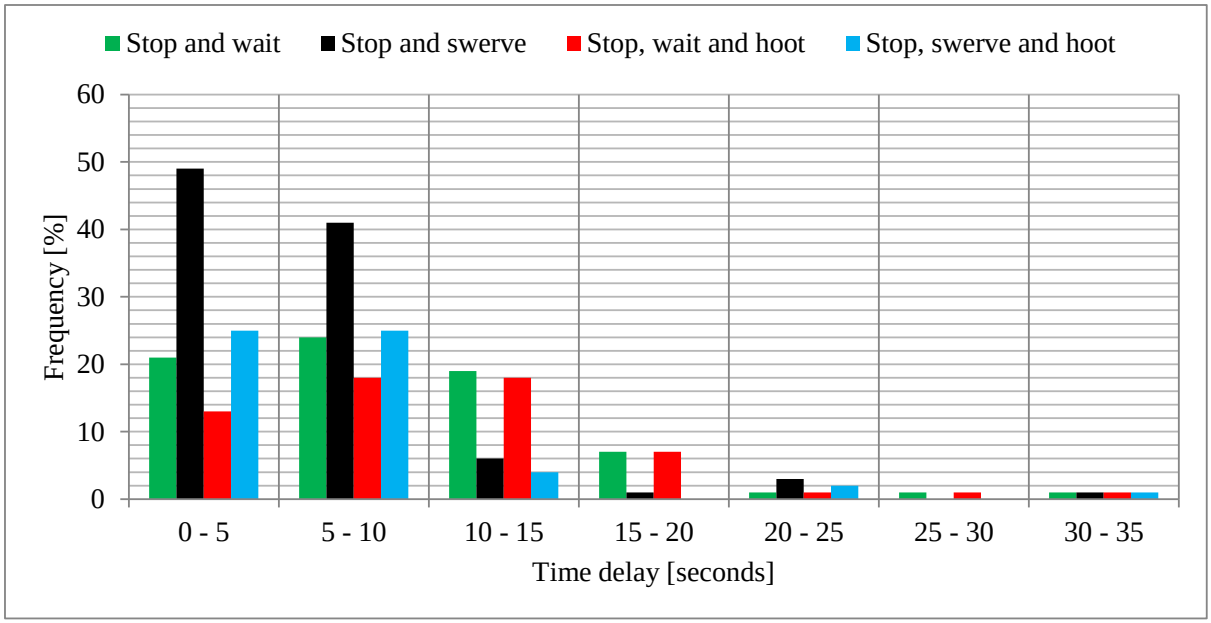


Figure 27 Response behaviours to obstructing minibus taxis as a function of time delay

In Table 11, the weighted average time delay for obstructed drivers who stopped and waited for taxis was equal to 9.2 seconds, that for obstructed drivers who stopped and swerved to the next lanes to pass was 6.2 seconds, that for obstructed drivers who stopped, wait, and hooted was 10.1 seconds, and that for obstructed drivers who stopped, swerved, and hooted at obstructing taxis was 6.6 seconds. These results shows that a time delay of 6.2 seconds was enough for obstructed drivers to start showing their frustration. In Figure 28, 95 percent of drivers blocked behind minibus taxis experienced a time delay of less than or equal to 20 seconds, regardless types of response behaviour they demonstrated.

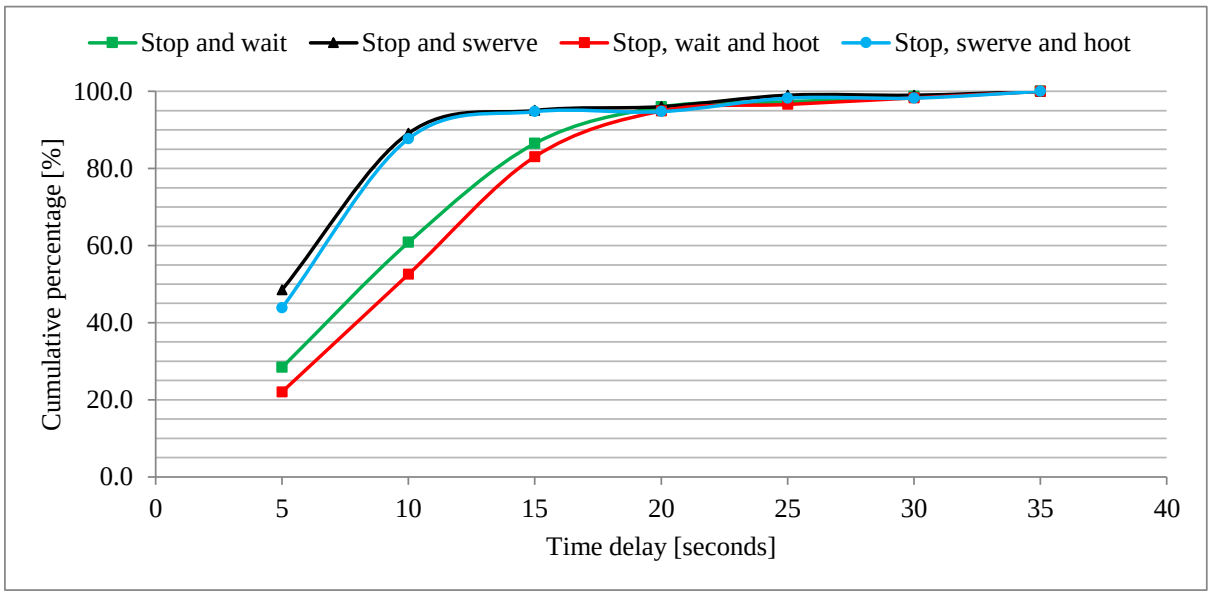


Figure 28 Cumulative distributions of response manoeuvres as a function of time delay

The response behaviours showed by drivers of the vehicles obstructed behind minibus taxis were classified into two perspectives. In Appendix 24, a driving behaviour was coded as non-aggressive when the driver of the obstructed vehicle waited and only moved after the obstructing minibus taxi has left. Some drivers waited for some time and then engaged in sustained hooting or even swerved into the next lane as the time delay increased. These response behaviours were coded as aggressive responses even though the driver stopped and waited for some time before he or she started hooting or swerving. The number of aggressive and non-aggressive response behaviours exhibited by drivers of the obstructed vehicles are detailed in Table 12 and represented in Figure 29.

Table 12 Aggressive and non-aggressive response behaviours of obstructed drivers

	Aggressive responses	Non-aggressive responses	Total
Stop and wait	59	15	74
Stop and swerve	101	0	101
Total	160	15	175

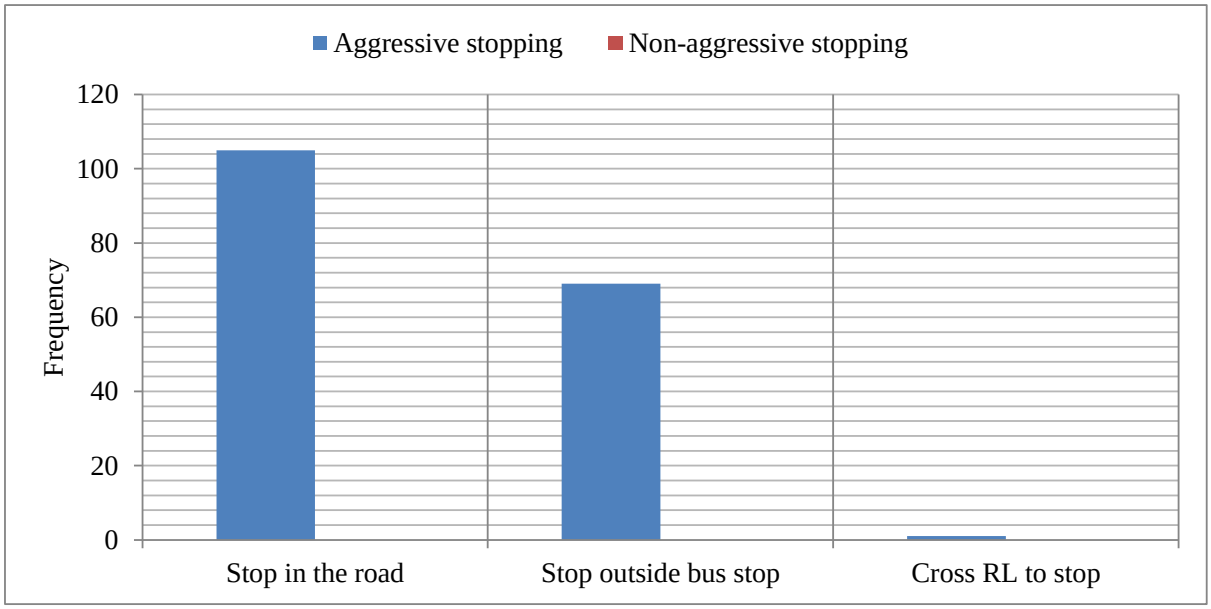


Figure 29 Response behaviours to minibus taxis' traffic obstructions

Regardless of where the minibus taxis stopped to cause obstructions to moving vehicles, only 15 (8.5%) out of 175 drivers blocked behind minibus taxis responded non-aggressively. These drivers stopped their vehicles and waited for stopping minibus taxis to clear the road to move on. In Figure 29, it can be seen that the type of aggressive response behaviour to traffic obstructions that occurred more frequently was stopping and swerving (57.7%). In Table 12, 59 (79.7%) drivers out of 74 were coded

as aggressive because they stopped, waited and hooted at the obstructing taxis whereas 101 (100%) drivers that swerved to the next lane to pass their reactions were coded as aggressive responses.

4.2.1.4 Discussion

This study aimed to classify the nature and the frequency of the most common forms of minibus taxi drivers' aggressive behaviours. Minibus taxi drivers appeared to obstruct traffic by either stopping in the road or outside designated bus stops to load or offload passengers. Over the observation period, and in a total of 7,266 minibus taxis observed, 175 were involved in traffic obstructions. The frequency of minibus taxis that blocked traffic in the road was higher than that of minibus taxis that caused obstructions to moving vehicles after they stopped outside bus stops (60% against 39.5%). In Appendix 24, all traffic obstructions observed were coded as aggressive.

Drivers of the obstructed vehicles either had to wait for the obstructing minibus taxis until they cleared the road for them or swerved aggressively to the next lane to find way out and move. However, some obstructed drivers preferred to engage in sustained hooting at the obstructing minibus taxis and wait until the road was free. In Table 12, 59 (33.7%) obstructed drivers out of 175 aggressively hooted at the obstructing minibus taxis, 101 (57.7%) swerved to the next lane and passed, and only 15 (8.5%) remained patiently until the road was free. This implies that 160 (91.4%) obstructed drivers out of 175 reacted aggressively to the obstructing minibus taxis. In Figure 27, it can be seen that the number of vehicles that stopped and waited for obstructing minibus taxis decreases as the time delay increases. The calculated mean time delay for 175 obstructed drivers was equal to 7.03 seconds and more than 95 percent drivers experienced a delay of 18 seconds. These results provide a partial support to Shinar (1998)'s Frustration and Aggression Model of aggressive driving. The model states that the level of aggression that may be expected from victims is a function of level of frustration experienced. In Table 11, it can be seen that the number of obstructed drivers who reacted by hooting or by swerving aggressively to the next lane to overcome frustration has increased with the increase of time delay. However, a sample of 175 vehicles was too small to provide a reliable trend.

4.2.2 Minibus taxis' red Light Running and Stop Line violations

Red light running and stop line violations by minibus taxis were studied on taxi fleets that approached signalised intersections (M10 and Bellrail Road, M4 and Station Road) at the onset of Yellow Lights. To study these two behaviours, a minibus taxi driver had to approach a signalised intersection as a platoon leader and behind him or her a vehicle other than minibus taxi had to be present in order to investigate its response behaviours. In a total of 242 minibus taxis that approached two signalised intersections as platoon leaders, 197 of them were followed. In order to characterise minibus taxis as they approached signalised intersections, this study included also 45 minibus taxis that were not followed due to infrequent incidence of situations where minibus taxis had to approach as platoon

leaders and at the same time being followed by vehicles other than minibus taxis. The ensuing section takes into consideration the characterisation of taxis as they approached signalised intersections at the onset of yellow lights. This examination is based on a consideration of 242 minibus taxis.

4.2.2.1 Characterisation of minibus taxis' red light running and stop line violations

The mean distance from Stop Line and the standard deviation of minibus taxis that approached signalised intersections at the onset of yellow light were computed using equation 2 and equation 3 in Chapter 3. In Table 13, the calculated mean distance was equal to 31.7 meters and the standard deviation was equal to ± 5.9 meters. The minimum distance from stop line recorded at the onset of yellow lights was 1.0 meter and the maximum distance was 78.0 meters. In Figure 30, it is seen that more than 95 percent of minibus taxis that approached signalised intersections as platoon leaders at the onset of yellow light were at a distance less than or slightly above 70 meters from the stop line.

Table 13 Frequency distribution table for set of minibus taxis' distance from stop line data

Distance class (m)	Mid-values (xi)	Frequency (fi)	(fi*xi)	$(xi - X)^2$	Percentage (%)	Cumulative percentage (%)
0 - 5	2.5	4	10	1197	1.7	1.7
5 - 10	7.5	18	135	876	7.4	9.1
10 - 15	12.5	25	313	605	10.3	19.4
15 - 20	17.5	31	543	384	12.8	32.2
20 - 25	22.5	28	630	213	11.6	43.8
25 - 30	27.5	18	495	92	7.4	51.2
30 - 35	32.5	30	975	21	12.4	63.6
35 - 40	37.5	25	938	0	10.3	74.0
40 - 45	42.5	15	638	29	6.2	80.2
45 - 50	47.5	9	428	108	3.7	83.9
50 - 55	52.5	4	210	237	1.7	85.5
55 - 60	57.5	8	460	416	3.3	88.8
60 - 65	62.5	5	313	645	2.1	90.9
65 - 70	67.5	7	473	924	2.9	93.8
70 - 75	72.5	8	580	1253	3.3	97.1
75 - 80	77.5	7	543	1632	2.9	100.0
Total		242	7680	8635	100.0	100.0

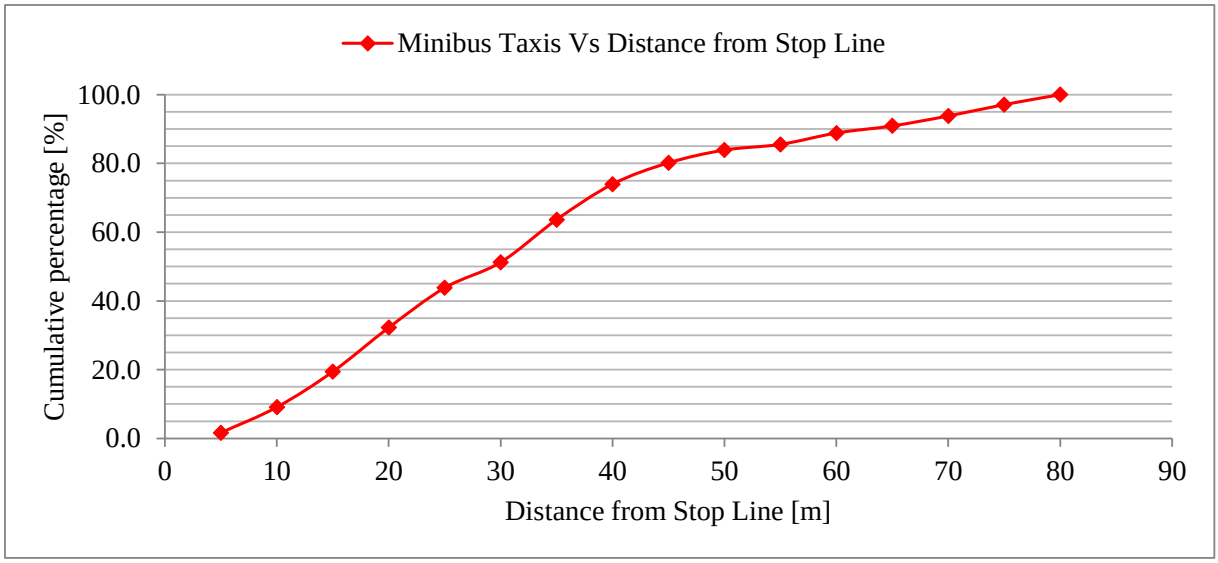


Figure 30 Cumulative distribution of minibus taxi drivers' distances at the onset of Yellow Lights

Furthermore, the time-to-intersection (TTI) and intersection approaching speed of minibus taxis were determined. The mean TTI measured for 242 minibus taxis that approached signalised intersections at the onset of yellow lights was 3.7 seconds and standard deviation was equal to ± 0.7 seconds. In Figure 31, it can be seen that slightly above 95 percent of minibus taxis used a travel time of less than or equal to 7 seconds to move from their positions at the onset of yellow lights to the stop line. The travel time equal to six seconds is four seconds higher than a TTI of two seconds set in Appendix 25 as a lower boundary for minibus taxis' red light running evaluation indices.

Table 14 Frequency distribution table for set of minibus taxis' time to intersection data

TTI (seconds)	Frequency	Mid-values	(fi*xi)	$(xi - X)^2$	Percent (%)	Cum. (%)
0 - 1	0	0.5	0	7.29	0.0	0.0
1 - 2	38	1.5	57	2.89	15.7	15.7
2 - 3	60	2.5	150	0.49	24.8	40.5
3 - 4	56	3.5	196	0.09	23.1	63.6
4 - 5	38	4.5	171	1.69	15.7	79.3
5 - 6	25	5.5	137.5	5.29	10.3	89.7
6 - 7	14	6.5	91	10.89	5.8	95.5
7 - 8	8	7.5	60	18.49	3.3	98.8
8 - 9	2	8.5	17	28.09	0.8	99.6
9 - 10	1	9.5	9.5	39.69	0.4	100.0
Total	242		889	114.9	100.0	0.0

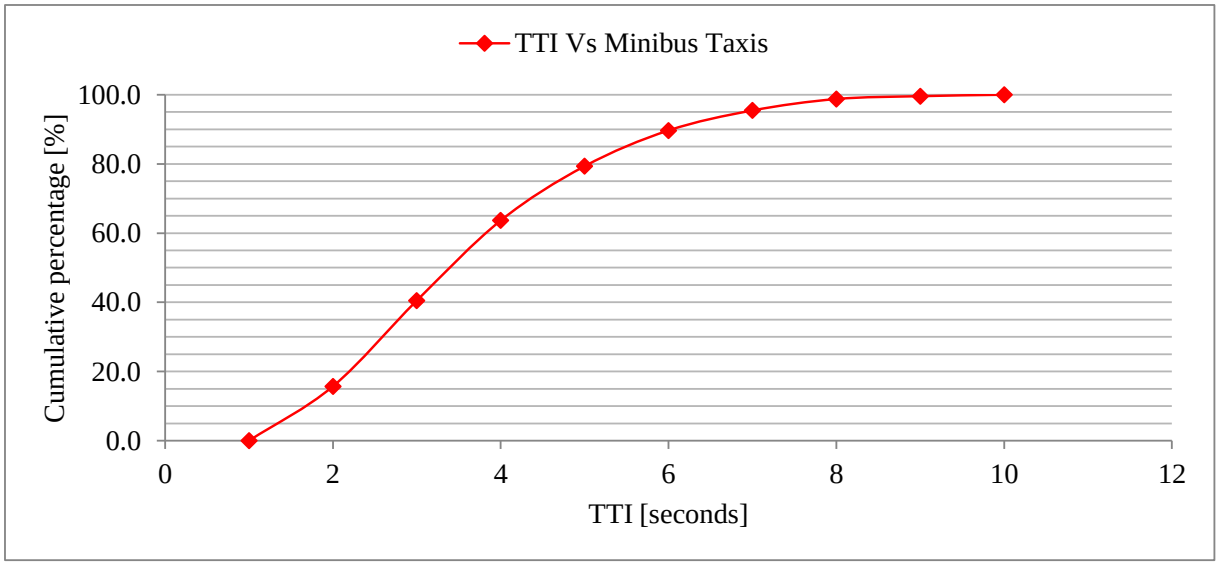


Figure 31 Cumulative distribution of minibus taxi drivers' Time to Intersection [TTI]

The mean speed and standard deviation calculated for 242 minibus taxis were 37.2 km/h and ± 7.4 km/h respectively. In Figure 32, it can be seen that more 95 percent of minibus taxis approached signalised intersection at a speed of less than or slightly above 75 km/h. This speed is eighteen kilometres higher than the urban posted speed limit of 60km/h used in the Appendix 25 for classification minibus taxi drivers' aggressive approaching speed at onset of yellow lights.

Table 15 Frequency distribution table for set of minibus taxis' intersection approaching speed data

Speed class (km/h)	Mid-values	Frequency	(fi*xi)	$(xi - X)^2$	Percent (%)	Cum. (%)
0 - 5	2.5	1	3	1202.0	0.4	0.4
5 - 10	7.5	4	30	880.3	1.7	2.1
10 - 15	12.5	17	213	608.6	7.0	9.1
15 - 20	17.5	37	648	386.9	15.3	24.4
20 - 25	22.5	23	518	215.2	9.5	33.9
25 - 30	27.5	23	633	93.5	9.5	43.4
30 - 35	32.5	16	520	21.8	6.6	50.0
35 - 40	37.5	34	1275	0.1	14.0	64.0
40 - 45	42.5	14	595	28.4	5.8	69.8
45 - 50	47.5	11	523	106.7	4.5	74.4
50 - 55	52.5	12	630	235.0	5.0	79.3
55 - 60	57.5	6	345	413.3	2.5	81.8
60 - 65	62.5	15	938	641.6	6.2	88.0
65 - 70	67.5	10	675	919.9	4.1	92.1
70 - 75	72.5	11	798	1248.2	4.5	96.7

75 - 80	77.5	2	155	1626.6	0.8	97.5
80 - 85	82.5	5	413	2054.9	2.1	99.6
85 - 90	87.5	1	88	2533.2	0.4	100.0
Total		242	8995	13216.2	100.0	100.0

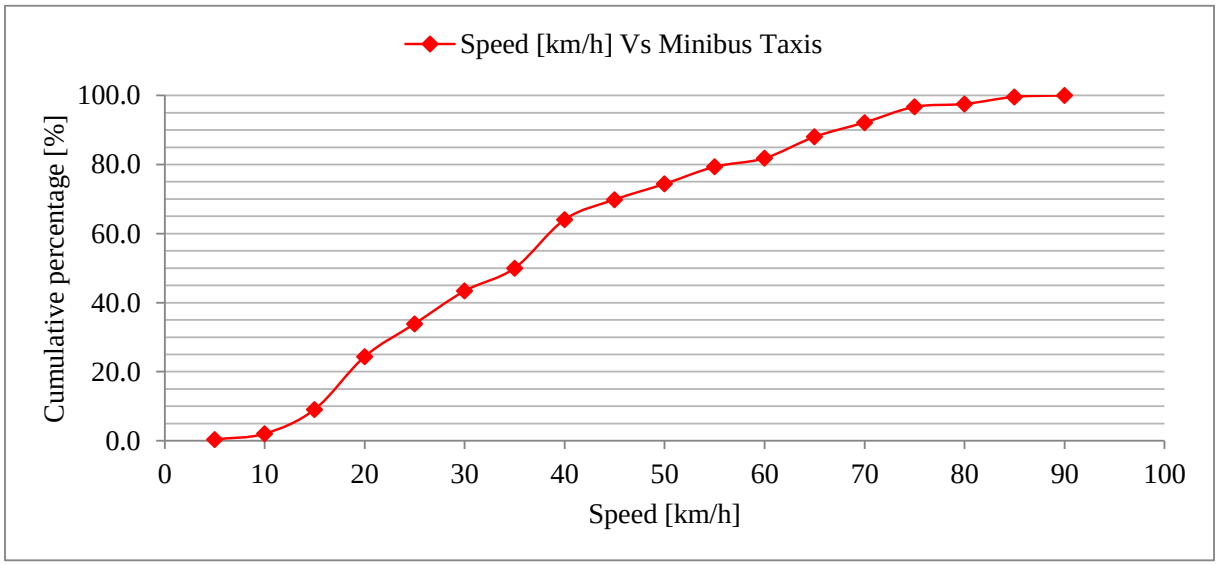


Figure 32 Cumulative distribution of taxi drivers' approaching speeds at onset of YL

In addition to the distance from stop line and time to intersection, the speed change behaviour was investigated for further characterisation of minibus taxis as they approached signalised intersections. Table 16 presents numbers of minibus taxis that accelerated at the onset of yellow lights to run red lights as they were driving towards signalised intersections. In a total of 242 minibus taxis studied, 120 (49.5%) accelerated to clear the intersection before the red signal whereas 122 (50.5%) reduced their travelling speeds to stop at the stop line.

Table 16 Frequency distribution table for set of minibus taxis' speed change behaviour data

Distance (m)	Mid-values (m)	Minibus taxis' speed change behaviour at onset of Yellow Light					
		Accelerated minibus taxis			Decelerate minibus taxis		
		Frequency	%	Cum. %	Frequency	(%)	Cum. (%)
0 - 5	2.5	3	2.5	2.5	1	0.8	0.8
5 - 10	7.5	16	13.3	15.8	2	1.6	2.5
10 - 15	12.5	17	14.2	30.0	8	6.6	9.0
15 - 20	17.5	14	11.7	41.7	17	13.9	23.0
20 - 25	22.5	12	10.0	51.7	16	13.1	36.1
25 - 30	27.5	5	4.2	55.8	13	10.7	46.7
30 - 35	32.5	9	7.5	63.3	21	17.2	63.9

35 - 40	37.5	16	13.3	76.7	9	7.4	71.3
40 - 45	42.5	10	8.3	85.0	5	4.1	75.4
45 - 50	47.5	5	4.2	89.2	4	3.3	78.7
50 - 55	52.5	2	1.7	90.8	2	1.6	80.3
55 - 60	57.5	2	1.7	92.5	6	4.9	85.2
60 - 65	62.5	0	0.0	92.5	5	4.1	89.3
65 - 70	67.5	2	1.7	94.2	5	4.1	93.4
70 - 75	72.5	5	4.2	98.3	3	2.5	95.9
75 - 80	77.5	2	1.7	100.0	5	4.1	100.0
Total		120	100	100.0	122	100	100.0

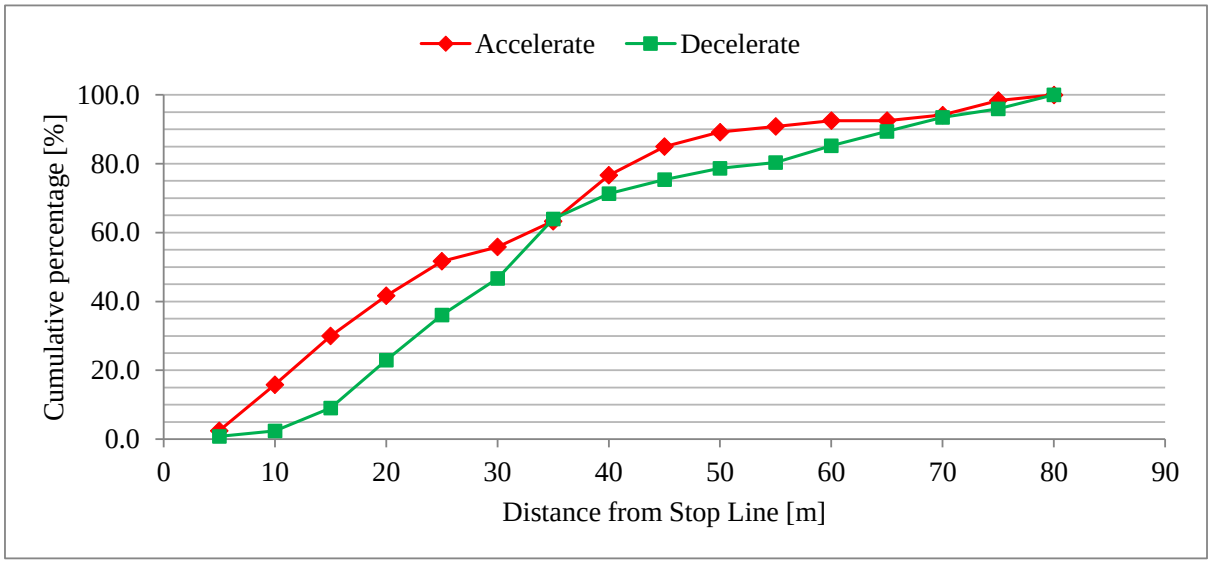


Figure 33 Cumulative distributions of minibus taxis' speed change behaviours

Figure 33 shows that approximately 60 percent of the vehicles that accelerated to clear the intersection before the red signal were at a distance of less than 28.0 meters. At this point, the cumulative percentage of minibus taxis that accelerated and that of minibus taxis that reduced the speed to stop at the stop line was equal. The frequency of accelerated minibus taxis was always higher than that of decelerated minibus taxis. It is also evident that more than 95 percent of minibus taxis that accelerated i.e. 114 out of 120 were at a distance of less than or slightly above 70 meters away from the stop line.

4.2.2.2 Frequency of minibus taxis' red light running and stop line violations

In a total of 5,556 minibus taxis that approached two signalised intersections as platoon leaders, only 242 approached exactly at the onset of yellow lights. Of these, 145 (60%) minibus taxis ran red lights, 51 (21%) violated the stop line, and only 46 (19%) managed to stop before the stop line. In Figure 34, the frequency of red light running and stop line violations by minibus taxi drivers increased between 1

and 4 seconds time to intersection and started to decrease from 5 to 9 seconds. The numbers of minibus taxis that stopped without violating stop line as well as those that crossed the stop line to stop increased with the TTI. In Figure 34, it can be seen that ninety five percent (95%) of minibus taxis that ran red lights used a TTI less than or equal to 4 seconds.

Table 17 Frequency distribution table for set of minibus taxis' aggressive stopping options data

TTI (sec)	Minibus taxi drivers' stopping options								
	Stopped before stop line			Crossed stop line			Red Light Running		
	fi	%	cum. %	fi	%	cum. %	fi	%	cum. %
0 - 1	0	0.0	0.0	0	0.0	0.0	0	26.2	26.2
1 - 2	0	0.0	0.0	0	9.8	9.8	38	37.9	64.1
2 - 3	0	10.9	10.9	5	31.4	41.2	55	24.1	88.3
3 - 4	5	28.3	39.1	16	27.5	68.6	35	7.6	95.9
4 - 5	13	34.8	73.9	14	11.8	80.4	11	2.1	97.9
5 - 6	16	13.0	87.0	6	9.8	90.2	3	2.1	100.0
6 - 7	6	10.9	97.8	5	5.9	96.1	3	0.0	100.0
7 - 8	5	2.2	100.0	3	2.0	98.0	0	0.0	100.0
8 - 9	1	0.0	100.0	1	2.0	100.0	0	0.0	100.0
Total	46	100.0	100.0	51	100.0	100.0	145	100.0	100.0

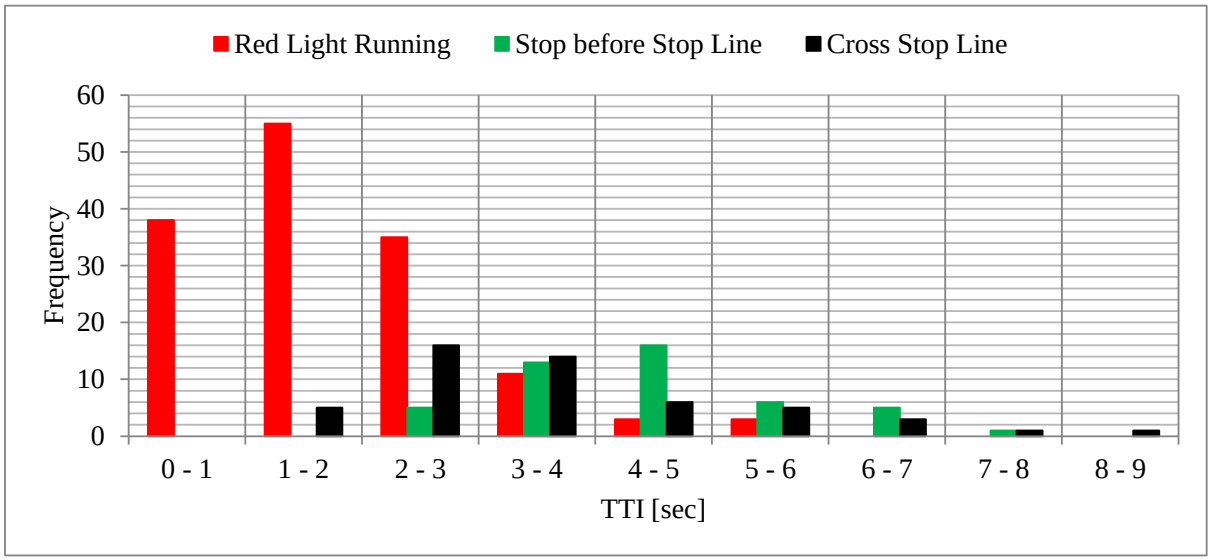


Figure 34 Frequency distributions of minibus taxi drivers' stopping options

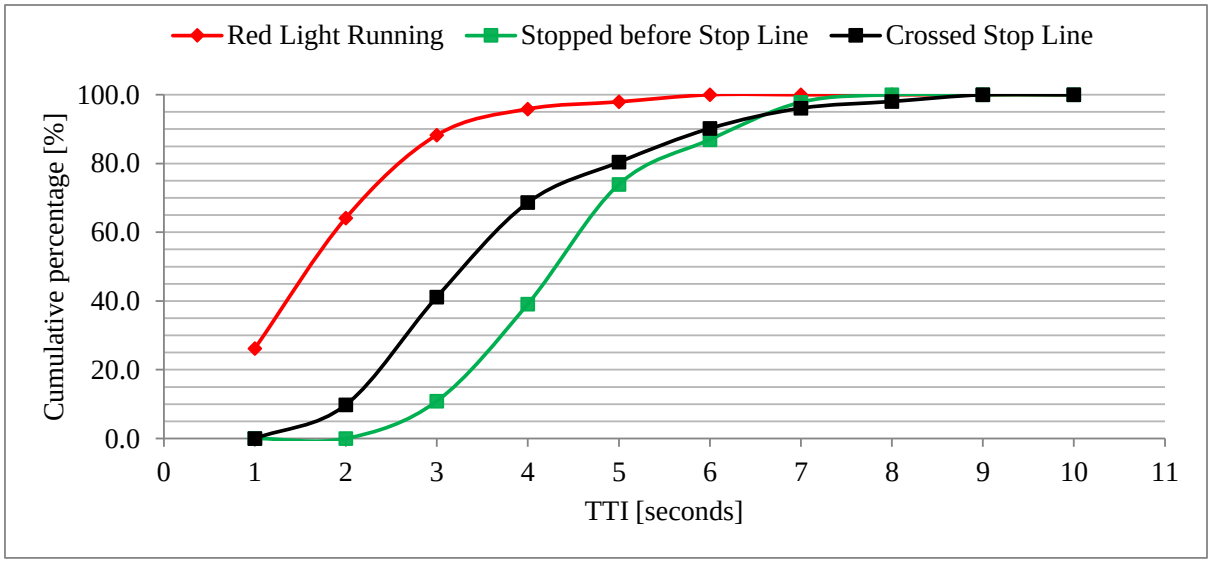


Figure 35 Cumulative distribution of minibus taxis' stopping options

For red light running and stop line violation behaviours to be coded as aggressive, minibus taxis' TTI and intersection approaching speed were determined. Thus, red light running and stop line violations accompanied with a TTI greater than 2 seconds (Lower boundary of Yellow Time Dilemma Zone) or with an intersection approaching speed of more than 60 km/h (Appendix 25) were coded as aggressive behaviours. In the event that the computed TTI for minibus taxi red light runner or stop line violator was less than or equal to two seconds or in the case the computed intersection approaching speed was less than or equal to 60 km/h, the red light running or stop line violation behaviour was coded as non-aggressive. For minibus taxis whose drivers chose to decelerate at the onset of yellow lights and stop before Stop Line, their manoeuvres were coded as non-aggressive. In Table 18, crossing stop line, running red lights at TTI of greater than 2 seconds, and approaching signalised intersection at a speed greater than 60 km/h were considered as aggressive. In 144 minibus taxis that used TTI greater than two seconds (TTI > 2 seconds) to move from their positions at onset of yellow light up to the stop line; 52 (36 %) of them run red light; 46 (32 %) violated the stop line; and 46 (32 %) stopped safely without crossing the stop line. For minibus taxis that approached with speeds greater than 60 km/h, 39 (91 %) ran red lights, 3 (7 %) violated the stop line, and 1 (2 %) safely stopped before the stop line.

Table 18 Minibus taxis' stopping options at TTI > 2 seconds and speed > 60 km/h

Minibus taxis' aggressive RLR	Minibus taxis' stopping options			
	Crossed Stop Line	Ran Red Light	Stopped before Stop Line	Total
RLR at TTI > 2 sec	46	52	46	144
RLR at S > 60 km/h	3	39	1	43
Total	49	91	47	187

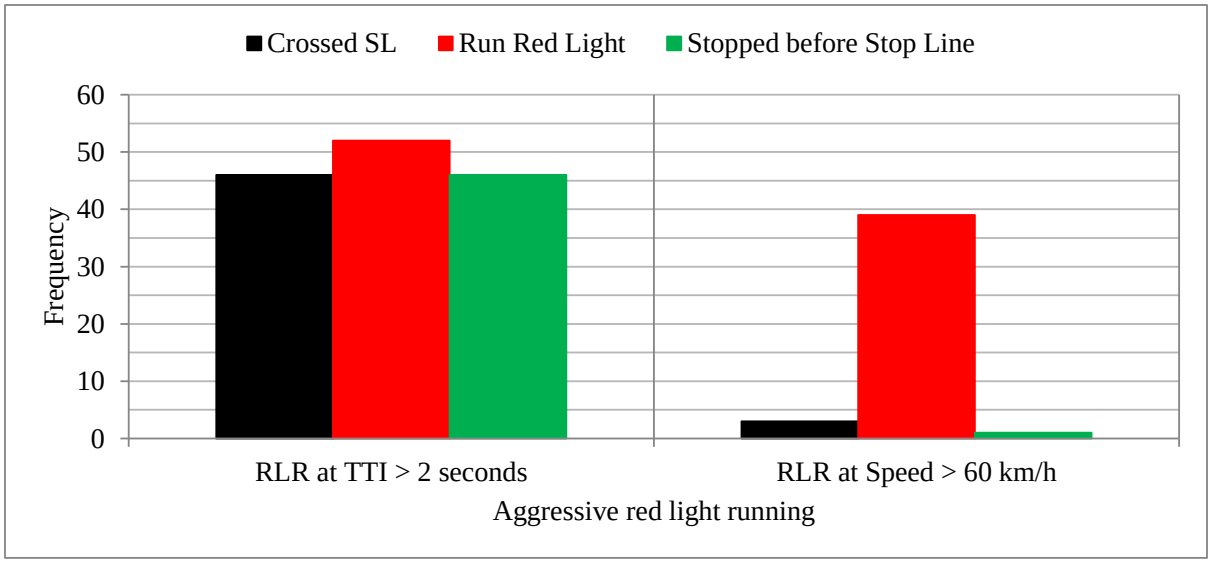


Figure 36 Frequency distribution of minibus taxis' stopping option at TTI > 2 sec, S > 60 km/h

In addition to the TTI and intersection approaching speed, the speed change behaviour of minibus taxis approaching signalised intersections at the onset of yellow lights was observed. In a situation where a minibus taxi driver increased his speed to clear the intersection before the red light, the behaviour was coded as aggressive. This behaviour was coded as non-aggressive when the minibus taxi driver decided to decelerate and stop before without crossing the stop line. In Table 19, 120 (49.5%) minibus taxis out of 242 that approached signalised intersections at onset of yellow lights accelerated to run red lights.

Table 19 Frequency distribution table for set of minibus taxis' speed change behaviour data

Speed change behaviour at onset of Yellow Light	Minibus taxi drivers' stopping options			Total
	Crossed Stop Line	Red Light Running	Stopped before Stop Line	
Accelerate	3	116	1	120
Decelerate	48	29	45	122
Total	51	145	46	242

The number of minibus taxis that accelerated or reduced speed as they were moving towards signalised intersections together with their corresponding stopping options are illustrated in **Error! Reference source not found.**. In a total of 120 minibus taxis that accelerated at the onset of yellow lights, 116 (96.7%) of them ran red lights, 3 (2.5%) crossed the stop line, and only 1 (0.8%) stopped before the stop line. When the number of minibus taxis that decelerated as they perceived yellow lights is considered, it can be seen that 45 (36.8%) stopped before the stop line, 48 (39.3%) violated the stop line, and 29 (23.7%) ran red lights. In Table 19, the number of aggressive red light running and stop line violations has increased from 140 (49 stop line violations and 91 red light running) in Table 19 to

196 (51 stop line violations and 145 red light running) in Table 19. These results suggest that when the TTI and intersection approaching speed were considered individually, some minibus taxis that cleared intersections with a speed less than 60 km/h were coded as non-aggressive although they increased their speed at the onset of yellow lights.

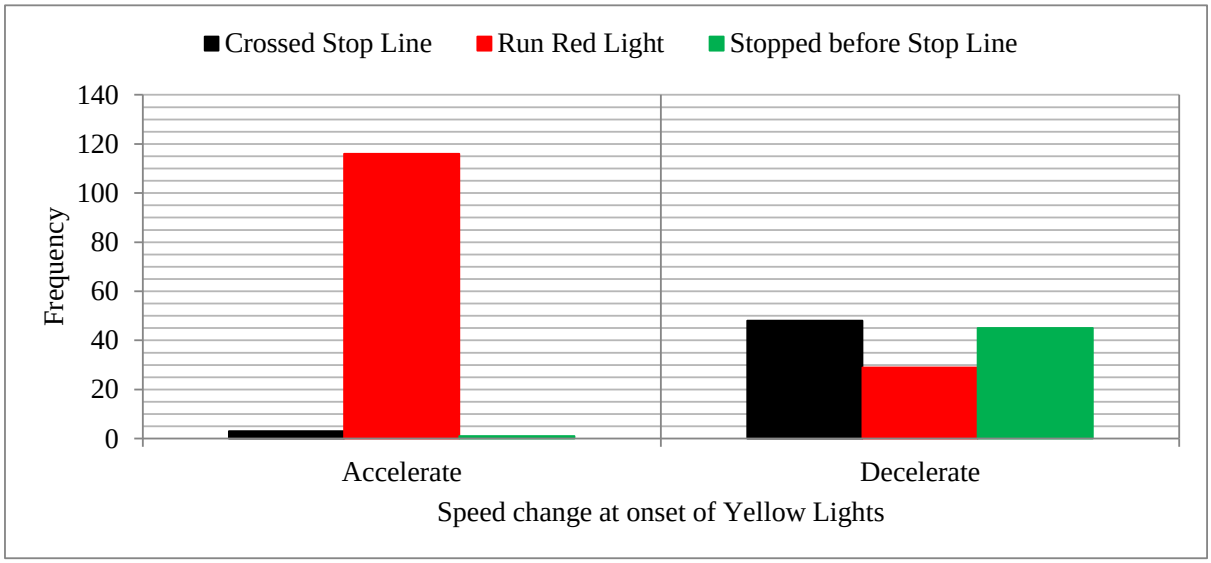


Figure 37 Distribution of minibus taxis' stopping options with respect to speed change

4.2.2.3 Response behaviours to minibus taxis' red light running and stop line violations

Two driving behaviours were observed from drivers behind minibus taxi red light runners. These drivers either decelerated or accelerated and followed minibus taxi red light runners. In addition, some of these drivers hooted at the minibus taxis to show dissatisfaction with their driving behaviours whereas others remained calm and focused on safe driving. In Appendix 25, the TTI and intersection approach speed were not estimated for drivers directly behind minibus taxi red light runners. The decision on whether drivers behind minibus taxis red light runners decided to accelerate and followed minibus taxis because it was difficult for them to safely stop was taken based on the TTI and intersection approach speed computed for minibus taxis in front. In the event that the TTI computed for minibus taxi red light runners in front was greater than 2 seconds (TTI > 2 Seconds) or the approach speed was greater than 60 km/h (S > 60km/h), the running behaviour by drivers of the vehicles behind minibus taxis were coded as aggressive responses. Table 20 illustrates the frequency of aggressive responses i.e. accelerate, hoot, and run and non-aggressive responses i.e. decelerate and stop showed by drivers of the vehicles behind minibus taxi red light runners and stop line violators. In Appendix 25, 19 (13.5%) cases out of 140 represent situations where there was no vehicle behind minibus taxi red light runners.

Table 20 Frequency table for set of response behaviours to aggressive red light running data

Taxis 'aggressive RLR behaviours	Response behaviours to minibus taxis' red light runners					Total
	Non-aggressive	Aggressive responses			Taxis not followed	
	Decelerate and stop	Accelerate and run	Decelerate, hoot &stop	Accelerate, hoot & run		
RLR at TTI > 2 sec	34	12	1	0	6	52
RLR at S > 60 km/h	17	17	3	0	5	39
Stop line violations at TTI > 2 seconds	37	1	0	0	8	46
Stop line violations speed S > 60 km/h	3	0	0	0	0	3
Total	91	30	4	0	19	140

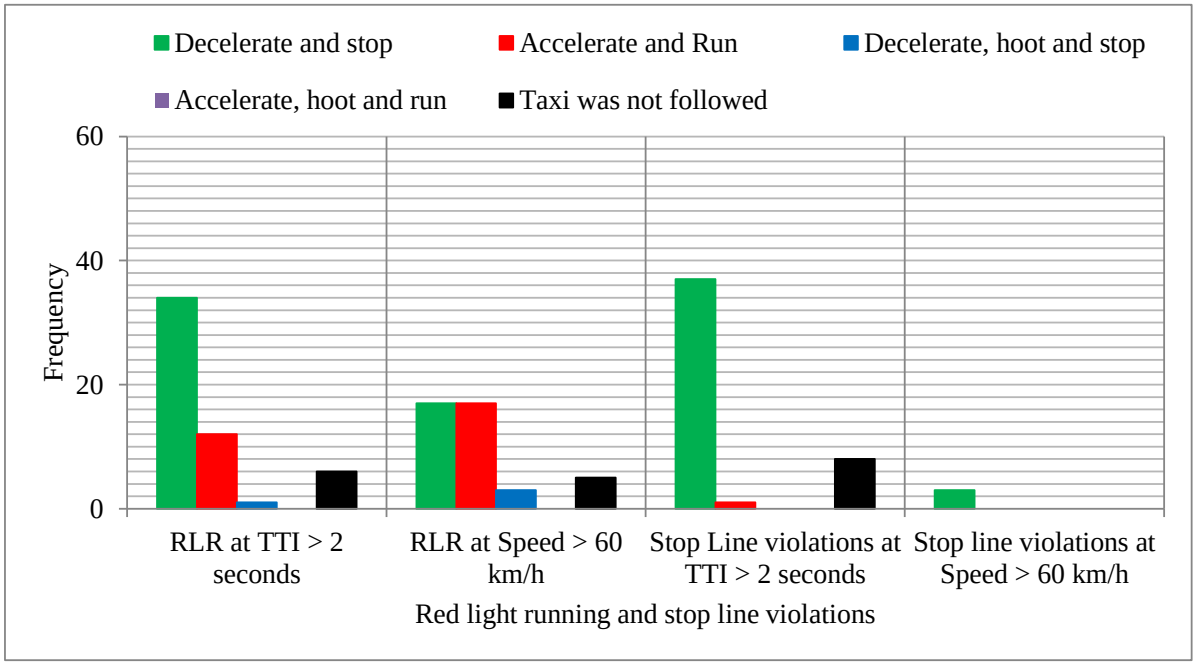


Figure 38 Frequency distribution of aggressive responses to minibus taxis' red light running

In Figure 38, the frequency of drivers behind minibus taxi red light runners and stop line violators that decelerated to stop was higher at TTI greater than 2 seconds than at a speed greater than 60 km/h. The numbers of drivers that accelerated to follow minibus taxi red light runners was again higher when the speed was greater than 60 km/h than when the TTI was greater than 2 seconds. These results suggest that minibus taxis were using a TTI less than or equal 2 seconds to travel from their position at the onset

of yellow lights to the stop line not because the distance was short but because they were driving with a speed very far from 60 km/h.

Lastly, the response behaviour to speed change behaviours by minibus taxis approaching signalised intersections at the onset of yellow lights was investigated. Figure 39 shows the frequency of drivers that accelerated and followed minibus taxis as the latter increased their speeds to clear intersections before the red light comes. These unsafe driving behaviours were coded as aggressive responses.

Table 21 Frequency distribution table for set of responses to speed change behaviour data

Speed change and aggressive red light running	Responses to minibus taxis' speed change behaviours					Total
	Non-aggressive	Aggressive responses			Taxi not followed	
	Decelerate and stop	Accelerate and run	Decelerate, hoot and stop	Accelerate, hoot and run		
Accelerate and RLR	43	46	4	0	27	116
Decelerate and RLR	17	9	0	0	3	29
Accelerate and cross stop line	3	0	0	0	0	3
Decelerate and cross stop line	39	1	0	0	8	48
Total	102	56	4	0	38	196

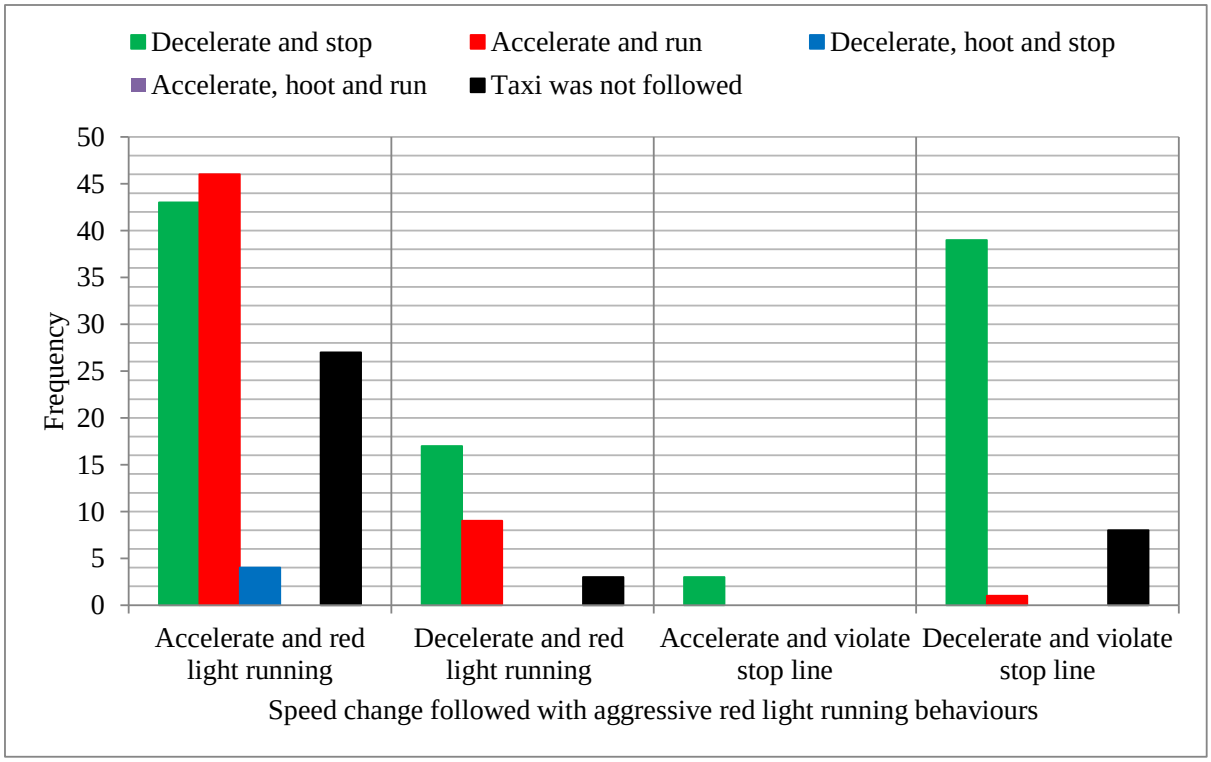


Figure 39 Frequency distributions of responses to minibus taxis' speed change behaviours

Table 21 shows that in a total of 92 drivers that were behind 92 minibus taxis (89 red light runners and 3 stop line violators) that accelerated to run red lights, 46 (50%) accelerated and followed minibus taxis whereas 46 (50%) decelerated and stopped before stop line. In summary, 56 (28.5%) drivers that were behind 196 minibus taxis involved in speed change behaviours, accelerated and followed minibus taxi red light runners, 102 (52.0%%) drivers decelerated and stopped before stop line. The rest 38 (19.5%) cases constituted situations where minibus taxi red light runners were not followed by other vehicles.

4.2.2.4 Discussion

Two evaluation indices i.e. Time to Intersection (TTI) and intersection approach speed were identified to examine the nature and the frequency of minibus taxis' aggressive red light running and stop line violations. In addition, the speed change behaviours of minibus taxis approaching signalised intersections as platoon leaders at the onset of yellow lights was examined. The mean distance and standard deviation calculated for 242 minibus taxis that approached signalised intersections at the onset of yellow lights were 31.7 meters and ± 5.9 meters respectively. In Figure 30, 95 percent of all minibus taxis observed were at a distance of less than or slightly equal to 70 meters at the onset of yellow lights. The mean TTI calculated was 3.7 seconds and standard deviation was equal to ± 0.7 seconds. In Figure 31, 95 percent of taxis used a travel time of less than or equal to 7.0 seconds to move from their positions at yellow lights to the stop line. The mean intersection approaching speed was 37.2 km/h and standard deviation was equal to ± 7.4 km/h.

In Figure 32, 98 percent of minibus taxis approached signalised intersections with a traveling speed less than 78 km/h. Finally, the speed change behaviours for minibus taxis facing yellow lights were observed. In total, 122 (50.4%) minibus taxis decelerated as they perceived yellow lights whereas 120 (49.6%) accelerated to clear intersections before the red light comes.

In Table 18, 49 (26.2%) stop line violations and 91 (48.7%) red light running behaviours were coded as aggressive red light running behaviours whereas 47 (25.1%) were coded as non-aggressive. These numbers were 51 (26.0%) stop line violations and 145 (74%) red light running when the speed change behaviours by minibus taxi drivers were considered. The increment of 56 aggressive red light running behaviours was due to the fact that when a TTI was greater than 2 seconds and a speed greater than 60 km/h were considered, some minibus taxis appeared to approach with a speed less than 60km/h but increased a little bit their speed as they perceived yellow lights and cleared intersections before the red light comes. However, this behaviour of accelerating instead of decelerating at yellow light displays was always coded as aggressive. In total, 196 aggressive red light running behaviours (145 red light running and 51 stop line violations) were coded from 242 minibus taxis that approached signalised intersections as platoon leaders at the onset of yellow lights.

In Table 20, it can be seen that when the TTI greater than 2 seconds and intersection approach speed greater than 60 km/h were taken into consideration, 91 (65%) drivers that were behind minibus taxis decelerated and stopped, 30 (21.5%) accelerated and followed taxi red light runners, and 4 decelerated but hooted at the taxis. In the remaining 19 (13.5%) cases, minibus taxi red light runners were not followed. In total, 34 (28.0%) response behaviours out of 121 were coded as aggressive whereas 87 (72%) were coded as non-aggressive responses. In Table 21, when the speed change behaviour of minibus taxis approaching signalised intersections was considered, 98 (50.0%) drivers behind minibus taxis red light runners decelerated and stopped before the stop line, 56 (28.5%) accelerated and followed red light runners, and 4 (2.0%) decelerated but hooted at minibus taxis. In the remaining 38 (19.5%) cases, minibus taxis were not followed. In total, 60 (38.0%) aggressive response behaviours (56 drivers followed minibus taxi red light runners and 4 drivers hooted continuously at minibus taxi red light runners) and 89 (62.0%) non-aggressive responses were coded.

4.2.3 Improper passing behaviours by minibus taxi drivers

Five different types of minibus taxi drivers' improper passing manoeuvres were observed in the video footage. These passing manoeuvres included: indicator use; cutting in too close; passing by driving on road shoulders or on yellow lanes; crossing solid line to pass vehicles in the next lane, and use of turn lanes as through lanes or vice versa. In order to distinguish aggressive passing manoeuvres from non-aggressive passing manoeuvres, both cutting distances and cutting angles by minibus taxi drivers were estimated. These two indices served again in classifying aggressive and non-aggressive responses from

drivers of overtaken vehicles. Table 22 summarises six types of minibus taxi drivers' improper passing manoeuvres observed in the video.

Table 22 Improper passing manoeuvres by minibus taxi drivers

Improper passing manoeuvres	Number of minibus taxis	Percent (%)
1. Failure to indicate before passing	190	31.7
2. Cutting in too close in front of cars	259	43.2
3. Passing on road shoulders or on yellow lanes	17	2.8
4. Use of turning lanes to pass vehicles in front	88	14.7
5. Use of through lanes to turn	69	11.5
6. Cross solid lines to pass cars in the next lanes	166	27.8

4.2.3.1 Characterisation of minibus taxis' improper passing manoeuvres

In order to characterise minibus taxi drivers' improper passing manoeuvres, both minibus taxis' cutting distances and cutting angles were estimated. Firstly, the distance between two moving vehicles in order to accommodate a cutting minibus taxi named (S_{d1}) was estimated. Secondly, the distance between the cutting minibus taxi and the vehicle that is being overtaken named (S_{d2}) was determined. Thirdly, the cutting angle (θ) between the cutting minibus taxi and the vehicle being overtaken was estimated from a computer screen where road markings were obscured and it was impossible to estimate neither S_{d1} nor S_{d2}. Figure 40 illustrates cutting distances (S_{d1}) estimated between two following cars during minibus taxis cutting manoeuvres.

Table 23 Frequency distribution table for set of minibus taxis' cutting distance S_{d1} data

Cutting distance (m)	Mid-values	Frequency	(fi*xi)	$(xi-X)^2$	Percent (%)	Cum. (%)
0 - 5	2.5	1	2.5	69.3	0.5	0.5
5 - 10	7.5	98	735	11.1	45.0	45.4
10 - 15	12.5	95	1187.5	2.8	43.6	89.0
15 - 20	17.5	21	367.5	44.5	9.6	98.6
20 - 25	22.5	3	67.5	136.3	1.4	100.0
Total		218	2360	264.0	100.0	100.0

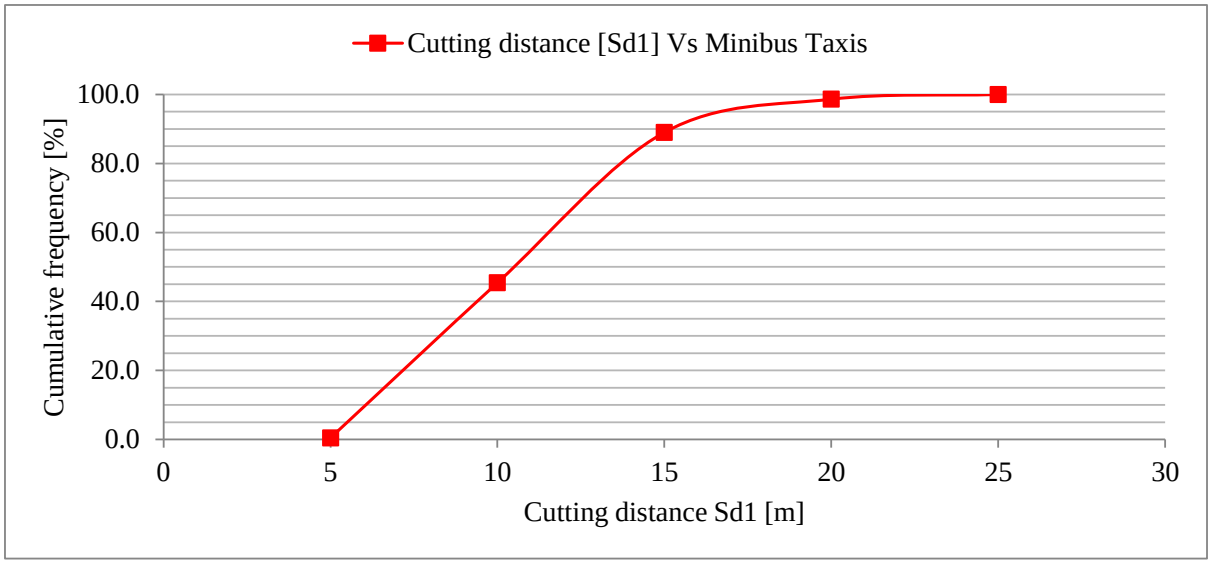


Figure 40 Cumulative distribution of minibus taxis' cutting distances [Sd1]

In Figure 40, it is seen that 95 percent of minibus taxis cut in with S_{d1} less than or slightly above 15 meters. The mean cutting distance and standard deviation calculated are 10.8 meters and ± 1.1 meters. The mean cutting distance equal to 10.8 meters was smaller than the estimated cutting distance S_{d1} of 12.5 meters in Figure 21. Table 24 presents values of distances measured between cutting minibus taxis and vehicles being overtaken (S_{d2}). The mean S_{d2} was 2.3 meters and standard deviation was equal to ± 0.5 meters. The cutting distance equal to 2.3 meters was smaller than the estimated S_{d2} of 4.0 meters. Figure 41 it is seen that more than 95 percent of taxis cut in with an S_{d2} less than or equal to 4.5 meters.

Table 24 Frequency distribution table for set of minibus taxis' cutting distance S_{d2} data

Cutting distance (m)	Mid-values	Frequency	(fi*xi)	$(xi - X)^2$	Percent (%)	Cum. (%)
0 - 1	0.5	43	21.5	3.4	19.7	19.7
1 - 2	1.5	62	93	0.7	28.4	48.2
2 - 3	2.5	42	105	0.0	19.3	67.4
3 - 4	3.5	49	171.5	1.3	22.5	89.9
4 - 5	4.5	12	54	4.6	5.5	95.4
5 - 6	5.5	3	16.5	10.0	1.4	96.8
6 - 7	6.5	3	19.5	17.3	1.4	98.2
7 - 8	7.5	4	30	26.6	1.8	100.0
Total		218	511	63.9	100.0	100.0

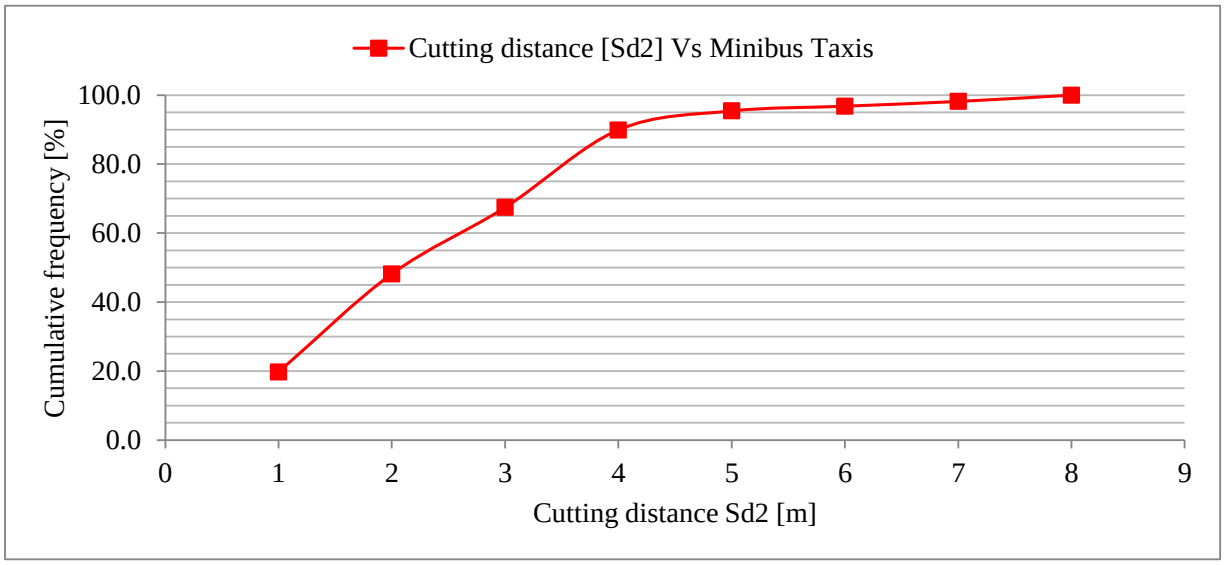


Figure 41 Cumulative distribution of minibus taxis' cutting distances [Sd2]

Lastly, the cutting angles between minibus taxis and vehicles being overtaken were estimated. Figure 41 shows that 95 percent of minibus taxis cut at an angle less than or equal to 53.0°. In Table 25, the calculated mean cutting angle was 35.7 degrees and standard deviation was equal to ± 11.1 degrees.

Table 25 Frequency distribution table for set of minibus taxis' cutting angle data

Cutting angle (θ)	Mid-values	Frequency (fi)	(fi*xi)	$(xi - X)^2$	Percent (%)	Cum. (%)
0 - 5	2.5	0	0	1101.7	0.0	0.0
5 - 10	7.5	0	0	794.8	0.0	0.0
10 - 15	12.5	1	12.5	537.8	2.1	2.1
15 - 20	17.5	3	52.5	330.9	6.4	8.5
20 - 25	22.5	9	202.5	174.0	19.1	27.7
25 - 30	27.5	8	220	67.1	17.0	44.7
30 - 35	32.5	4	130	10.2	8.5	53.2
35 - 40	37.5	5	187.5	3.3	10.6	63.8
40 - 45	42.5	4	170	46.4	8.5	72.3
45 - 50	47.5	4	190	139.4	8.5	80.9
50 - 55	52.5	4	210	282.5	8.5	89.4
55 - 60	57.5	3	172.5	475.6	6.4	95.7
60 - 65	62.5	1	62.5	718.7	2.1	97.9
65 - 70	67.5	1	67.5	1011.8	2.1	100.0
Total		47	1531	4932.7	100.0	100.0

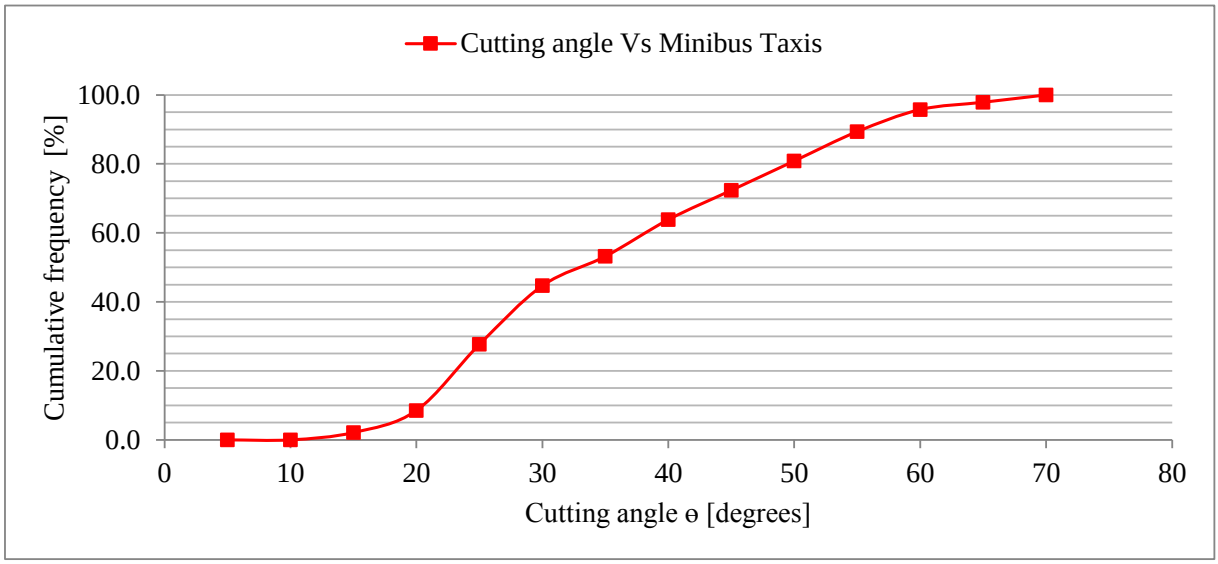


Figure 42 Cumulative distribution of minibus taxis' cutting angles [θ]

4.2.3.2 Frequency of minibus taxis' aggressive passing behaviours

For a minibus taxi's passing manoeuvre to be coded as aggressive in Appendix 26, three evaluation indices (indicator use before cutting, estimated S_{d2} and θ) in Table 6 have to be checked. In Appendix 26, when the cutting distance S_{d2} estimated from video footage was less than the S_{d2} computed of 4.0

m, the cutting manoeuvre by minibus taxi drivers was coded as aggressive. In the event that the estimated cutting distance S_{d2} was greater than 4.0 m computed, the cutting manoeuvre was coded as non-aggressive. Minibus taxis' passing behaviours such as passing on road shoulders or on the yellow lane, crossing the continuous line to pass, and inappropriate lane utilisation were coded as aggressive with no difficulty from video footage. Table 26 illustrates minibus taxis' aggressive and non-aggressive passing manoeuvres.

Table 26 Minibus taxis' aggressive and non-aggressive passing manoeuvres

Minibus taxis' passing manoeuvres	Indicator use		Cutting distance (m)		Cutting angle (degrees)		Aggress passing	Non-aggress	Total
	Yes	No	$S_{d2} \leq 4.0$	$S_{d2} > 4.0$	$\theta \leq 20$	$\theta > 20$			
Cutting in too Close	222	37	192	20	8	39	231	28	259
Pass by driving on road shoulders	13	4	-	-	-	-	17	0	17
Pass from turning lane	14	74	-	-	-	-	88	0	88
Turn from through lane	36	33	-	-	-	-	69	0	69
Cross solid line to pass	125	42	-	-	-	-	166	0	166
Total	410	190	192	20	8	39	572	28	599

In Table 26, a cutting angle less than or equal to 20 degrees was taken as a threshold for minibus taxis' aggressive cutting manoeuvres. More details on how minibus taxi cutting angles were measured and how a cutting angle equal to 20 degrees was selected as the threshold for non-aggressive cutting manoeuvres are provided in section 4.2.3.3 and in Figure 21. In Appendix 26, minibus taxis that cut in with an angle less than or equal to 20 degrees were coded as non-aggressive while those that cut with an angle greater than 20 degrees where coded as aggressive. In Table 26, 572 (95.3%) minibus taxis' cutting manoeuvres were coded as aggressive whereas 28 (4.7%) were coded as non-aggressive passing manoeuvres. In Figure 43, the type of minibus taxis' aggressive passing that occurred more frequently was cutting in too close in front of cars 231 (40.4%), followed by crossing continuous line to pass 166 (29.2%), inappropriate lane utilisation 157 (27.4%), and driving on road shoulders or on yellow lanes to pass vehicles 17 (3.0%).

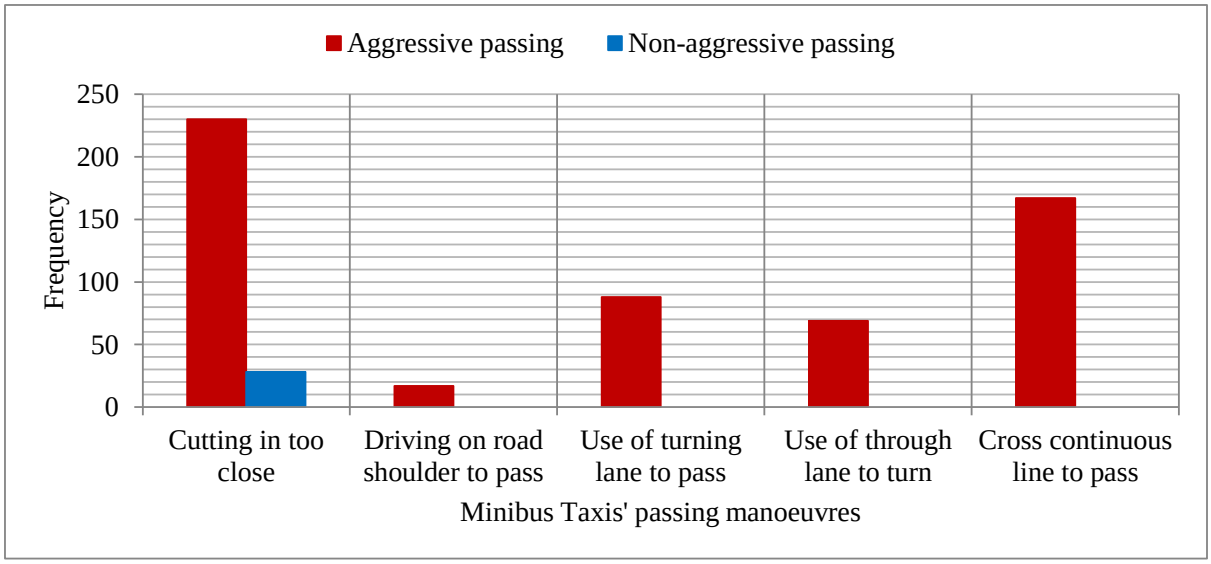


Figure 43 Frequency of aggressive and non-aggressive minibus taxis' passing manoeuvres

4.2.3.3 Behaviours of victims of minibus taxis' aggressive passing manoeuvres

Table 27 illustrates response behaviours showed by drivers of the overtaken vehicles with respect to types of minibus taxis' aggressive passing manoeuvre experienced. The column named "none" in the table represents cases where improper passing minibus taxis were not followed.

Table 27 Response behaviours to minibus taxis' aggressive passing manoeuvres

Taxis' aggressive passing manoeuvres	Response behaviours to minibus taxis' aggressive passing					Total
	Decelerate	Accelerate	Swerve	Stop	None	
Cutting in too close	96	6	45	112	0	259
Driving on road shoulder to pass	4	5	5	3	0	17
Utilisation of turning lane to pass	53	26	3	5	1	88
Utilisation of through lane to pass	45	13	2	9	0	69
Crossing solid line to pass	75	11	52	9	20	167
Total	273	61	107	138	21	600

In Table 27, 112 (81.0%) drivers out of 138 that stopped completely had experienced cutting manoeuvres from minibus taxi drivers. The number of drivers that accelerated was higher for the use of turning lane to pass manoeuvre (26 out of 61) than for the rest four passing manoeuvres. High frequencies of vehicles that swerved to the next lane were found for improper passing behaviours such as crossing continuous lane to pass (52 out of 107) and cutting in too close in front of cars (45 out of 107). In Figure 44, it can be seen that the frequency of vehicles that decelerated regardless of the type of improper passing manoeuvre was higher than that of accelerated and swerved vehicles. These results

suggest that victims of improper passing manoeuvres were more affected by cutting in too close behaviours (112 stopped, 45 swerved to the next lane, 6 accelerated, and 96 decelerated) and by crossing continuous to pass (9 stopped, 52 swerved to the next lane, 11 accelerated, 75 decelerated).

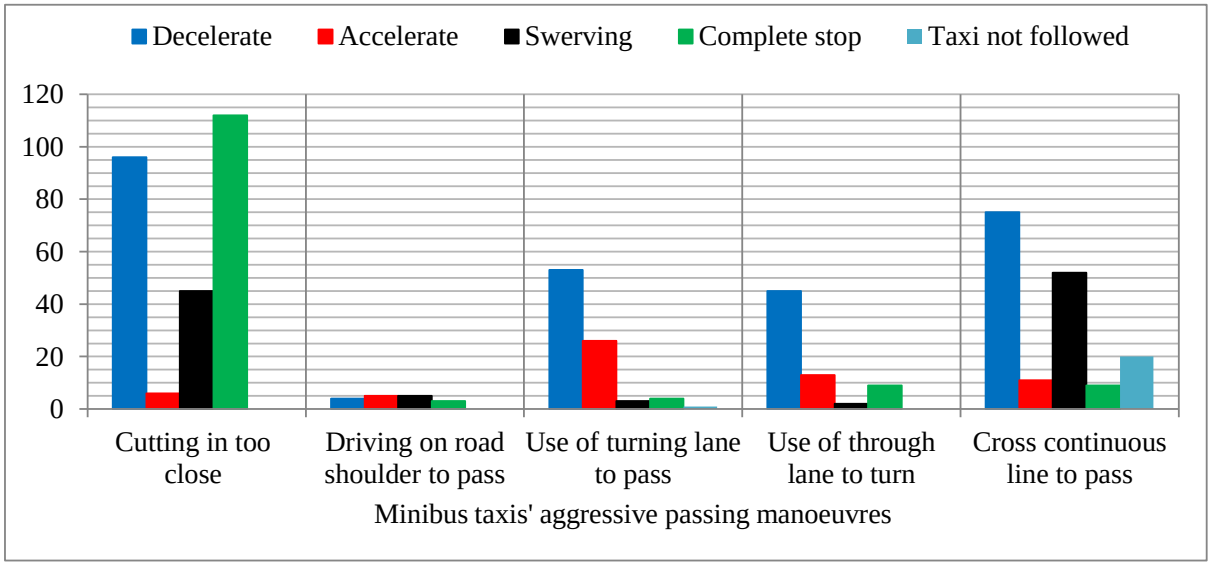


Figure 44 Frequency distribution of responses to minibus taxis' passing manoeuvres

Furthermore, response manoeuvres of victims of minibus taxis' improper passing manoeuvres were observed taking into account both minibus taxis' cutting distances and cutting angles. Table 28 shows responses of drivers of the overtaken vehicles as a function of minibus taxis' cutting distances.

Table 28 Frequency table for set of response manoeuvres to minibus taxis' cutting distance data

Cutting distance S_{d2} (m)	Response manoeuvres as function of minibus taxi drivers' cutting distances											
	Decelerate			Accelerate			Swerving			Complete stop		
	(fi)	(%)	Cum	(fi)	(%)	Cum	(fi)	(%)	Cum	(fi)	(%)	Cum
1	2	2.6	2.6	1	16.7	16.7	5	13.9	13.9	34	34.7	34.7
2	14	18.2	20.8	0	0.0	16.7	8	22.2	36.1	40	40.8	75.5
3	16	20.8	41.6	3	50.0	66.7	6	16.7	52.8	17	17.3	92.9
4	29	37.7	79.2	1	16.7	83.3	12	33.3	86.1	7	7.1	100
5	9	11.7	90.9	0	0.0	83.3	3	8.3	94.4	0	0.0	100
6	2	2.6	93.5	1	16.7	100	0	0.0	94.4	0	0.0	100
7	2	2.6	96.1	0	0.0	100	1	2.8	97.2	0	0.0	100
8	3	3.9	100	0	0.0	100	1	2.8	100.0	0	0.0	100
Total	77	100	100	6	100	100	36	100	100	98	100	100

Figure 45 illustrates cumulative distribution curves for each of the four response manoeuvres showed by overtaken vehicles as a function of minibus taxis' cutting distances. Around 95 percent of overtaken

vehicles experienced complete stop at a cutting distance of less than or slightly above 3.0 m, 95 percent swerved at a cutting distance less than or equal to 5 m, and 95 percent of the vehicles that accelerated were at a cutting distance of less than or equal to 5 m. These results suggest that as the minibus taxi drivers' cutting distance increases, overtaken drivers tended to either swerve to the next lane or increase the speed in response frustrating situations created by cutting minibus taxis.

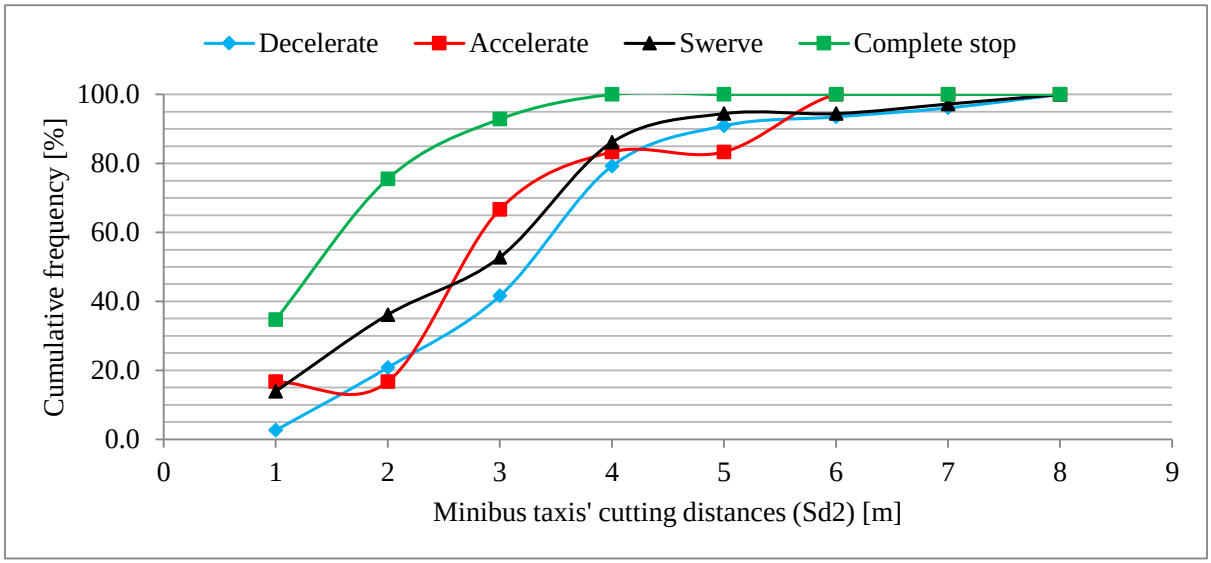


Figure 45 Cumulative distribution responses as a function of minibus taxis' cutting distances

Table 29 displays response manoeuvres of overtaken drivers as a function of minibus taxis' cutting angles. The response behaviours for 47 out of 259 vehicles cut off by minibus taxis were examined after measuring cutting angles between them and the cutting minibus taxis. Here, road markings on the video were obscured and it was difficult to estimate the cutting distances between vehicles. In Figure 46, it can be seen that twenty five percent (15%) of overtaken drivers decelerated at a cutting angle of less than or equal to 20 degrees. At this cutting angle, no vehicle stopped completely. However, only two overtaken vehicles swerved to the next lane and continued their movements. Slightly above to the right hand of the curve in Figure 46, 7 (60%) overtaken vehicles decelerated whereas 3 (46.2) swerved to the left for a cutting angle equal to 23 degrees. Again there was no vehicle that completely stopped. In this study, a minibus taxis' cutting angle where twenty five percent (25%) of overtaken vehicles either decelerated or swerved to the left to share lane was assumed as a threshold cutting angle for non-aggressive cutting manoeuvres. Hence, minibus taxis that cut in with an angle less or equal to 20 degrees where coded as non-aggressive whereas those that cut in with an angle greater than 20 degrees were coded as aggressive.

Table 29 Frequency table for set of response manoeuvres to minibus taxi drivers' angle data

Cutting angle Range upper boundary (θ)	Response manoeuvres as function of minibus taxi drivers' cutting angles											
	Decelerate			Accelerate			Swerving			Complete stop		
	(fi)	(%)	Cum	(fi)	(%)	Cum	(fi)	(%)	Cum	(fi)	(%)	Cum
5	0	0	0	0	0	0	0	0.0	0.0	0	0.0	0.0
10	0	0	0	0	0	0	0	0.0	0.0	0	0.0	0.0
15	1	5	5	0	0	0	0	0.0	0.0	0	0.0	0.0
20	2	10	15	0	0	0	1	7.7	7.7	0	0.0	0.0
25	6	30	45	0	0	0	3	23.1	30.8	0	0.0	0.0
30	4	20	65	0	0	0	3	23.1	53.8	1	7.1	7.1
35	2	10	75	0	0	0	0	0.0	53.8	2	14.3	21.4
40	2	10	85	0	0	0	3	23.1	76.9	0	0.0	21.4
45	1	5	90	0	0	0	1	7.7	84.6	2	14.3	35.7
50	0	0	90	0	0	0	0	0.0	84.6	4	28.6	64.3
55	2	10	100	0	0	0	1	7.7	92.3	1	7.1	71.4
60	0	0	100	0	0	0	1	7.7	100	2	14.3	85.7
65	0	0	100	0	0	0	0	0.0	100	1	7.1	92.9
70	0	0	100	0	0	0	0	0.0	100	1	7.1	100
Total	20	100	100	0	0	0	13	100	100	14	100	100

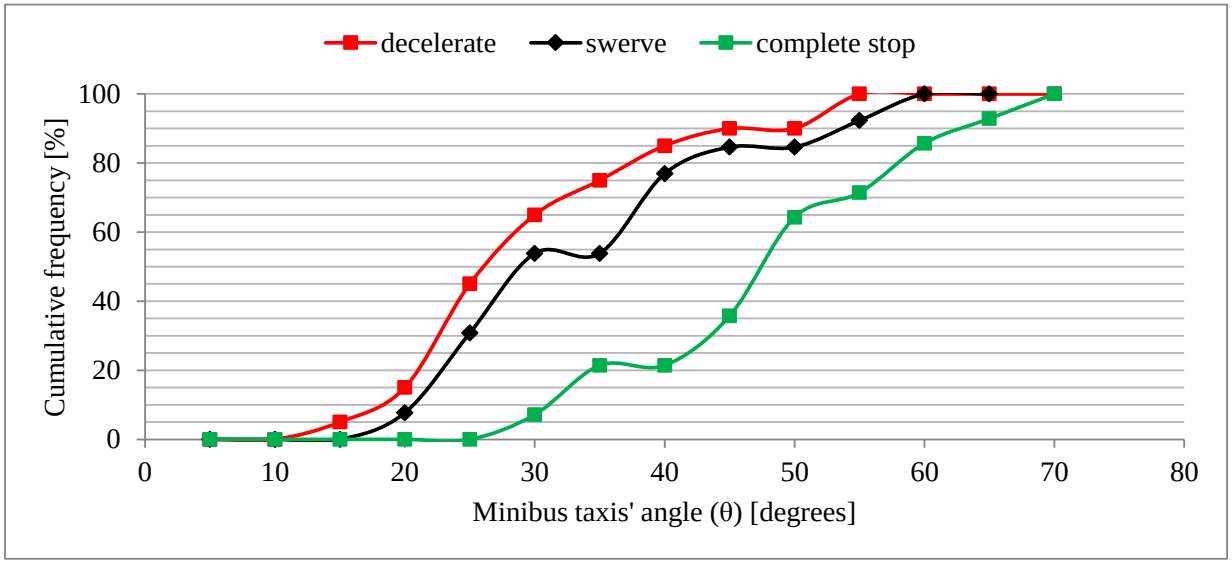


Figure 46 Cumulative distribution of responses as a function of minibus taxis' cutting angles

4.2.3.4 Prevalence of aggressive responses to the minibus taxis' improper passing

In Appendix 26, aggressive responses to minibus taxis' improper passing manoeuvres were defined as swerving to the next lane, hooting, and accelerating to prevent cooperation with cutting minibus taxis. The non-aggressive response behaviours on the other hand were braking or stopping completely and for cutting minibus taxis. As discussed previously, the hooting behaviour by overtaken drivers to express annoyance was not examined. In Table 30, 160 (28.0%) response behaviours out of 572 were coded as aggressive, 390 (68.2%) as non-aggressive responses, and 22 (3.5%) represented cases where there were no vehicles next to the passing minibus taxis.

Table 30 Frequency of response behaviours to minibus taxis' improper passing

Minibus taxis' aggressive passing manoeuvres		Aggressive response manoeuvres		Non- aggressive response manoeuvres		Cars in next lanes	Total
		Acceler.	Swerved	Deceler.	Stopped		
Cutting in too close	$S_{d2} \leq 4$ m	5	28	61	98	0	192
	$\theta \geq 20$ deg.	0	10	15	14	0	39
Passing on road shoulders		5	5	4	3	0	17
Use of turning lane to pass		26	3	54	4	1	88
Use of through lane to turn		13	2	45	9	0	69
Cross continuous line to pass		11	52	74	9	20	166
Total		60	100	253	137	22	572

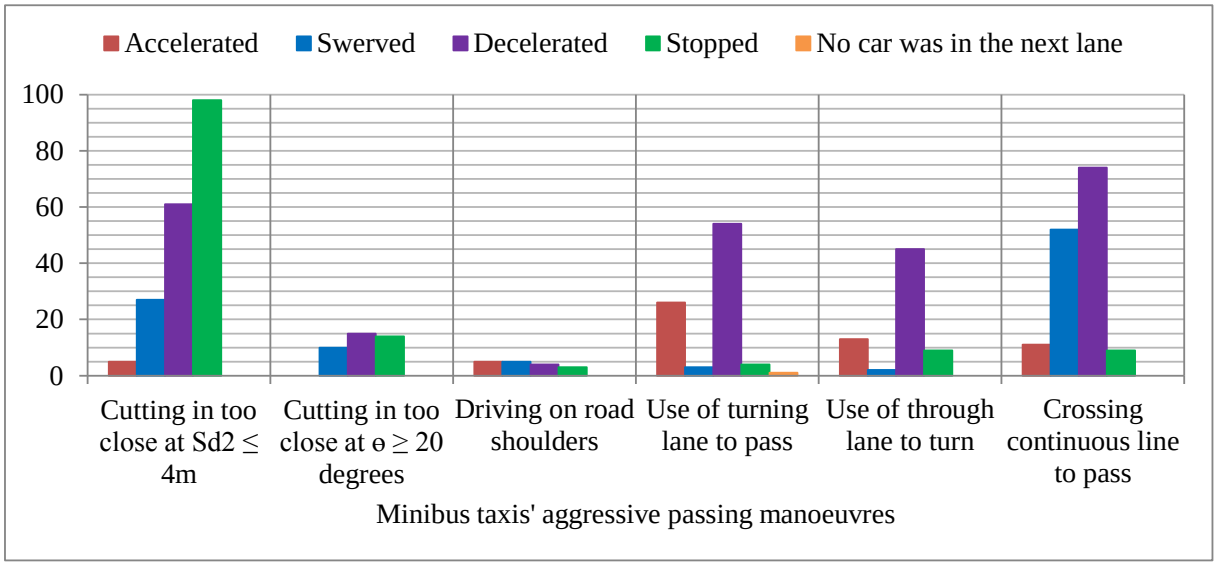


Figure 47 Frequency of response manoeuvres to minibus taxis' aggressive passing behaviours

In Figure 47, it can be seen that the frequency of non-aggressive response behaviours was higher than that of aggressive response behaviours regardless the type of improper passing manoeuvre experienced

by the victims. In Table 30, more frequent swerving manoeuvres were observed for vehicles subjected to minibus taxis' cutting in too close 28 (28.0%) and crossing the continuous line to pass vehicles in front 52 (52.0%). A high frequency of accelerating and refusing to extend cooperation with cutting minibus taxis was observed for minibus taxis' inappropriate lane utilisation behaviours (43.3% for utilisation turning lane to pass and 21.6% for utilisation of passing lane to turn).

4.2.3.5 Discussion

In Table 22, 259 (43.2%) minibus taxis out of 600 involved in improper passing behaviours cut closely in front of cars, 166 (27.8%) crossed continuous line and passed vehicles in the next lane, 17 (2.8%) drove on yellow lanes and passed vehicles in front, and 157 (26.2%) used turning lane to pass or vice versa. To examine the frequency of minibus taxis' aggressive and non-aggressive cutting manoeuvres, both cutting distances and cutting angles were estimated for minibus taxis involved in cutting behaviours. The calculated mean cutting distance and standard deviation for 218 (82.0%) minibus taxis out of 259 were 10.8 metres and ± 1.1 m whereas the mean cutting angle and standard deviation measured for 47 (18.0%) were 35.7 degrees and 11.1 degrees respectively. In Table 26, 231 (89.2%) minibus taxis' cutting manoeuvres out of 259 observed were coded as aggressive whereas 28 (10.8%) were non-aggressive cutting manoeuvres. In Table 30, the two aggressive passing manoeuvres that occurred more frequently were crossing continuous line to pass cars in front 167 (29.2%) and cutting in too close in front of cars 231 (40.4%).

Table 30 illustrates the response behaviours to the minibus taxis' improper passing manoeuvres. It seems that for improper passing behaviours such as cutting in too close in front of cars and crossing continuous line to pass vehicles in the next lane, the most frequent aggressive response observed was swerving to the next lane and continue driving (16.4% swerved against 2.2% accelerated and 31.1% swerved against 6.5% accelerated respectively). The most common aggressive response observed from drivers subjected to the minibus taxis' inappropriate lane utilisation was accelerating to prevent cooperation (28.8% accelerated against 3.0% swerved). In Table 28, it can be seen that when the minibus taxis' cutting distance increases (cutting angle increases in Table 29) the frequency of swerving vehicles reduces (swerving vehicles increase in table 29). These results support the Frustration and Aggression Model of aggressive driving proposed by Shinar (1998). In the context of this study, the frequency of aggressive responses increased with the increase of frustration i.e. increase of minibus taxis' cutting angle or decrease of minibus taxis' cutting distance.

4.3 Survey

4.3.1 Introduction

One of the major challenges in this study was the inability of the researcher to examine the effect of driver age and gender on both minibus taxis' aggressive driving behaviours and response behaviours of drivers of other vehicles directly from video footage. The researcher was unable to estimate the age of the offending minibus taxi driver or to see whether he or she was male or female. In consequence, a series of surveys were used to examine the effect of driver age and gender on the minibus taxi drivers' on-road aggressive behaviours, effect of driver age and gender on levels of anger aroused and on the response behaviours showed was examined.

This section presents results on how frequent by the minibus taxi drivers reported engaging in the six types of on-road aggressive behaviours highlighted by participants in the pilot study. It shows results on the effect of age and gender of minibus taxi drivers on those aggressive behaviours. Secondly, this part presents results on the types of minibus taxis' on-road aggressive behaviours experienced by drivers of other vehicles in the last 12 months. The effect of driver age and gender on levels of anger aroused, as well as on the response behaviours reported is presented. In addition, this part shows results on the motives of minibus taxis' on-road aggressive behaviours. This section also presents findings on whether or not there was a relationship between minibus taxi drivers' exposure time and the frequency of on-road aggressive behaviours on one hand and the link between accident history and safe driving practices on the other hand are presented. In total, results obtained from a sample of 273 drivers (91 minibus taxi drivers and 182 other drivers) interviewed are presented.

4.3.2 Minibus taxis' on-road aggressive behaviours

To examine the frequency with which minibus taxi drivers engage in the six types of aggressive on-road behaviours, a sample of 91 minibus taxi drivers was selected and surveyed. From this sample, the effect of age and gender of minibus taxi drivers on those aggressive behaviours was studied. All participants in the minibus taxi driver survey were men 91 (100%) and were mostly between the ages of 30 and 39 (35.3%). Table 31 presents some of the characteristics of the respondents.

Table 31 Characteristics of minibus taxi drivers

Item	Category	Frequency (fi)	Percent (%)
Gender	Male	91	100.0
	Female	0	0.0
Age	18 – 29	27	29.7
	30 – 39	32	35.2

	40 – 49	21	23.1
	50 and above	11	12.1
Total		91	100.0

4.3.2.1 Prevalence of minibus taxis' on-road aggressive behaviours

The frequencies of taxi drivers' aggressive behaviours were determined in terms of the definition: There are those repeated minibus taxis' on-road behaviours which affect the movement of other drivers. Those behaviours include actions or practices that tend to harm physically or psychologically other road users, cause anger, irritation, and/or increase the risk of collisions. These actions or practices may be done deliberately or unwillingly and are all unwanted by other vehicles. This definition was adapted following the same line of thought as Dula and Geller (2003); Shinar and Compton (2004).

Frequency tables and charts were used to show the frequencies of minibus taxi drivers' aggressive on-road behaviours. Table 32 presents results obtained from 91 minibus taxi drivers. Participants were asked to specify circumstances under which they perform each of the seven on-road aggressive behaviours and how frequent they do that.

Table 32 Frequency distribution table of minibus taxi drivers' on-road aggressive behaviours

On-road aggressive behaviours	Category	Frequency (fi)	Percentage (%)
How often do you hoot at other drivers?	Never	1	1.1
	Seldom	3	3.3
	Sometimes	47	51.6
	Often	22	24.2
	Always	18	19.8
How often do you drive fast or speeding?	Never	6	6.6
	Seldom	4	4.4
	Sometimes	48	52.7
	Often	26	28.6
	Always	7	7.7
How often do you run red lights at Robots?	Never	54	59.3
	Seldom	2	2.2
	Sometimes	28	30.8
	Often	6	6.6
	Always	1	1.1
How often do you change lane without indicating?	Never	47	51.6
	Seldom	3	3.3
	Sometimes	15	16.5
	Often	16	17.6
	Always	10	11.0
How often do you cut closely in front of cars?	Never	29	31.9

	Seldom	7	7.7
	Sometimes	38	41.8
	Often	14	15.4
	Always	3	3.3
How often do you drive on road shoulder or on yellow lane to pass vehicles in front of you?	Never	50	54.9
	Seldom	6	6.6
	Sometimes	18	19.8
	Often	14	15.4
	Always	3	3.3
How often do you obstruct other traffic from moving?	Never	56	61.5
	Seldom	2	2.2
	Sometimes	25	27.5
	Often	6	6.6
	Always	2	2.2

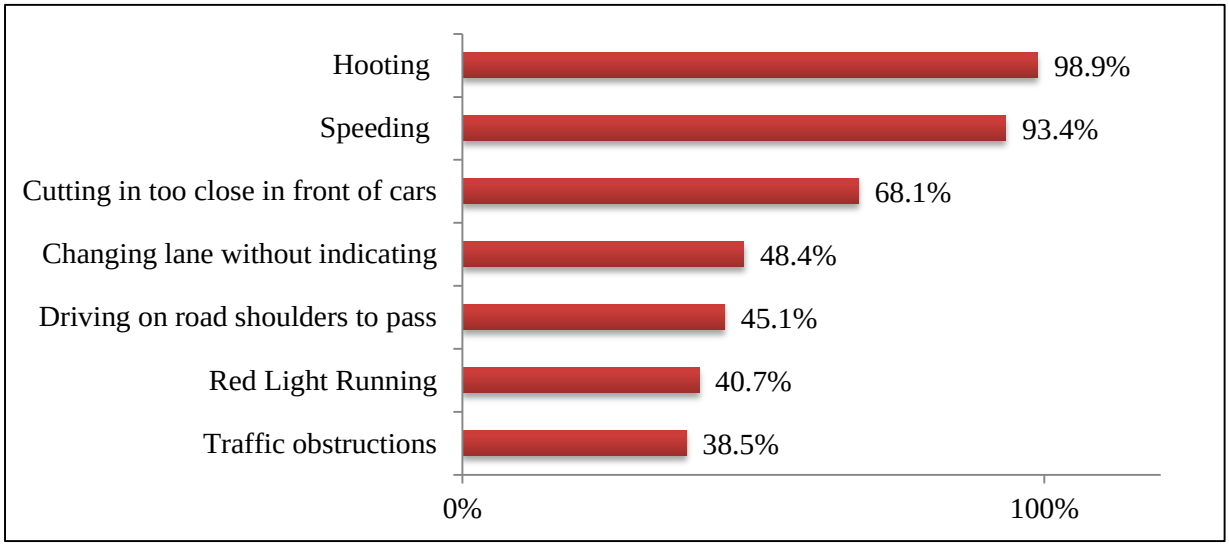


Figure 48 Respondents who agreed they perform each of the seven forms of aggressive behaviours

Figure 48 shows the seven forms of minibus taxi drivers' on-road aggressive behaviours reported by participants with respect to their chances of being performed. Seven forms of on-road aggressive behaviours are presented instead of six as highlighted in the pilot study because two different forms of improper passing manoeuvres i.e. cutting in too close in front of cars and driving on road shoulder to pass were included in questionnaires. In the sample of 91 minibus taxi drivers surveyed, 90 (98.9 %) reported to hoot at other drivers. For this same behaviour, 47 (51.6 %) reported to hoot sometimes, 22 (24.2 %) often hoot, and 18 (19.8 %) hoot almost always. The results also show that aggressive hooting was more frequent among minibus taxi drivers (98.9 %), followed by speeding (93.4), cutting in too close in front of cars (68.1 %), changing lanes without indicating (48.4 %), passing on road shoulder to pass (44.0 %), red light running (40.7 %), and traffic obstructions (38.5 %).

In Figure 49, it can be seen that minibus taxi drivers more frequently perform aggressive hooting (24.2% often hoot whereas 19.8% hoot always), exceeding speed limits (28.6% often speed whereas 7.7% speed always), and changing lanes without signalling (17.6% often fail to indicate whereas 11.0% fail to indicate always). The results also show that minibus taxi drivers less frequently run red lights (59.3% never run red lights whereas 2.2% run red lights rarely), push through on hard shoulders (54.9% never pass on road shoulders while 6.6 % drive on road shoulders rarely), and cut in too close in front of cars (31.9% never cut in too close whereas 7.7% cut in too close rarely). For almost all the seven forms of aggressive on-road behaviours, respondents agreed to sometimes perform each of them.

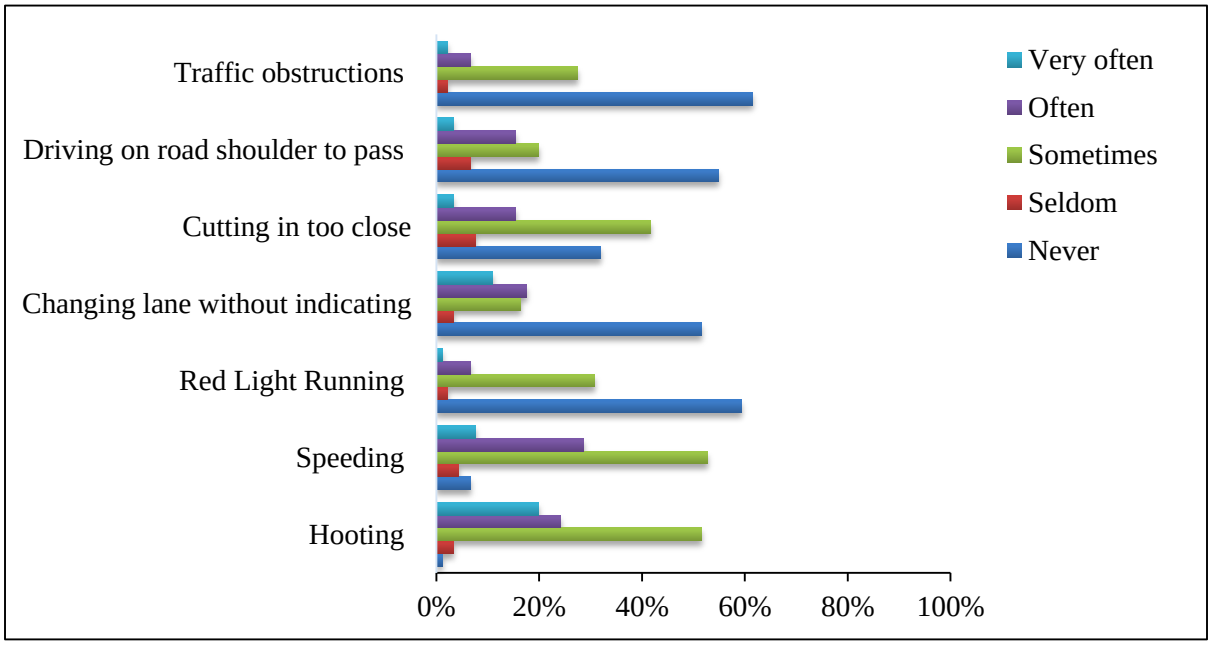


Figure 49 Frequency distributions of minibus taxi drivers' on-road aggressive behaviours

4.3.2.2 Effect of driver age on minibus taxi drivers' aggressive on-road behaviours

One of the specific objectives of this study was to investigate the effect of age and gender of minibus taxi drivers' on-road aggressive behaviours reported. To see whether there was a relationship between these two variables, a cross tabulation test together with chi-square test of relationship were performed. The Chi-square test results are detailed in Appendix 27 while cross tabulation results are tabulated in Table 33 and represented in Figure 50.

Table 33 Driver age and aggressive on-road behaviours

On-road aggressive behaviours by minibus taxi drivers	Taxi driver' age groups				Total "YES"				
	18 - 29	30 - 39	40 - 49	50 - above					
Sample size	27	32	21	11	91				
1. Hooting	27	31	21	11	90				
2. Speeding	27	27	21	10	85				
3. Red light running	14	12	7	4	37				
4. Changing lane without signalling	13	16	9	6	44				
5. Cutting in too close in front of other cars	20	23	13	6	62				
6. Driving on road shoulders or on yellow lanes to pass	16	12	8	4	40				
7. Obstructing traffic from moving	10	9	10	6	35				
Percentage of sample in age group	(%)	(%)	(%)	(%)	Average of %	Ratios to average (R)			
1. Hooting	100.0	96.9	100.0	100.0	99.2	1.01	0.98	1.01	1.01
2. Speeding	100.0	84.4	100.0	90.9	93.8	1.07	0.90	1.07	0.97
3. Red light running	51.9	37.5	33.3	36.4	39.8	1.30	0.94	0.84	0.91
4. Changing lane without signalling	48.1	50.0	42.9	54.5	48.9	0.98	1.02	0.88	1.12
5. Cutting in too close in front of other cars	74.1	71.9	61.9	54.5	65.6	1.13	1.10	0.94	0.83
6. Driving on road shoulders or on yellow lanes	59.3	37.5	38.1	36.4	42.8	1.38	0.88	0.89	0.85
7. Obstructing traffic from moving	37.0	28.1	47.6	54.5	41.8	0.89	0.67	1.14	1.30

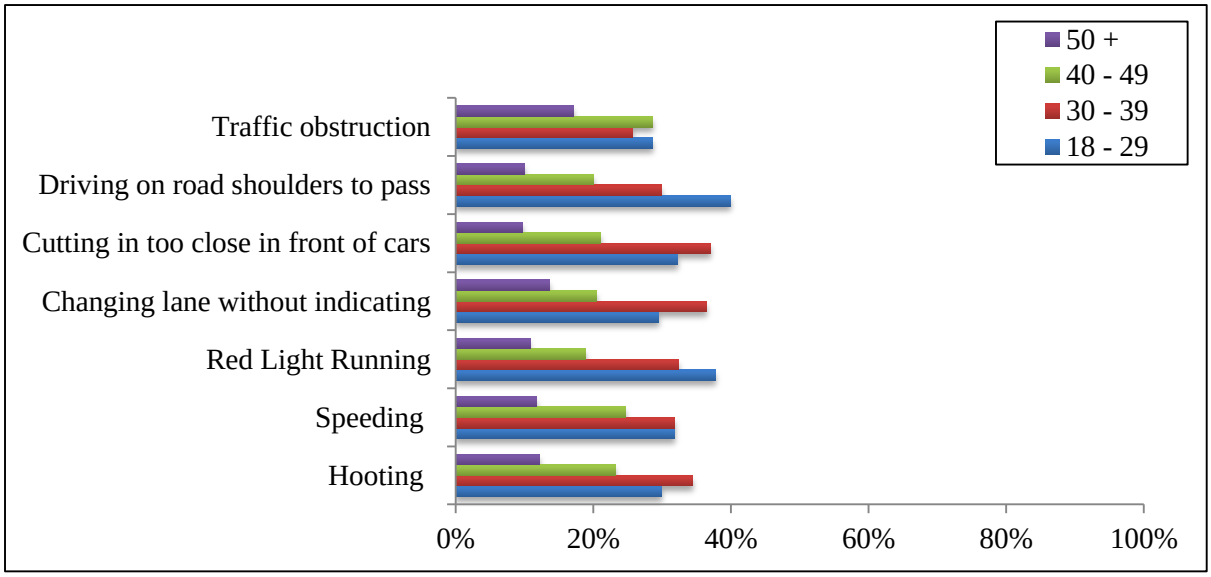


Figure 50 Distribution of minibus taxi drivers' age and on-road aggressive behaviours

4.3.2.3 Discussion

In Table 33, it can be seen that there were differences between taxi drivers' age groups and frequencies of reporting aggressive on-road behaviours. For instance, the percentages per age groups for red light running behaviour were 52 %, 38 %, 33 %, and 36 % respectively; and for the case of traffic obstructions the percentages were 37 %, 28 %, 48 % and 55 %. If we look at the two extreme age groups i.e. taxi drivers aged between 18 and 29 years designated as "*Younger drivers*" and taxi drivers aged from 50 years and above designated as "*Older taxi drivers*", we see that the percentages of younger drivers in aggressive behaviour were greater than or equal to those of older taxi drivers except for hooting and for traffic obstructions. For hooting, the percentages of older and younger taxi drivers were the same at about 100% whereas for traffic obstructions the percentage of older taxi drivers was higher than that of younger taxi drivers (Ratio = 0.89, sample of younger taxi drivers over the average percentage against Ratio = 1.30, sample of older taxi drivers over the average percentage). The chi-square test results in Appendix 27 revealed statistically significant relationships only between taxi driver age and exceeding speed limits (χ^2 (df = 1, N = 91) = 15.935, p = 0.000) and between taxi driver age and cutting in too close (χ^2 (df = 1, N = 91) = 4.958, p = 0.026). These results support what has been reported by the AAA in 1997. In their report titled "Road rage on the rise" established after analysing 10,037 police incidents of aggressive driving behaviour collected between 1990 and 1996, majority of perpetrators of aggressive behaviours were men aged between 18 and 26 (Mizell, 1997). The effect of gender on the taxi drivers' aggressive behaviours was not be studied as there were no female taxi drivers in sample.

4.3.2.4 Motives of minibus taxi drivers' on-road aggressive behaviours

The motives of the minibus taxis' on-road aggressive behaviours were assessed in addition to their occurrence. In order to examine the specific reasons why minibus taxi drivers engage into each of the seven forms of aggressive behaviours, respondents were asked to identify circumstances under which they would drive aggressively. Table 34 to Table 40 are cross tabulation results between participants and a set of circumstances mentioned to induce each of the seven forms of minibus taxis' on-road aggressive behaviours. The categories in tables were open ended answers consolidated into groups.

Table 34 Motives of obstructing vehicles from passing

	Frequency (fi)	Percent (%)
I don't do that	55	60.4
To remove any obstruction that prevent me to pass	1	1.1
When I stop to say something to my fellow taxi drivers	2	2.2
I want to make next load. It's all about money!	6	6.6
When a traffic officer asks me to stop	1	1.1
When there are few cars behind or no cars close to me	2	2.2
When I stop to pick passengers. I am a taxi driver!	24	26.4
Total	91	100.0

Table 35 Motives of passing on road shoulders or on yellow lanes

	Frequency (fi)	Percent (%)
I don't do that	50	54.9
To call passengers for taxi	2	2.2
I want to make next load. It's all about money!	6	6.6
I need to load waiting people and another taxi is in front of me	5	5.5
I drive on road shoulder when I have space	6	6.6
When drivers in front of me drives slow I will pass them	3	3.3
On a two-lane road where I have to take left to overtake	6	6.6
When the road is blocked. I can't wait!	12	13.2
When I stop to pick passengers. I am a taxi driver!	1	1.1
Total	91	100.0

Table 36 Motives of cutting in too close in front of cars

	Frequency (fi)	Percent (%)
I don't do that	28	30.8

I want to make next load. It's all about money	24	26.4
When there are few cars behind or no cars close to me	1	1.1
When my indicators are not working and I use hands	1	1.1
When I have space or chance I cut	32	35.2
When drivers in front of me drive slow I will pass them	5	5.5
Total	91	100.0

Table 37 Motives of changing lane without indicating

	Frequency (fi)	Percent (%)
I don't do that	47	51.6
I want to make next load. It's all about money!	15	16.5
When there are few cars behind or no cars close to me	20	22.0
When my indicators are not working and I use hands	8	8.8
When I have a space or chance to do so	1	1.1
Total	91	100.0

Table 38 Motives of red light running

	Frequency (fi)	Percent (%)
I don't do that	53	58.2
I want to make next load. It's all about money!	14	15.4
I have a problem with my car	3	3.3
I run because I will be charged later	1	1.1
I run when a traffic officer asks me to do so	3	3.3
I run when the robots turn to red and I was driving fast	4	4.4
When there are few cars behind or no cars close to me	1	1.1
I run when robots delay to turn to green	11	12.1
When the road is free	1	1.1
Total	91	100.0

Table 39 Motives of speeding

	Frequency (fi)	Percent (%)
I don't do that	4	4.4
I want to make next load. It's all about money!	50	54.9
On highways like N2	13	14.3
When the speed limit on the road allows me to do so	15	16.5

I need to load waiting people and another taxi is in front of me	2	2.2
Passengers in taxi ask me to drive fast	7	7.7
Total	91	100.0

Table 40 Motives of unnecessary hooting at other drivers

	Frequency (fi)	Percent (%)
I do not do that	1	1.1%
To remove any obstruction that may prevent me to pass	42	46.2
To call passengers for taxi	8	8.8
To make people aware of me and move off the road	14	15.4
The driver in front of me is driving wrong	2	2.2
To alert vehicles next or behind me. I am a taxi driver!	2	2.2
To greet or say something to my fellow taxi drivers	3	3.3
To alert a driver in front of me who is sleeping at robots	8	8.8
When I am about to hit a car in front of me	1	1.1
I want to make next load. It's all about money	7	7.7
When drivers in front of me drive slow I will pass	1	1.1
When the road is blocked. I can't wait!	2	2.2
Total	91	100.0

4.3.2.5 Discussion

From Table 34 to Table 40, the motive for on-road aggressive behaviours reported by a large number of respondents was: "I want to make the next load. It's all about money". In Table 34, 24 (26.4%) minibus taxi drivers out of 91 said that sometimes they stop in the road to load or unload passengers and obstruct moving vehicles. In Table 35, 12 (13.2%) reported road blockage such as traffic jam in peak hours or road works as the reason for them to drive on road shoulders or on yellow lanes. For aggressive behaviours such as cutting in too close in front of cars (Table 36), changing lanes without signalling (Table 37), red light running (Table 38), and speeding (Table 39), respondents who reported:" I want to make the next load, it's all about money" as one of the motives of aggressive behaviours were: 24 (26.4%), 15 (16.5), 14 (15.4%), and 50 (54.9%) respectively. In addition, 32 (35.2%) added that they cut in when they have space or chance to do so, 20 (22.0%) failed to indicate to vehicles behind when there are few cars behind on next to them, 11 (12.1%) run red lights when robots delay to change to green mostly in peak hours, and 7 (7.7%) drive over the speed limit when passengers inside minibus taxis ask them to speed. In brief, all the motives of aggressive behaviours stated by respondents are money related. The nature of work in the minibus taxi industry is difficult. Minibus taxi drivers push

themselves to work maximum hours in order to collect the amount of money that owners wish to receive per day. They do not adhere to traffic rules due to the fact that their salaries rely mainly on the number of trips taken. For unnecessary hooting behaviour in Table 40, 56 (62.5%) respondents reported that they want to remove obstructions or to alert people for minibus taxis and move off the road.

4.3.2.6 Time exposure, accident history, and safe driving practices

This study also considered the relationships between minibus taxi drivers' exposure time and reported aggressive on-road behaviours. It also tested whether safe driving practices by taxi drivers implies low involvement in road traffic crashes. Table 41 illustrates cross tabulation results performed between taxi drivers' exposure time and aggressive on-road behaviours while Table 42 displays results obtained between taxi drivers' accident history in the last 12 months and safe driving practices. The chi-square test results of relationships are presented in Appendix 28 and Appendix 29.

Table 41 Exposure time and aggressive driving behaviours

Aggressive driving behaviour by taxi drivers	Exposure Time per day (hours)		Total "YES"	% of samples		Ratios (R)
	3 – 8 hrs	+ 8 hrs		3 – 8 hrs	+ 8 hrs	
Hooting	12	78	90	0.9	1.0	0.90
Speeding	13	72	85	1.0	0.9	1.11
Red Light Running	6	31	37	0.5	0.4	1.25
Changing lane without indicating	4	40	44	0.3	0.5	0.60
Cutting in too close	8	54	62	0.6	0.7	0.86
Driving on road shoulder to pass	11	30	41	0.8	0.4	2.00
Traffic obstructions	3	32	35	0.2	0.4	0.50
Sample size	13	78	91			

Table 42 Safe driving practices and road traffic accident history

Safe driving practices by taxi drivers	Frequency of accident in the last 12 months		Total "YES"	% of sample		Ratio
	Not at all	1–2 times		Not	1-2 times	
Drive on the right way	59	12	71	0.8	0.9	0.8
Correct lane manoeuvres	52	1	53	0.7	0.1	8.7
Follow traffic signals and signs	61	13	74	0.8	1.0	0.8
Correct Left/Right and U-turns	44	3	47	0.6	0.2	2.4
Follow prescribed speed limit	55	10	65	0.7	0.8	0.9
Driving with good health conditions	60	11	71	0.8	0.8	0.9

Sample size	78	13				

4.3.2.7 Discussion

In Table 41, all respondents reported driving from three to more than eight hours per day. Except for driving on road shoulder to pass vehicles in front and for red light running behaviours where the ratios of taxi drivers who reported driving between 3 and 8 hours over those who drove more than 8 hours per day were greater than one (Ratio = 1.25, Ratio = 2.00 respectively), the samples of taxi drivers who reported driving more than 8 hours were greater than or equal to those of taxi drivers who said that they drive from 3 to 8 hours for the remaining cases. In Appendix 28, statistically significant relationships were only found between hooting and time of exposure per day (χ^2(df = 1, N = 91) = 6.067, p = 0.014) and between traffic obstructions and time of exposure per day (χ^2(df = 1, N = 91) = 1.517, p = 0.002).

In Table 42, no respondents reported being involved in a road accident three or more than three times in a twelve months period. These results also show that the samples of taxi drivers who reported not being involved in accidents at all were the same as those of taxi drivers who agreed that they have been involved in road accidents from one to two times except for correct lane manoeuvres (Ratio = 8.7) and for correct left/right and U-turns (Ratio = 2.4). In Appendix 29, a statistically significant relationship was found between driving with good health conditions and not being involved in road traffic accidents (χ^2(df = 3, N = 78) = 11.002, p = 0.012).

4.3.3 Response behaviours to minibus taxis' on-road aggressive behaviours

Prior to the analysis of the response behaviours of other drivers, this study looked at how frequently these drivers reported to have been subject to the minibus taxi drivers' on-road aggressive behaviours in a period of twelve months. In addition, participants were asked to mention other forms of minibus taxis' on-road aggressive behaviours they had experienced apart from the seven forms highlighted in the pilot study. Table 43 presents the characteristics of the participants.

Table 43 Characteristics of drivers of other vehicles

Diver age	Driver gender		Total (%)
	Male	Female	
18 – 29	42 (41.6%)	37 (45.7%)	79 (43.4%)
30 – 39	26 (25.7%)	24 (29.6%)	50 (27.5%)
40 – 49	19 (18.8%)	13 (16.0%)	32 (17.6%)
50 and above	14 (13.9%)	7 (8.6%)	21 (11.5%)
Total	101(100%)	81(100%)	182 (100%)

4.3.3.1 Experiences of minibus taxi drivers' aggressive behaviours in the last 12 months

In a sample of 182 drivers of other vehicles, 167 (91.8%) reported having been subject to minibus taxi drivers' on-road aggressive behaviours in the last 12 months whereas only 15 (8.2%) have not. The different forms of the minibus taxi drivers' on-road aggressive behaviours experienced by drivers of other vehicles in the last twelve months are represented in Figure 51.

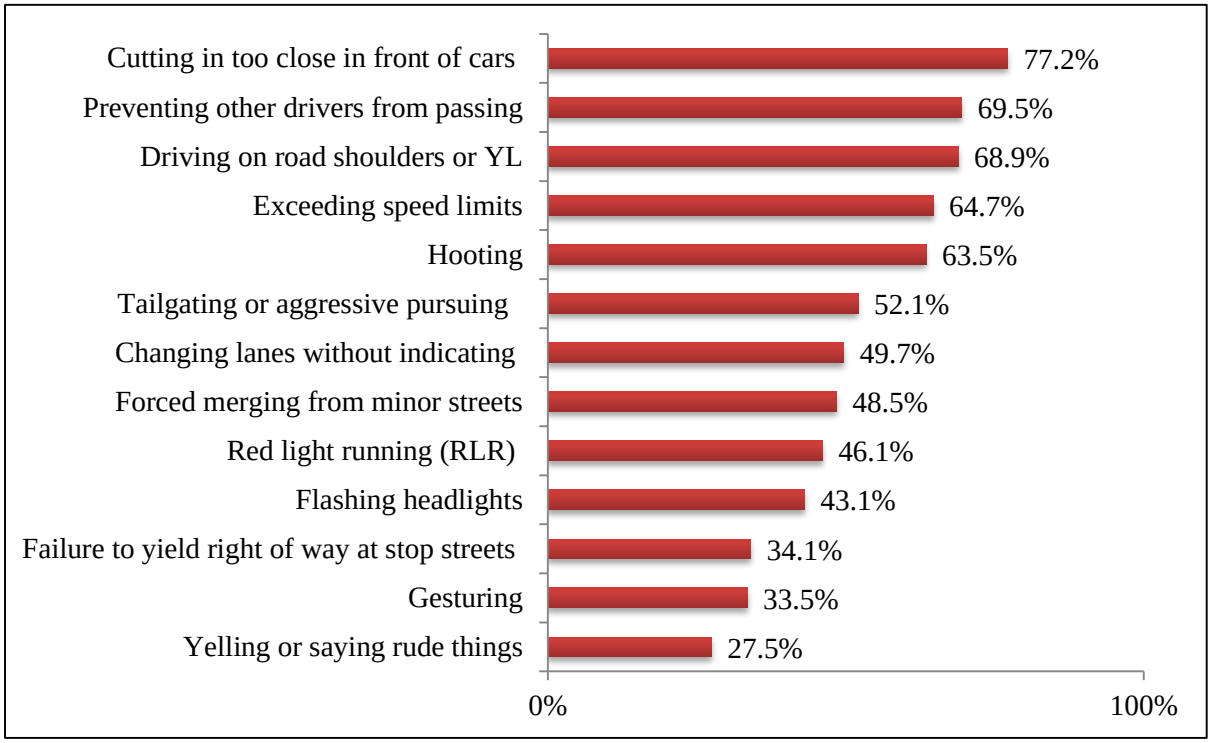


Figure 51 Taxis' on-road aggressive behaviours experienced by other drivers in the last 12 months

4.3.3.2 Effect of driver gender on levels of anger aroused

The effect of driver gender on levels of anger aroused as well as on the likely response behaviours was studied on the six forms of the minibus taxis' aggressive behaviours presented in Table 44. Changing lane without signalling behaviour was excluded in the analysis as its results were confusing. It seems respondents struggled to distinguish the changing lane without signalling behaviour from cutting in too close in front of cars. Their responses to these two types of aggressive driving behaviour were almost the same. The researcher thus, decided to exclude the changing lane without signalling behaviour and only consider cutting in too close in front of cars in the analysis. In all the driving scenarios considered, participants were assumed to be under no pressure as they reported their driving anger. The cross tabulation results performed between driver gender and anger aroused when exposed to each of the six types of minibus taxis' on-road aggressive behaviour are tabulated from "not at all angry" to "extremely angry" in Table 44 and represented in Figure 52 – 57. The chi-square test results of relationships are presented in Appendix 8.

Table 44 Effect of driver gender on levels of anger aroused by victims of taxis' aggressive behaviour

Driver gender	Taxi drivers' aggressive behaviours experienced by other drivers	Levels of anger aroused by drivers of other vehicles				Total
		Not at all angry	A little angry	Very angry	Extremely angry	
Male	Cutting in too close	4	12	33	24	73
	Obstructing traffic	9	13	22	11	55
	Overtaking on shoulder	14	13	20	11	58
	Speeding	24	20	6	5	55
	Hooting	8	7	21	18	54
	Red light running	11	7	8	8	34
Female	Cutting in too close	5	7	32	12	56
	Obstructing traffic	9	21	22	9	61
	Overtaking on shoulder	10	22	16	9	57
	Speeding	16	16	15	6	53
	Hooting	6	7	25	14	52
	Red light running	21	9	12	1	43

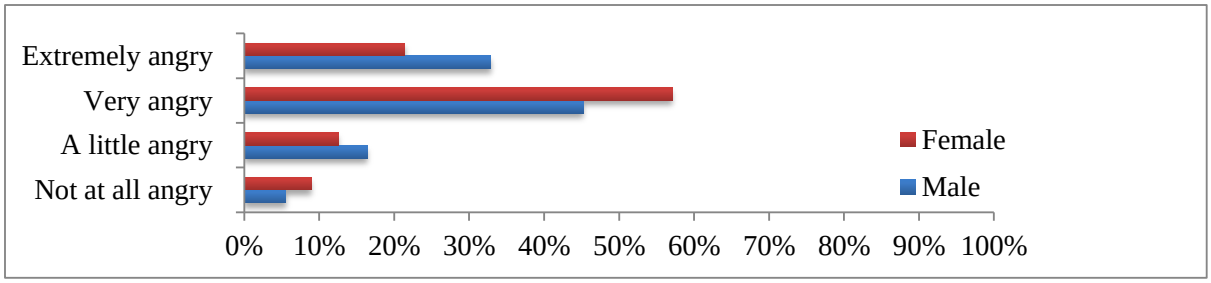


Figure 52 Driver gender and anger aroused against cutting taxi drivers

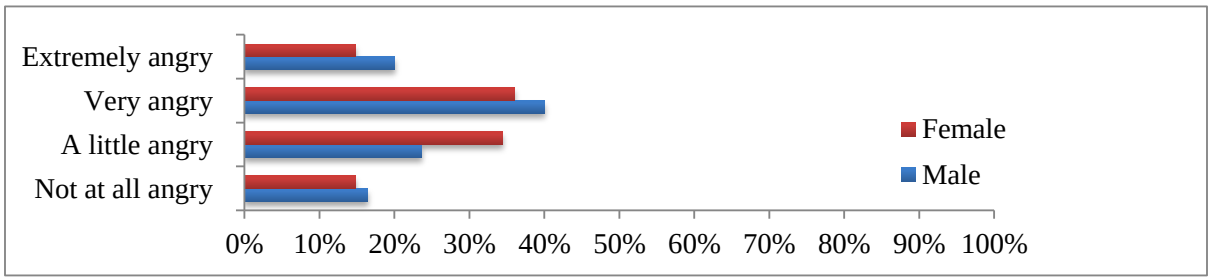


Figure 53 Driver gender and anger aroused against traffic obstructions by taxi drivers

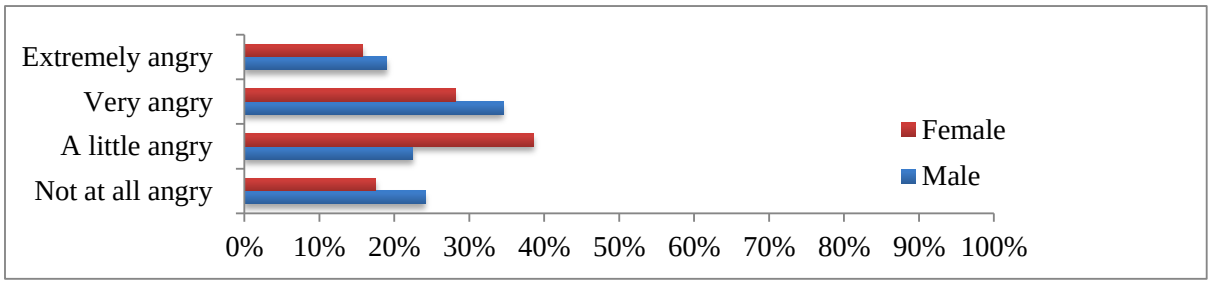


Figure 54 Driver gender and anger aroused against unsafe overtaking by taxi drivers

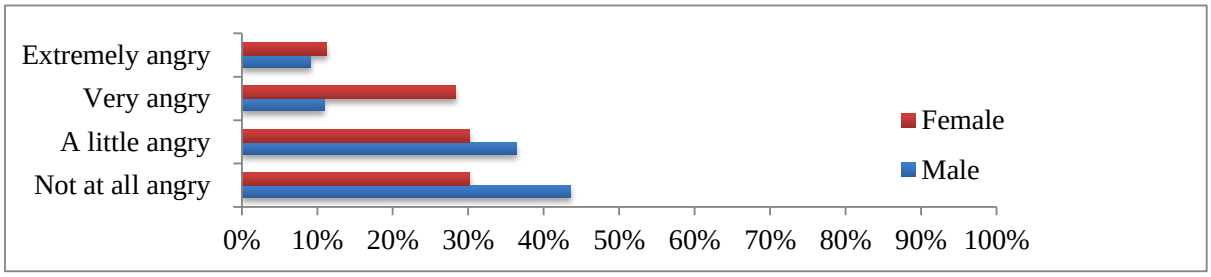


Figure 55 Driver gender and anger aroused against speeding taxi drivers

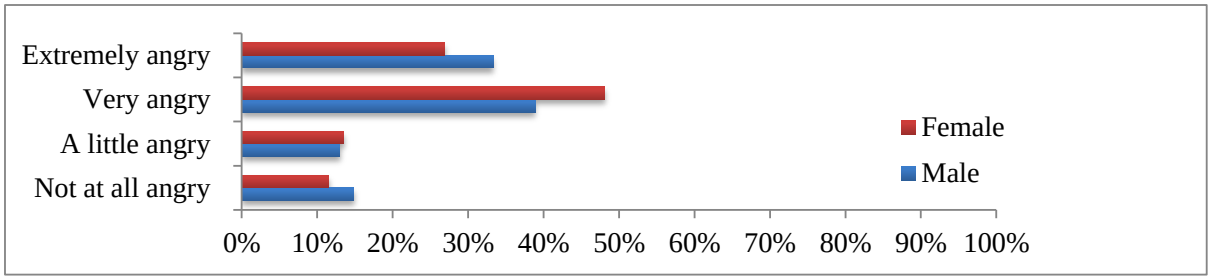


Figure 56 Driver gender and anger aroused against hooting taxi drivers

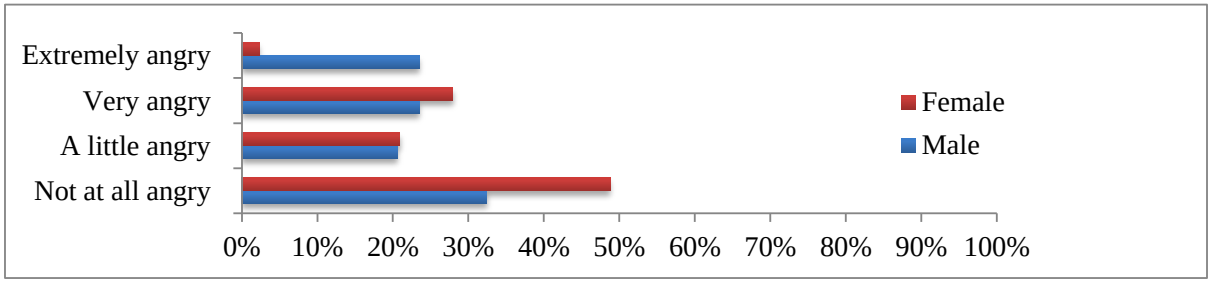


Figure 57 Driver gender and anger aroused against red light running taxi drivers

4.3.3.3 Discussion

The gender of the driver of the vehicle behind aggressive minibus taxis was hypothesised to have an influence on the levels of anger aroused. Previous findings on driving anger revealed that male drivers differ from female drivers in the way they perceive and interpret frustrating situations. Galovski and Blanchard (2004) found that frustrated male drivers get angry more quickly than female drivers. It seems that results from this study do not provide full support for this hypothesis. In Figure 53 and 54, it can be seen that male drivers got very angry than female drivers when subjected to minibus taxis' traffic obstructions (40.0 % of male and 36.1% female) and when minibus taxi drivers drove on road shoulder to overtake them (34.5% male and 28.1% female got very angry). More female drivers reported to get very angry compared to male drivers for minibus taxis' aggressive behaviours such as such cutting in too close in front of cars (57.2 % female against 45.2 % male) in Figure 52, speeding (28.3 % female against 10.9 % male) in Figure 54, red light running (27.9 % female against 23.5% male) in Figure 57, and hooting (48.1 % female against 38.9 % male) in Figure 56. These results do not show a remarkable difference between male drivers and female drivers in the ways they get angered by minibus taxi drivers' on-road aggressive behaviours. Frustrated female drivers got very angry than frustrated male drivers for almost all aggressive behaviours studied and were extremely angry than female drivers only against speeding taxi drivers (11.3 % female against 9.1 % male). In general, it can be concluded from these results that the hypothesis that both frustrated male and female drivers will arouse high levels of anger due to negative beliefs and attributions they have with minibus taxi drivers is supported. There were statistically significant relationships between being male and getting angered by red light running

taxi drivers (χ^2 (df = 3, N = 101) = 8.092, p = 0.04) and being female and getting annoyed by hooting minibus taxi drivers (χ^2 (df = 3, N = 81) = 8.177, p = 0.04).

4.3.3.4 Effect of driver age on levels of anger aroused

Four age groups of drivers of normal passenger cars were defined in this study. Drivers aged between 18 and 29 years were called young drivers, middle-aged drivers were between 30 and 39 years and between 40 and 40 years, and old drivers started from 50 years to above. In order to assess the effect of age on levels of anger aroused by drivers of normal passenger cars when exposed to the minibus taxi drivers' aggressive behaviours, cross tabulations accompanied by a series of chi-square tests were performed between driver age and levels of anger stimulated by each type of the six types of taxis' on-road aggressive behaviours. Results are tabulated in Table 45 and represented in Figure 58 - 63.

Table 45 Drive age and levels of anger aroused by victims of taxis' aggressive behaviour

Driver age	Taxi drivers' aggressive behaviours experienced by other drivers	Levels of anger aroused by the victims				Total
		Not at all angry	A little angry	Very angry	Extremely angry	
18 – 29	Cutting in too close	4	9	28	10	51
	Obstructing traffic	6	12	16	9	43
	Overtaking on shoulder	10	14	18	6	48
	Speeding	17	20	10	3	50
	Hooting	3	6	17	11	37
	Red light running	10	4	10	1	25
30 – 39	Cutting in too close	2	5	18	12	37
	Obstructing traffic	5	14	11	6	36
	Overtaking on shoulder	4	12	11	6	33
	Speeding	13	9	4	3	29
	Hooting	4	2	15	13	34
	Red light running	13	6	4	2	25
40 – 49	Cutting in too close	2	1	13	7	23
	Obstructing traffic	6	4	7	3	20
	Overtaking on shoulder	8	5	3	5	21
	Speeding	10	1	2	3	16
	Hooting	3	4	10	8	25
	Red light running	7	1	4	4	16
50 and +	Cutting in too close	1	4	6	7	18
	Obstructing traffic	1	4	10	2	17
	Overtaking on shoulder	2	4	4	3	13
	Speeding	0	6	5	2	13
	Hooting	4	2	4	0	10
	Red light running	2	5	2	2	11

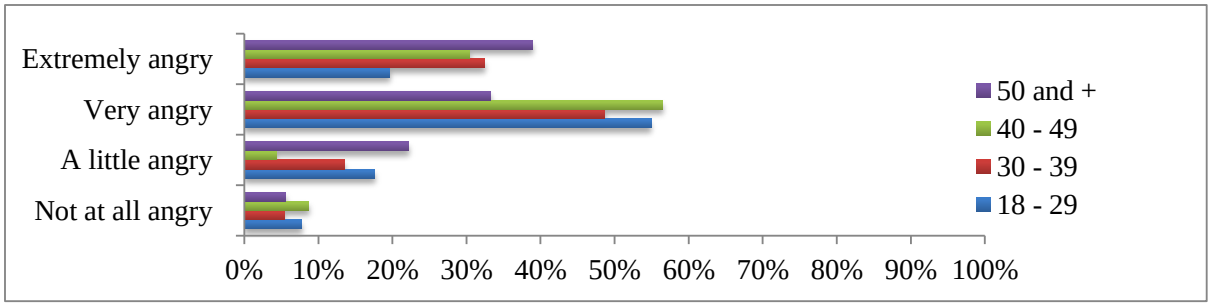


Figure 58 Driver age and anger aroused against cutting taxi drivers

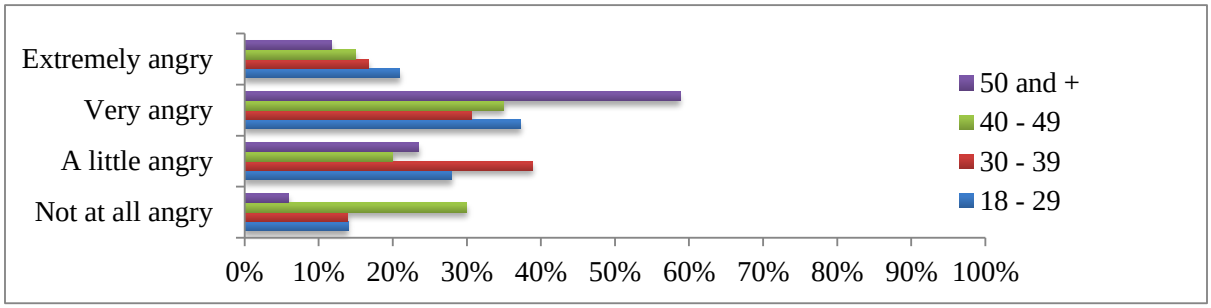


Figure 59 Driver age and anger aroused against traffic obstructions by taxi drivers

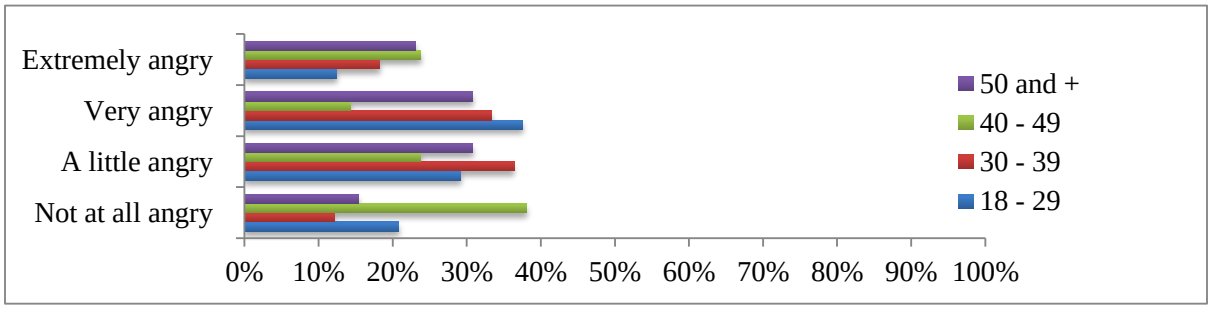


Figure 60 Driver age and anger aroused against unsafe overtaking by taxi drivers

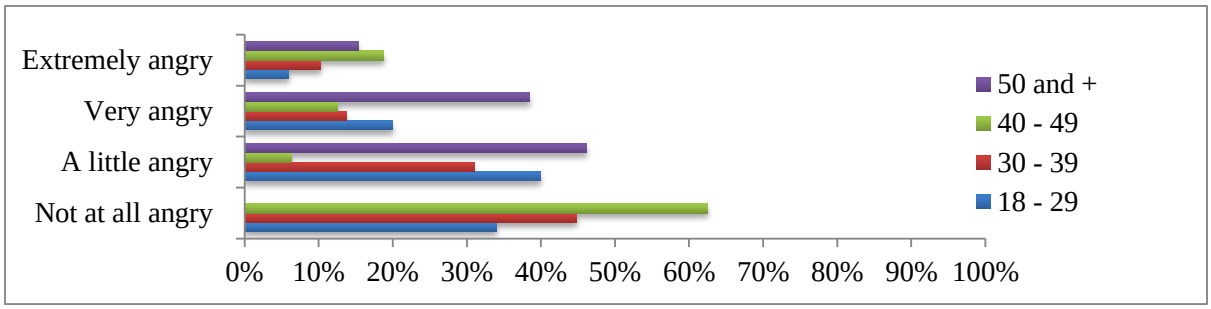


Figure 61 Driver age and anger aroused against speeding taxi drivers

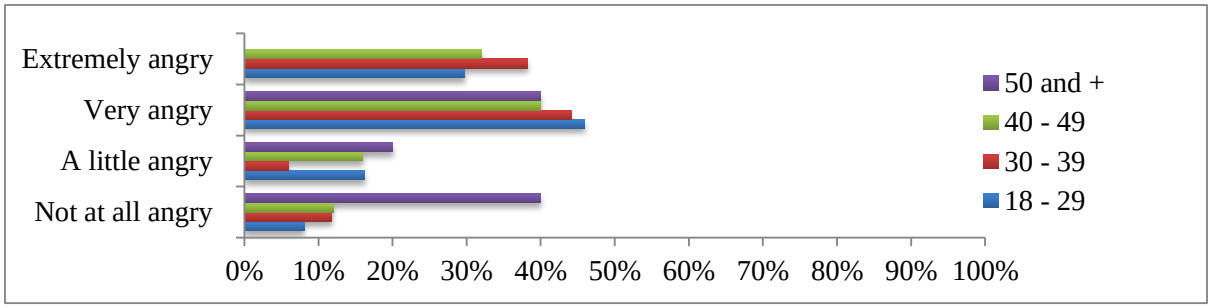


Figure 62 Driver age and anger aroused against hooting taxi drivers

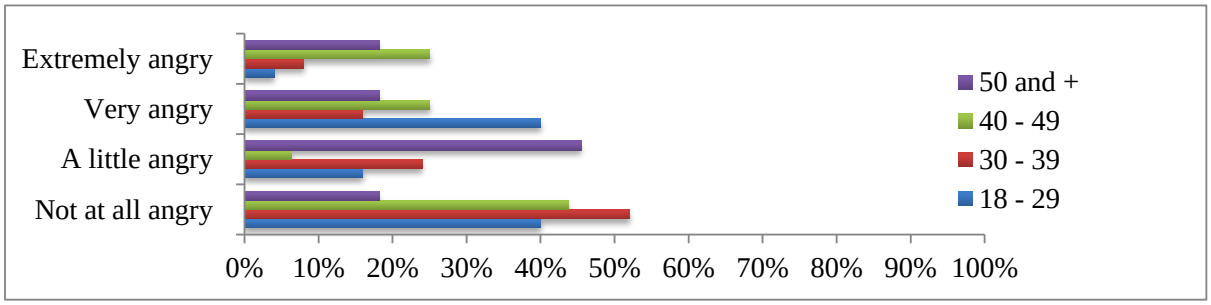


Figure 63 Driver age and anger aroused against red light running taxi drivers

4.3.3.5Discussion

It had also been hypothesised that young drivers frustrated by aggressive minibus taxis would generate higher levels of anger compared with frustrated older drivers. Lajunen et al. (1998) examined relationships between self-reported driver anger and aggressive driving on a sample of UK drivers and confirmed that the amount of anger exhibited by male drivers and the severity of their responses decrease with increase of age. If we look at the two extreme age groups (18 - 29; 50 and above) in Figure 61, it can be seen that old drivers reported to be very angry when exposed to speeding taxis (38.5 % old drivers against 20.0 % younger drivers) or when taxis obstructed them from passing (58.8 % old against 37.2% young) in Figure 59. Frustrated younger drivers on the other hand felt very angry when taxi drivers hooted at them (45.9 % young against 40.0 % old) in Figure 62, overtook them on road shoulders (37.5% young against 30.8 % old) in Figure 60, ran red lights in front of them (40.0 % young against 18.2 % old) in Figure 63, or when they cut in too close in front and pass them (54.9 % young against 33.3 % old) in Figure 58. Younger drivers reported getting extremely angry only when exposed to aggressive hooting (29.7% young against 0.0 % old) or to traffic obstructions by minibus taxis (20.9 % young against 11.8 % old). From these results, it appears that both younger and older drivers get angry in a similar way when frustrated by minibus taxi drivers. These results do not provide full support to the hypothesis. Younger drivers felt extremely angry for aggressive behaviours which directly focus on them such as hooting or obstructing them from moving whereas old drivers were extremely angry at aggressive behaviours which involve the safety of other road users, such as red light running, speeding, and overtaking on road shoulders. In Appendix 9, statistically significant relationships were found

between old drivers and getting angry by speeding taxi drivers (χ^2(df = 3, N = 21) = 8.986, p = 0.03), old drivers and getting angry by hooting taxis (χ^2(df = 3, N = 21) = 11.645, p = 0.01), and old drivers and getting angry by red light running taxi drivers (χ^2(df = 3, N = 21) = 10.576, p = 0.01).

4.3.3.6 Effect of driver gender on response behaviours

Figure 64 to Figure 69 present results on the effect of gender of frustrated drivers on the response behaviours showed. Lajenun et al. (1999) recruited 2500 drivers from three different countries (UK, Netherlands, Finland) and examined different ways they behave when exposed to anger-instigating situations on the roads. This study revealed seven alternative ways that angered drivers use to react to anger-instigating situations starting from no reaction to getting out of a car, ready to argue. In this study, the five other forms of reactions showed by angered drivers were; swear or mutter to yourself or other in your car, hoot or flash lights, gesture at the other driver, yelling at other driver, and driving aggressively such as swerving in traffic and tailgating. In these three countries, no differences were found in the ways frustrated drivers felt angry as well as in ways they expressed driving anger on the road (Lajunen, Parker & Summala, 1999:225). O'brien et al. (2004) added two more behavioural responses (getting out of your car, prepared to engage physically with the other driver and use of your car to damage the other car's) to a set of seven response behaviours by Lajenun et al. (1999). In their study on effects of situational factors on aggressive driving, subjects showed more severe forms of reactions towards young offender drivers than older offender drivers. For the sake of this study, the response behaviours reported by frustrated divers were regarded as aggressive in cases where frustrated drivers try to find ways out and move on without waiting or refusing cooperation with minibus taxis; and non-aggressive in those cases that frustrated drivers decided to do nothing but to wait for minibus taxis. The frequency tables of several response behaviours reported by participants and the chi-square test results of relationships between driver gender and response behaviours showed for each of the six types of minibus taxis' aggressive behaviours studied are detailed in Appendix 14.

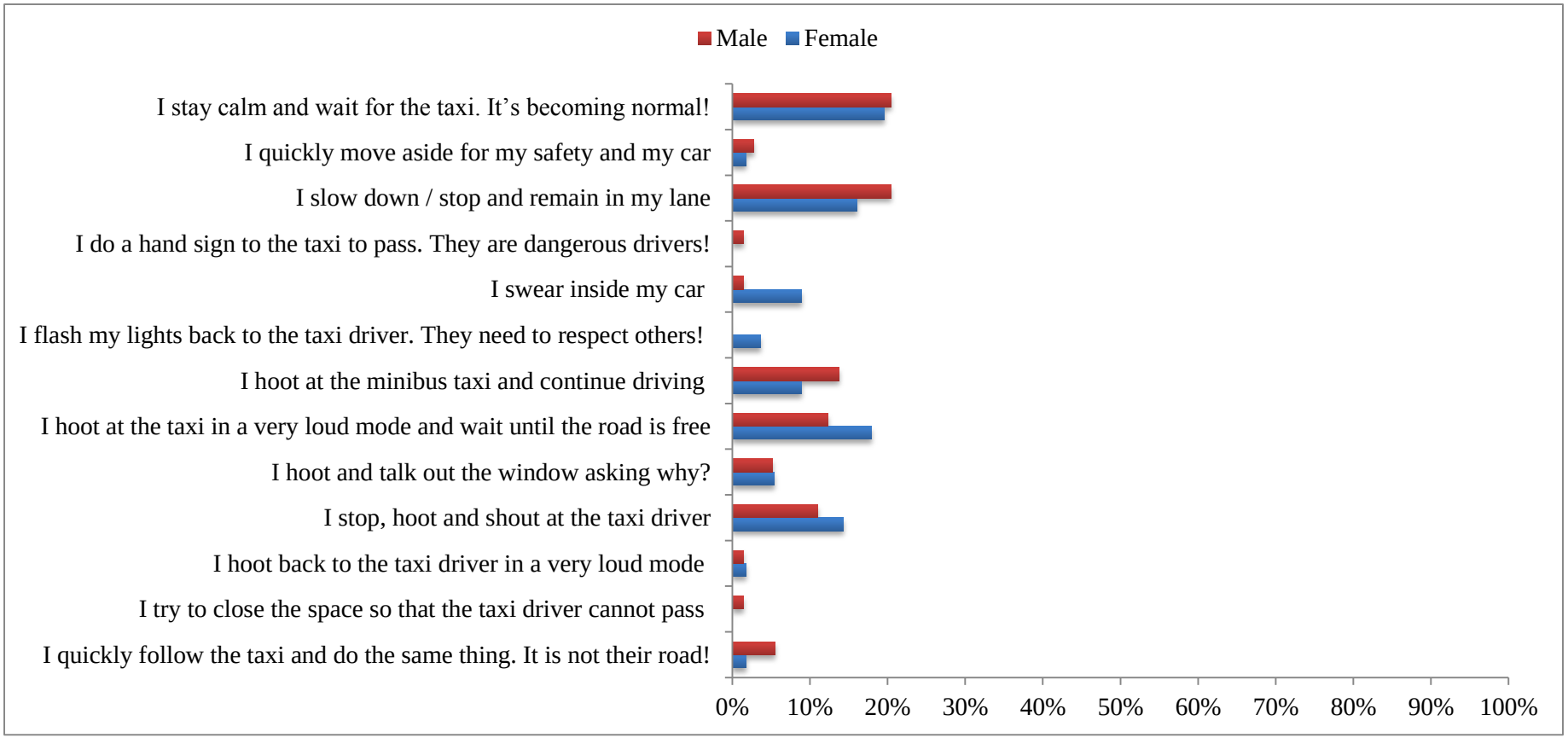


Figure 64 Driver gender and response behaviours to aggressive cutting in too close by taxi drivers

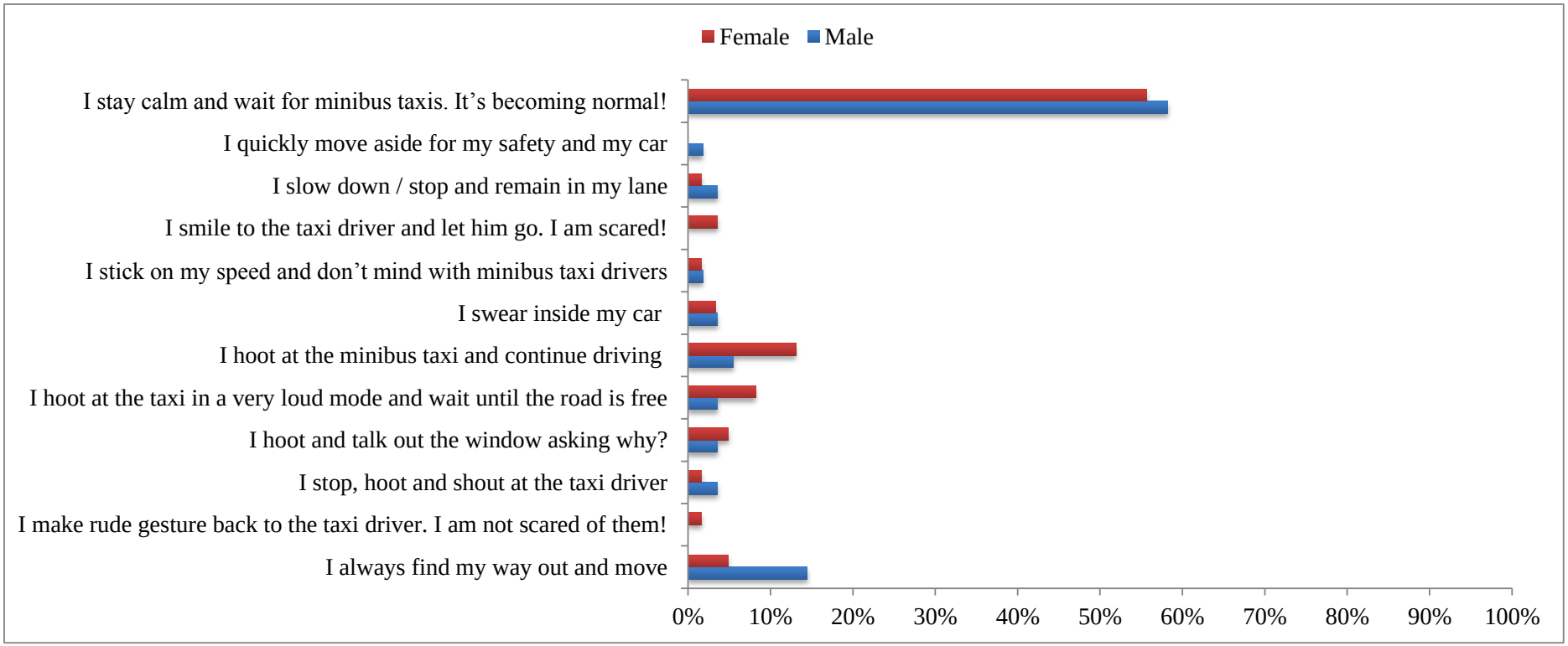


Figure 65 Driver gender and response behaviours to traffic obstructions by taxi drivers

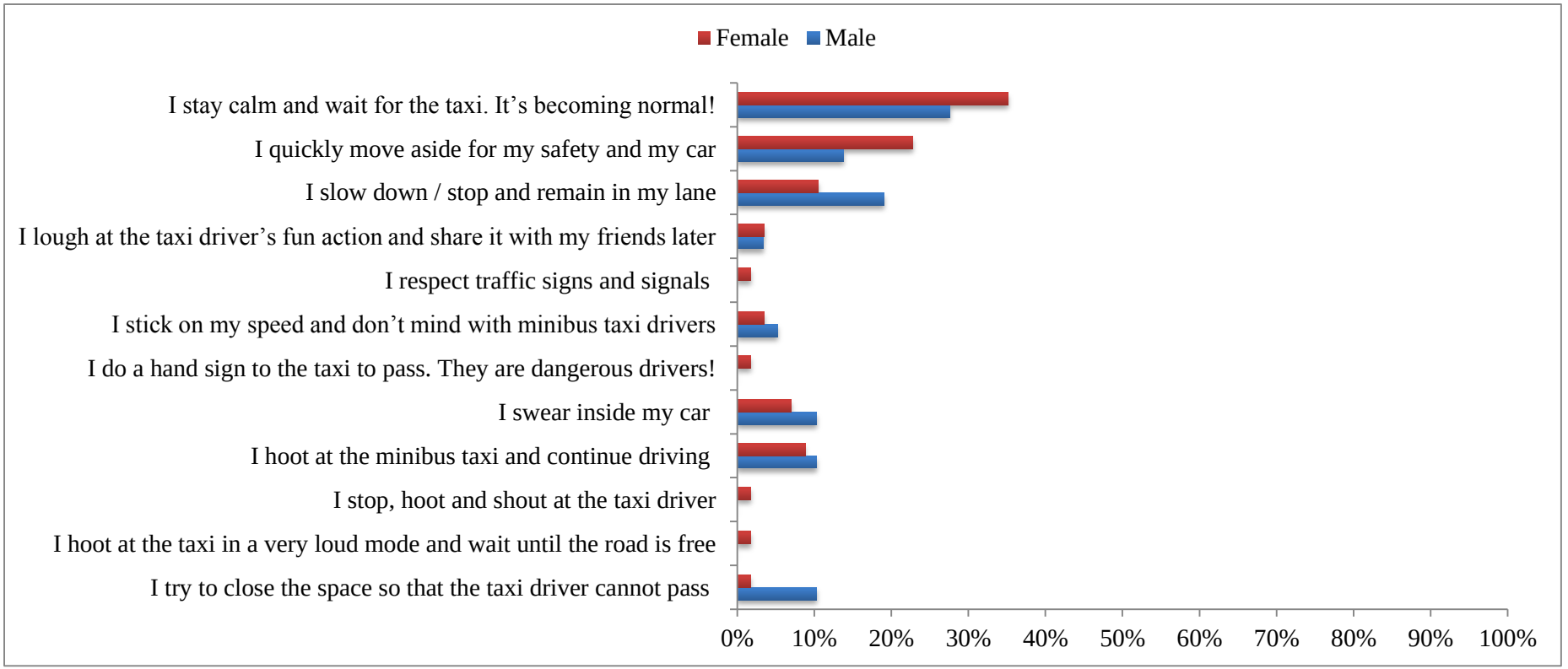


Figure 66 Driver gender and response behaviours to taxis overtaking on road shoulders or on yellow lanes

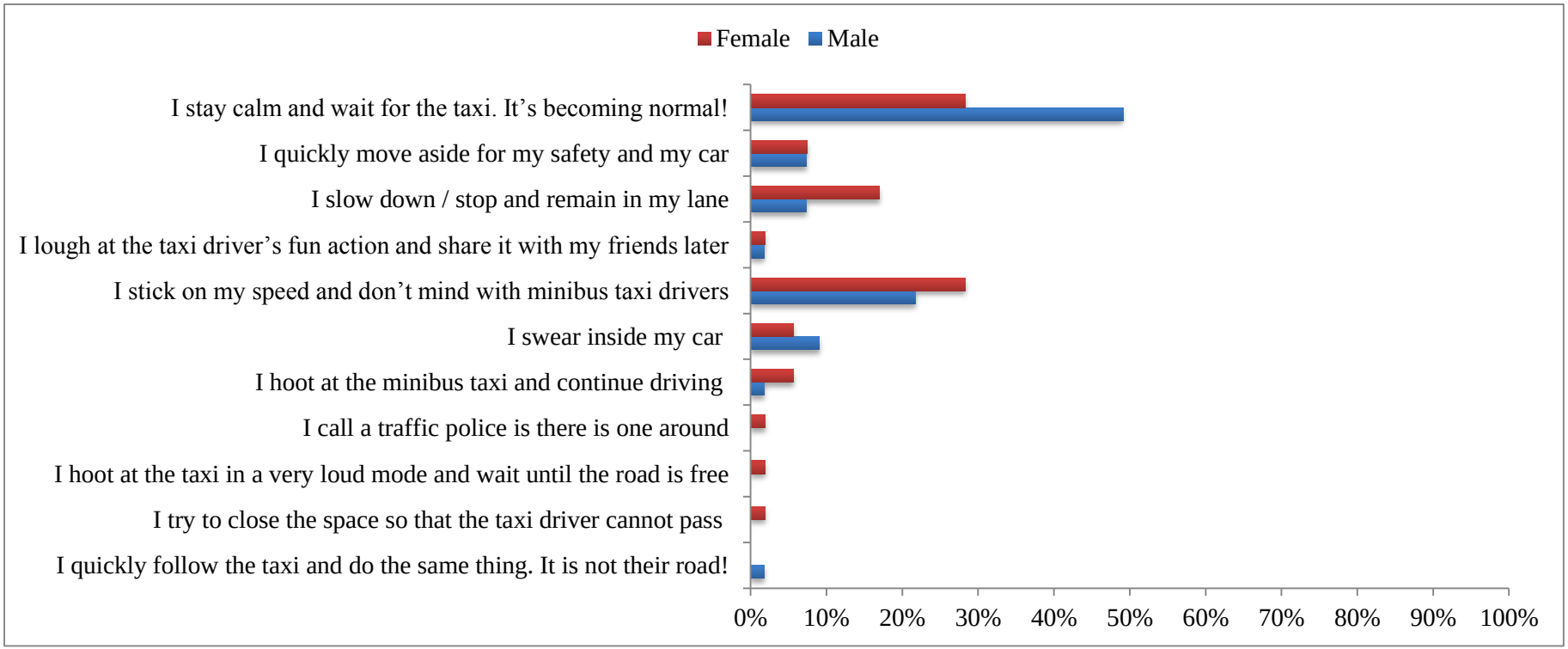


Figure 67 Driver gender and response behaviours to aggressive speeding minibus taxi drivers

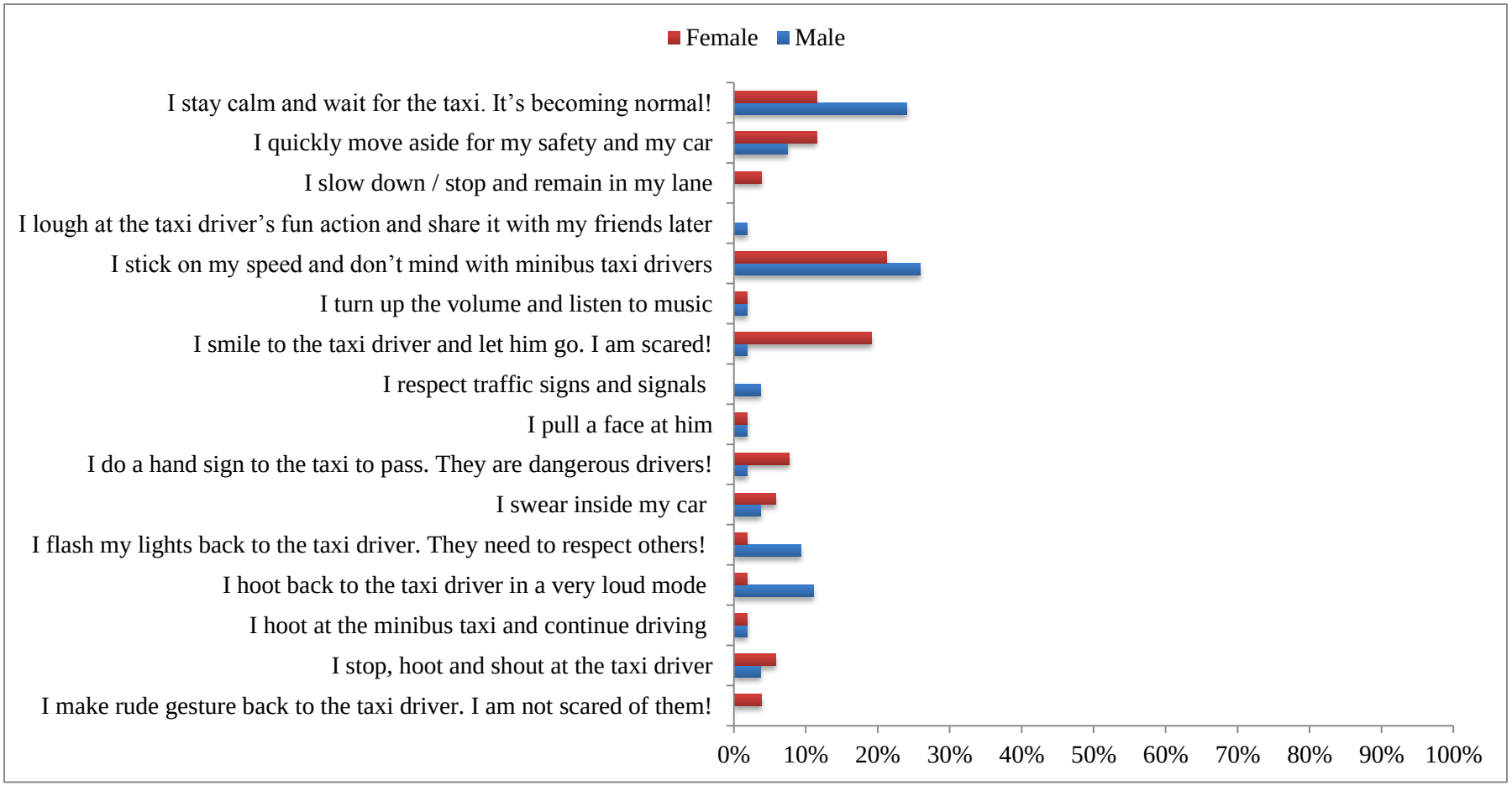


Figure 68 Driver gender and response behaviours to aggressive hooting by minibus taxi drivers

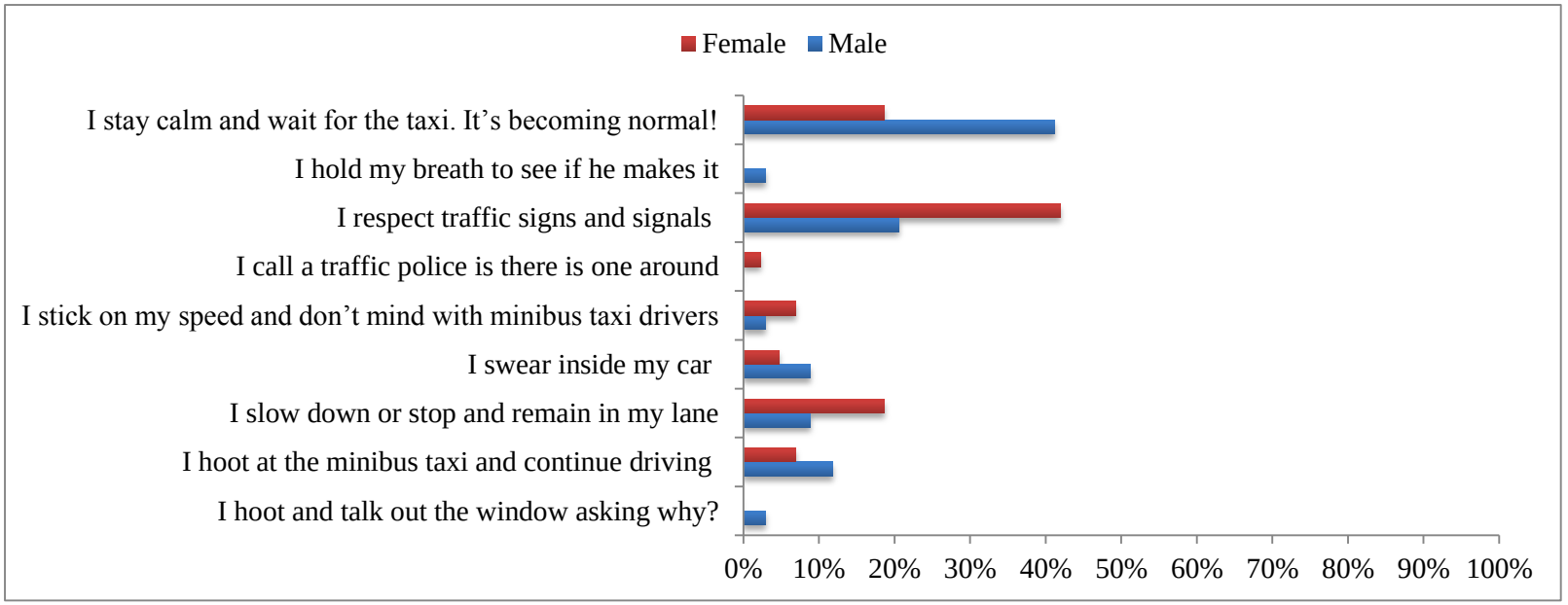


Figure 69 Driver gender and response behaviours to minibus taxis red light runners

4.3.3.7 Discussion

The gender of frustrated drivers was assumed to have an influence on the response behaviours showed. This study hypothesised that male drivers frustrated by minibus taxis would respond more aggressively than frustrated female drivers. Previous studies found that angered female drivers tend to adopt more covert or quieter forms of aggression such as swearing, whereas angered male drivers tend to express direct observable behaviours such as obscene gestures or yelling (Lonczak, Neighbors & Donovan, 2007:536). In another study of angry feelings while behind the steering wheel, male drivers reported more frequent opinions of revenge and physical aggression whereas female drivers tended to adopted constructive measures (Deffenbacher, Petrilli, Lynch, Oetting & Swaim, 2003:383).

In Figure 64, six different ways of reactions to the minibus taxis' aggressive cutting manoeuvres were frequently reported. The frequency of female drivers was higher for mild or less aggressive response behaviours such as hooting and shouting (14.3 % female against 11.0 % male), swearing inside the car (8.9 % female against 1.4 % male), and hooting in a very loud mode (17.9 % female against 12.3 % male). The frequency of male drivers was higher for riskier and more severe aggressive forms of reactions such as trying to close the space in order to prevent minibus taxis from overtaking (1.4 % male against 0.0 % female), following cutting minibus taxis and cutting them off (5.5 % male against 1.8 % female). The frequency of male and female drivers who reported staying calm and patiently waiting for minibus taxi was almost equal (20.5 % male against 19.6 % female). These results support the above hypothesis. In Appendix 14, a statistically significant relationship was found between being male driver and the response behaviours showed against cutting minibus taxis (χ^2 (df = 11, N = 81) = 22.325, p = 0.02).

In Figure 65, the frequency of drivers who reported always finding a way out and overtaking obstructing minibus taxis was higher for male drivers (14.5 % male against 4.9 % female) whereas the frequency of drivers who reported hooting at the minibus taxis was higher for female drivers (8.2 % female against 3.6 % male). Female drivers can respond as aggressively as male drivers for relative mild aggressive behaviours. For example, the numbers of both male and female drivers who reported to stay calm and wait for minibus taxis (58.2 % female against 55.7 % male) or to swear inside the car (3.6 % male against 3.3 % female) were almost the same. The above hypothesis is again supported by these results. There was no relationship between driver gender and the types of response behaviours showed against obstructing minibus taxis for both male and female drivers.

In Figure 66, the frequencies of male drivers were higher than those of female drivers in aggressive response behaviours such as closing the space and prevent minibus taxis to overtake (10.3 % male against 1.8 % female), sustained hooting (10.3 % male against 8.8 % female), maintain same driving speed and don't mind with overtaking minibus taxi drivers (5.2 % male against 3.5 % female). Female

drivers, in contrast, reported more non-aggressive responses such as driving aside and allowing more space for overtaking minibus taxis (13.8 % male against 22.8 % female) and staying calm and waiting for minibus taxis (27.6 % male against 35.1 % female). These results again support the hypothesis.

Figure 67, Figure 68, and Figure 69 display response behaviours of drivers subjected to minibus taxis speeding, hooting at other drivers, and running red lights. From these figures, the frequency of male drivers in the observable forms of aggressive responses was higher than that of female drivers. For instance, 11.1 % male drivers against 1.9 % female drivers reported hooting back in a very loud mode to aggressive hooting minibus taxis. For red light running behaviour, 2.8% male drivers against 0.0 % female drivers reported hooting and shouting out the window to let minibus taxi red light runners know that they disagree with their driving behaviours. Female drivers subjected to speeding minibus taxis reported hooting at them and continued driving (5.7 % female against 1.8 % male), nearly 42.0 % of female against 20.6 % male said that they respected traffic signs and signals while driving behind minibus taxis red light runners. In general, these results show greater gender differences for riskier and more aggressive response behaviours (14.5 % male and 4.9 % female reported to always find way out and move when obstructed by minibus taxis) and lower differences for less aggressive response behaviours (e.g. 10.3 % male and 8.8 % female reported to hoot in a loud mode to obstructing minibus taxis). The above hypothesis is supported by these results. In Appendix 14, chi-square test results show a statistically significant relationship between being female driver and responses showed against minibus taxi red light runners ($\chi 2$ (df = 10, N =81) = 18.497, p = 0.04).

4.3.3.8 Effect of driver age on response behaviours showed

Consistent with previous studies, this study lastly hypothesised that the age of the driver frustrated by minibus taxis will affect his or her response behaviours. Figure 70 to Figure 75 illustrates the response behaviours reported by drivers of normal passenger cars with respect to each of the six types of minibus taxis' on-road aggressive behaviours. The frequency tables of the response behaviours are found in Appendix 15 to Appendix 22. The effect of driver age on the response behaviours showed was tested by cross tabulating driver age and forms of aggressive response behaviours showed with respect to each of the six types of minibus taxis' on-road aggressive behaviours. The chi-square test results of relationships are presented Appendix 23.

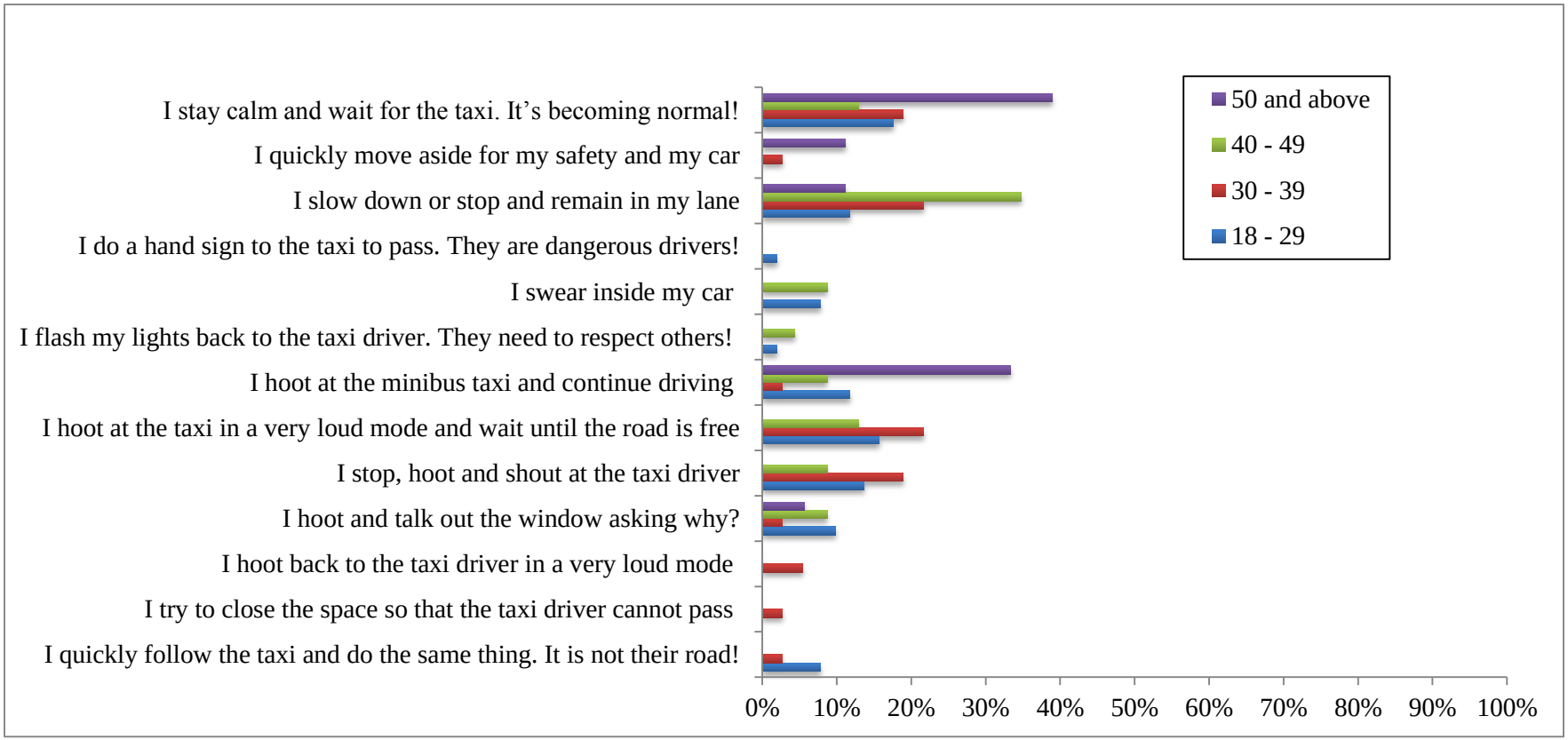


Figure 70 Driver age and response behaviours to aggressive cutting minibus taxis

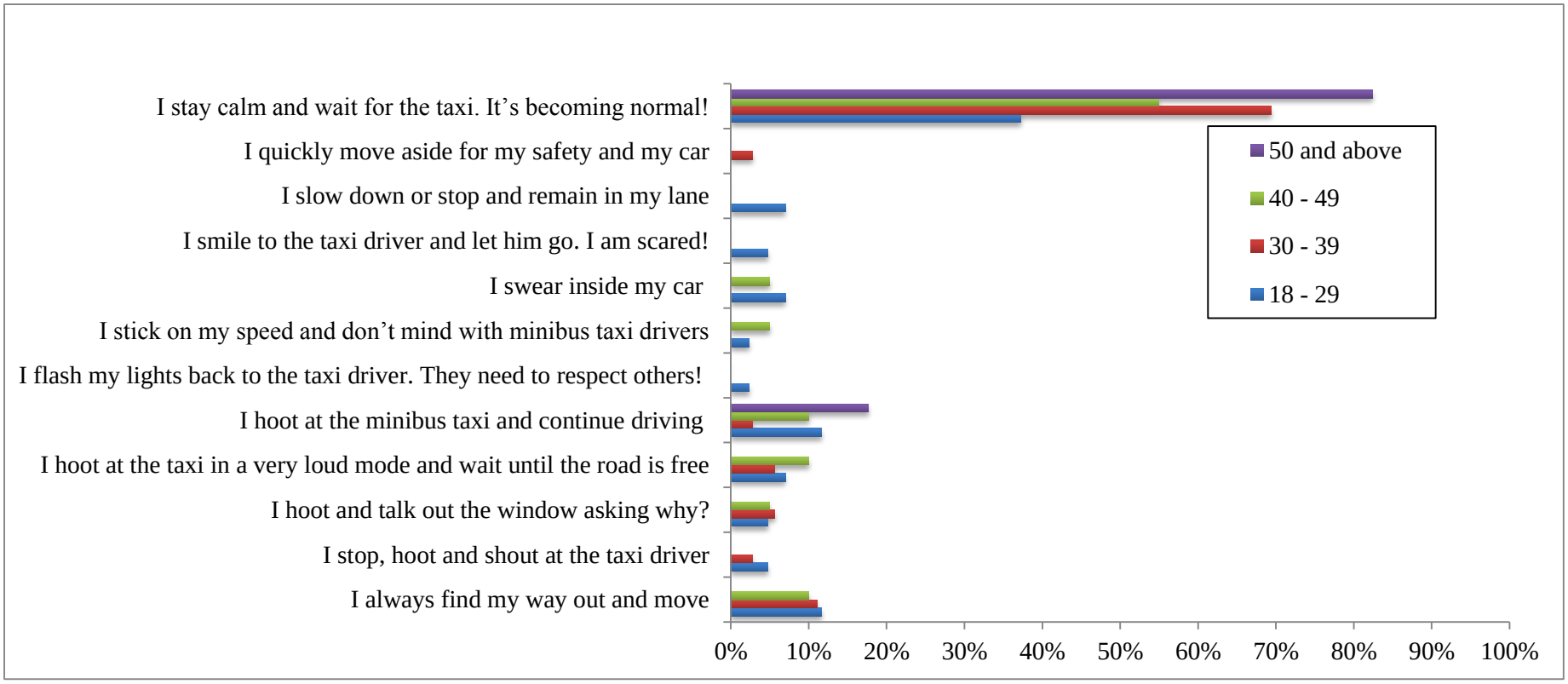


Figure 71 Driver age and response behaviours to traffic obstructions by minibus taxi drivers

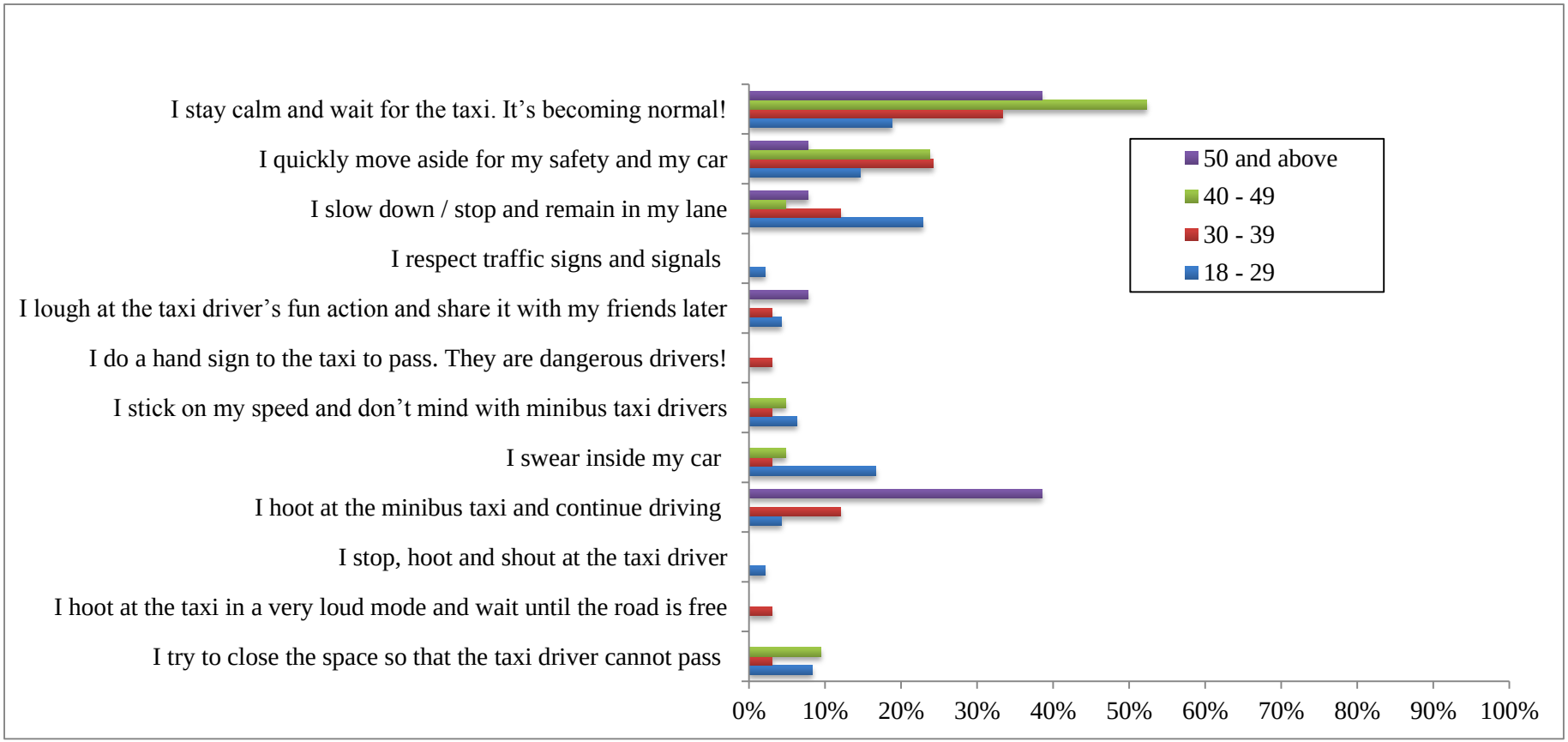


Figure 72 Driver age and response behaviours to taxi drivers overtaking on road shoulders or on YL

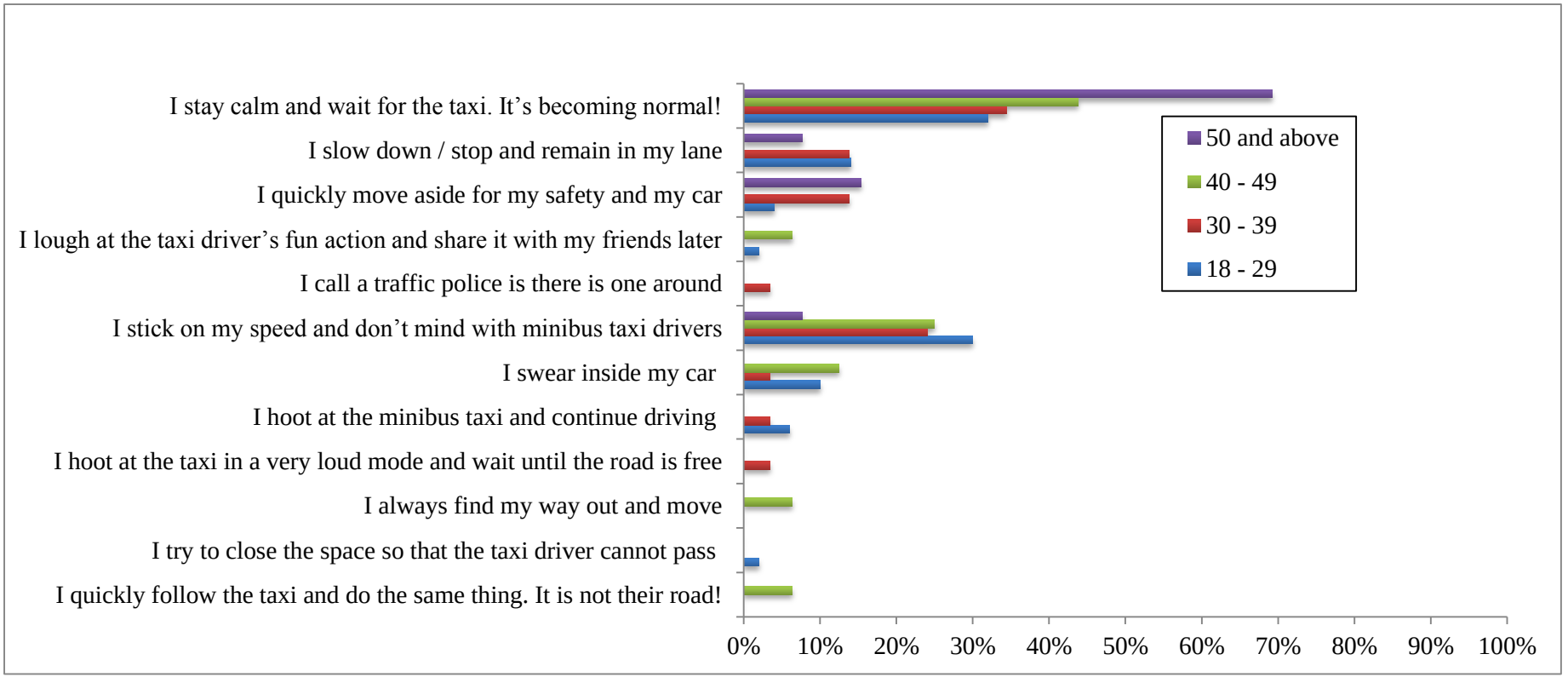


Figure 73 Driver age and response behaviours to speeding minibus taxis

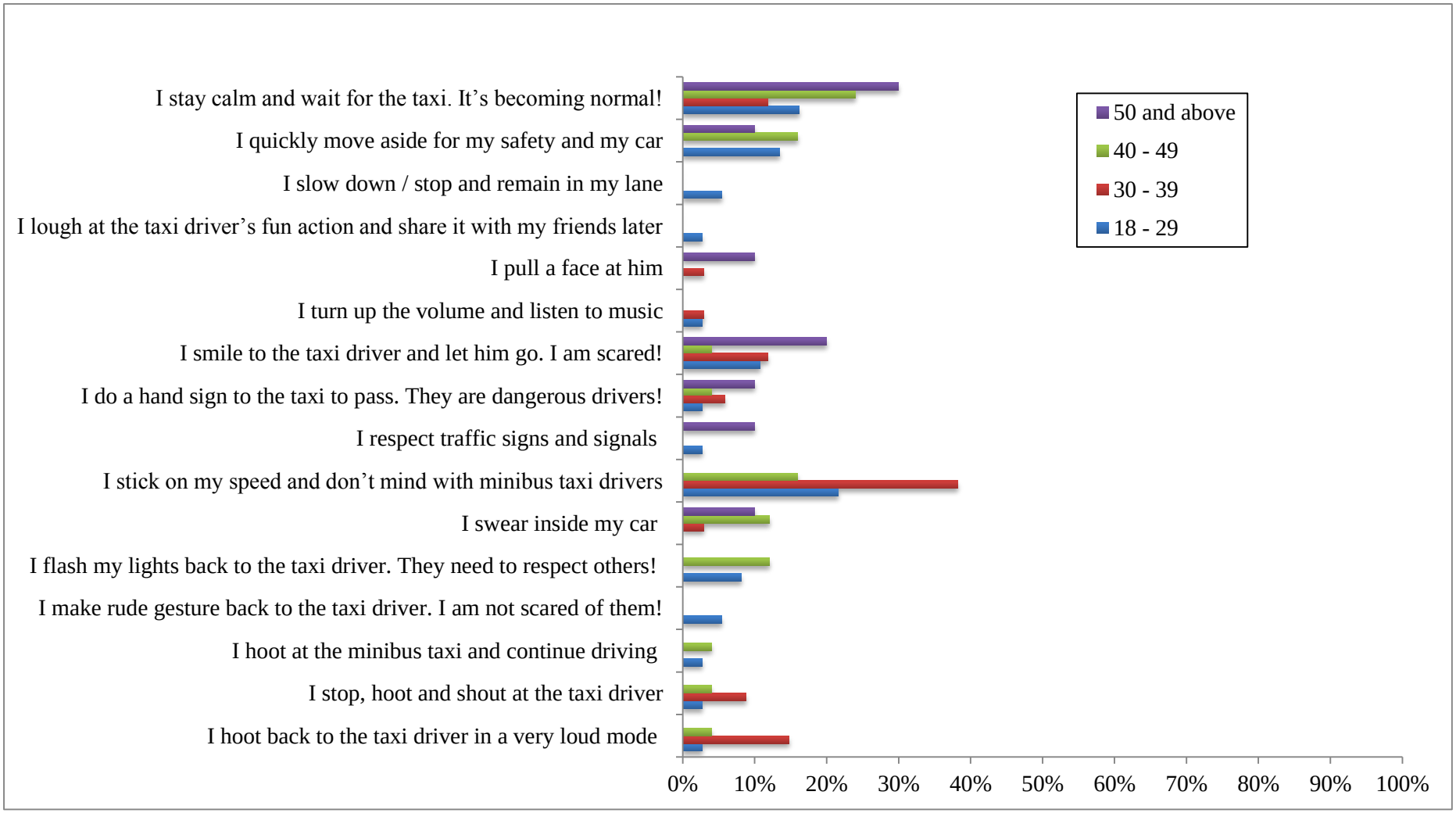


Figure 74 Driver age and response behaviours to aggressive hooting by minibus taxi drivers

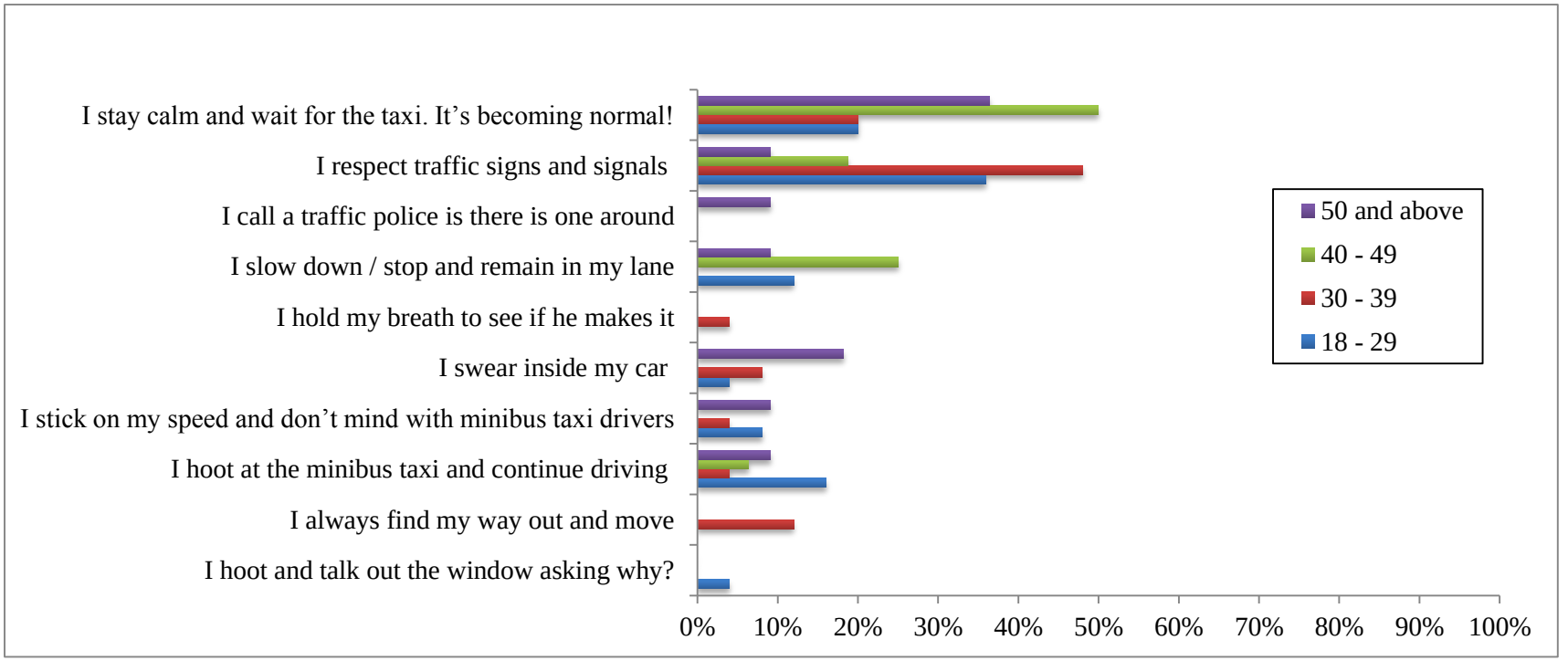


Figure 75 Driver age and response behaviours to red light running by minibus taxi drivers

4.3.3.9 Discussion

The last objective of this study was to test whether the age of the driver exposed to frustrating minibus taxis affects his or her response behaviours. It was hypothesised that young drivers frustrated by minibus taxis' on-road aggressive behaviours will respond more aggressively than frustrated older drivers. Literature findings on aggressive driving behaviours revealed that frustrated younger drivers are likely to show overt forms of aggression (such as making rude signs at another driver, sustained horn-hooking or engage risky driving) when they encountered drivers who impede their progress whereas middle-aged and older drivers likely show mild forms of aggression such as verbal protests (Parry, 1968). If we again look at the two extreme age groups in Figure 70, we see that the percentage of older drivers who reported hooting at the cutting minibus taxis in a very loud mode is low compared with younger drivers (9.8 % young drivers against 5.6 % old drivers). For this same behaviour, 7.8 % younger drivers aged between 18 and 29 years old reported to follow cutting minibus taxis and do the same. In Figure 71, 11.6 % young drivers said that they always find way out when obstructed by minibus taxis and move whereas 4.7 % hoot and shout at the obstructing minibus taxis. There was no older driver (aged from 50 years and above) who reported hooting and shouting at the minibus taxis or to find way out and escape for these two aggressive behaviours.

In Figure 72, 8.3 % younger drivers against 0.0 % older drivers reported to close the space in order to prevent minibus taxis to push through on hard shoulders. The numbers of older drivers who reported hooting at the overtaking minibus taxis and continue driving was higher than that of young drivers (38.5 % older drivers against 4.2 % younger drivers). In Figure 73, 15.4 % older drivers against 4.0 % younger drivers reported driving to the left and provide more space to speeding minibus taxis for their safety and 18.2 % older drivers against 4.0 % young drivers in Figure 75 swore inside the cars when minibus taxis in front of them accelerate to run red lights. In **Figure 74**, 10.0 % older drivers against 2.7 % younger drivers reported to give hand sign to hooting minibus taxis to let them pass. These results support the hypothesis that frustrated younger drivers react more aggressively than frustrated older drivers. There was a significant relationship between being younger driver and the response behaviours showed against minibus taxi red light runners (χ^2 (df = 10, N = 79) = 18.912, p = 0.04).

Chapter 5 CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The main focus of this study was to examine the nature and the frequency of the most common types of the minibus taxi drivers' on-road aggressive behaviours and to identify the corresponding response behaviours of drivers of other vehicles. To achieve these objectives, three study sites (two located in the immediate proximity of signalised intersections i.e. M10 and Belrail Road in Bellville and M4 and Station Road in Observatory and one stretch of the road located in proximity of an interchange i.e. Hospital Bend on the N2 in Cape Town) were selected and a video observation technique was applied to record both the nature and the frequency of the minibus taxi drivers' on-road aggressive behaviours, as well as response manoeuvres from drivers of other vehicles. Through the use of survey questionnaires, this study also explored the effect of driver age and gender on the minibus taxi drivers' aggressive on-road behaviours and their effect on both levels of anger reported and on the likely response behaviours of drivers exposed to those aggressive behaviours from within the context of a Frustration and Aggression Model of aggressive driving. This chapter presents the main conclusions drawn from results and suggests recommendations for further research.

5.2 Conclusions

5.2.1 Video observation

The purpose of the video observation was to record the nature and the frequency of the minibus taxi drivers' aggressive driving behaviours as well as the response manoeuvres performed by drivers of the vehicles directly behind offending minibus taxis. The minibus taxi drivers' aggressive driving behaviours observed fall into three categories. The first category included traffic obstructions such as stopping in the road or outside designated bus stops to load or offload passengers and block traffic. In this group, more frequent obstructions occurred inside the road (60.0%) than outside bus stops (39.5%). The frequency of drivers who swerved to the next lane and passed obstructing minibus taxis was higher than that of drivers who hooted and waited for minibus taxis (57.7% against 33.7%). In a total of 175 drivers obstructed behind minibus taxis, only 15 (8.5%) remained calm and waited for obstructing minibus taxis until the road was free. It appeared that aggressive responses increased with the increase of time delay of obstructed drivers. For a time delay of less than or equal to five seconds, 66.0% of obstructed drivers started to hoot or to swerve to the next lanes.

The second category included traffic signs and signals violations such as red light running and stop sign violations. In this group, when a TTI greater than 2 seconds and an intersection approaching speed greater than 60 km/h were considered, 49 (26.2%) minibus taxis out of 187 violated stop line whereas 91 (48.7%) ran red lights. The most frequent response manoeuvre observed from drivers behind minibus

taxi red light runners was decelerating and stopping before the stop line (65.0%) and the least common reaction was accelerating and following minibus taxi red light runners (21.4%). When the minibus taxi drivers' speed change behaviour at the onset of yellow lights was considered, 120 (49.5%) accelerated as they perceived yellow lights whereas 122 (50.5%) decelerated. More aggressive behaviours were observed for minibus taxi drivers who decided to accelerate (116 red light running and 3 stop line violations) than for minibus taxi drivers who decelerated after they saw yellow lights (29 red light running and 48 stop line violations). The most frequent response manoeuvre observed was decelerating and stopping before the stop line (52.0%) whereas the least common response manoeuvre was accelerating and run behind minibus taxi red light runners (28.6%). For a TTI greater than 2 seconds and intersection approaching speed greater than 60km/h, 65.0% of the drivers behind minibus taxi red light runners decelerated and stopped before stop line whereas 21.4% accelerated and ran behind minibus taxis. When the minibus taxi drivers' speed change behaviour was considered, the frequency of decelerated vehicles was 52.0% whereas that of accelerated vehicles was 28.6%. The frequency of drivers who hooted at the minibus taxis to express frustration was very small (4.4%).

The third category included improper passing behaviours such as pushing through on hard shoulders or on yellow lanes, cutting in too close in front of cars, and inappropriate lane utilisation. In a sample of 600 minibus taxis involved in improper passing manoeuvres, 259 (43.2%) cut in too close in front of cars, 167 (27.8%) crossed a continuous line to pass vehicles in the next lane, 157 (26.2%) used a turning lane to pass or vice versa, and 17 (2.8%) used yellow lanes to overtake vehicles in front. The cutting in too close in front of cars behaviour was the most prevalent aggressive passing manoeuvre observed whereas pushing through on hard shoulders or on yellow lanes was the least common. The more frequent aggressive response manoeuvres observed from the overtaken drivers were swerving to the next lane and pass (16.4% against aggressive cutting minibus taxis and 31.1% against minibus taxis crossing continuous line to overtake cars in the next lanes) and accelerating to prevent minibus taxis to pass (2.2% against cutting minibus taxis and 6.5% against minibus taxis crossing continuous line to pass vehicles in the next lanes). The aggressiveness of the overtaken drivers appeared to increase with the increase of frustration. In this context, increase in frustration was expressed as the increase of minibus taxis' cutting angle or the decrease of minibus taxis' cutting distance for overtaken drivers. The frequency of drivers who swerved to the next lanes increased with the increase of minibus taxis' cutting angle and decreased with the decrease of minibus taxis' cutting distance.

In the video observation section, speeding and weaving in traffic were not examined. This was due to the fact that these two types of minibus taxis' aggressive driving behaviour require long stretch of road to be observed and recorded. However, speeds of minibus taxis approaching signalised intersections were determined in order to classify aggressive red light running and stop line violation behaviours.

In addition to the list of the minibus taxis' aggressive driving behaviours highlighted in the pilot study, inappropriate lane utilisation such as use of turning lane to pass or use of passing lane to turn were observed and driving reactions to these behaviours were examined.

5.2.2 Survey

The purpose of the survey section was to assess the influence of driver age and gender on the minibus taxi drivers' on-road aggressive behaviours reported. It also studied the effect of age and gender on the levels of anger aroused by drivers of normal passenger cars as well as on their likely response behaviours to the minibus taxi divers' frustrating situations. The findings in Chapter 4 revealed that minibus taxi driver' aggressive driving behaviour was age related. Younger taxi drivers reported more aggressive on-road behaviours than older taxi drivers. This association was strong for the more severe forms of aggression such as cutting in too close in front of cars (32.3% younger against 9.7% older), red light running (37.8% younger against 10.8% older), and pushing through on road shoulders (40.0% younger against 10.0% older). The most frequent on-road aggressive behaviour reported by taxi drivers was hooting (98.9%) whereas traffic obstruction was the least (38.5%).

There was differences between driver age and the rate of performing each of the seven forms of on-road aggressive behaviours examined. For aggressive behaviours such as cutting in too close in front of cars, pushing through on hard shoulders and red light running, the frequency of younger taxi drivers was higher than that of older taxi drivers reported. In contrast, drivers of other vehicles reported having been mostly subjected to cutting minibus taxis (77.2%) and to traffic obstructions caused by taxis (69.5%). The least common types of the on-road aggressive behaviours experienced by drivers of other vehicles in the last 12 months were red light running (46.1%) and changing lane without indicating (49.7 %).

The effect of driver age and gender on levels of anger reported by frustrated drivers was also assessed. Results identified no remarkable differences between driver characteristics and levels of anger reported by frustrated drivers. For almost all the six forms of minibus taxis' on-road aggressive behaviours studied, male drivers reported getting extremely angry i.e. ready to get out of their cars and argue, whereas female drivers got very angry and tried to calm down. Frustrated younger drivers reported getting extremely angry for on-road aggressive behaviours which directly focus them such as being hooted or being obstructed from passing. Frustrated older drivers on the other hand got extremely angry for the minibus taxi drivers' on-road aggressive behaviours which risk the safety of transported passengers such as speeding, pushing through on hard shoulders, or running red lights.

The response behaviours to the minibus taxi drivers' on-road aggressive behaviours were gender and age related. The findings in Chapter 4 reveal greater age and gender differences for riskier and more severe aggressive reactions and lower differences for non-riskier and less aggressive reactions. The frequency of younger and male drivers in aggressive response behaviours such as closing the space to

prevent minibus taxis from overtaking, swerving to the next lanes to overcome obstructing minibus taxis, and following cutting minibus taxis and cut them off was higher than that of older or female drivers. Smaller differences was found for responses such as hooting loudly at the offending minibus taxis, swearing inside the cars, and remaining calm and wait for minibus taxis. In contrast to what was hypothesised before, the frequencies of mild or less severe forms of aggressive responses were always higher than those of severe forms of anger expressions for each of the six forms of the minibus taxi drivers' on-road aggressive behaviours studied. The most severe form of the aggressive response behaviours reported was driving aggressively towards the offending minibus taxi drivers. In the list of seven alternative reactions to driving angering situations established by Lajunen et al. (1998), driving aggressively to the offender driver was number five. The least severe form of response reported was to remain calm and wait for minibus taxis to free the roads.

To see whether patterns of the response behaviours identified among victims of minibus taxi drivers' on-road aggressive can be explained psychologically, the theory of bullying and victimisation detailed in the literature review chapter is considered. For each of the six types of the minibus taxi drivers' on-road aggressive behaviours studied, three types of victims were distinguished. For instance, frustrated drivers who reported hooting back to minibus taxis (11.0% male against 1.9% female; 14.7% younger against 0.0% older), swerving aggressively to the next lane and moving off (14.5% male against 4.9% female; 11.6% younger against 0.0% older), trying to close the space to prevent minibus taxis from overtaking (10.3% male against 1.8% female; 8.3% younger against 0.0% older), and following cutting minibus taxis quickly and do the same (5.5% male against 1.8% female; 8.5% younger against 0.0% older) could be classified as counter-aggressive or provocative victims.

Frustrated drivers who reported swearing inside the car after they perceived minibus taxis running red lights (8.8% male against 4.7% female; 4.0% younger against 18.2% older), stopping and waiting for obstructing minibus taxis (58.2% male against 55.7%female; 37.2% younger against 82.4% older), driving aside to leave enough space for overtaking minibus taxis (13.8% male against 22.8%female; 14.6% younger against 23.8% older) have some similarities with the passive victims as defined in bullying research.

Lastly, frustrated drivers who reported not caring about aggressive minibus taxi drivers while driving with response behaviour such as maintaining same driving speed when as speeding minibus taxis approached them (21.8% male against 28.3 female; 30.0% younger against 7.7% older drivers) can arguably be equated with indifferent or nonchalant victims. More frustrated younger and male frustrated drivers were provocative whereas more frustrated older and female drivers were passive victims. The proportion of indifferent or non-caring victims was relatively small for each of the six types of aggressive behaviours investigated.

For minibus taxi drivers' aggressive behaviours such as stopping in the road and obstructing traffic, running red lights, and cutting in too close observed in video footage and examined in survey, there were differences between the response behaviours directly observed from video footage and what was reported by drivers of normal passenger cars in survey. In the video observation, 57.7% of drivers obstructed behind minibus taxis aggressively swerved to the next lane and move out whereas 33.7% hooted at the obstructing minibus taxis. In contrast, more than half respondents (58.5% male and 55.7% female) reported remaining calm and waiting for obstructing minibus taxis until the road was free to move. Only 14.5% male and 4.9% of female drivers reported swerving to the next lane and moving out. Again clear parallels here can be seen between the expected behaviour of victims of bullying, and the responses to minibus taxis. The aggression shown by some of the drivers in response to minibus taxi driving is perhaps an indication that, as in the world of social bullying, aggressive behaviour from one driver can precipitate aggressive driving in another.

For red light running behaviour, 28.0% of vehicles behind accelerated and followed minibus taxi red light runners in video observation whereas 20.6 % male and 41.9% female drivers reported to always decelerate and stop before stop line. In survey, 41.0% male and 18.6% female drivers reported to remain calm and watch minibus red light runners. No participants reported sometime accelerating and following minibus taxi red light runners in survey. In the video observation, drivers who increased their speeds as minibus taxi drivers started to cut in or to cross continuous line in order to overtake vehicles in the next lane were 2.2% and 16.4% respectively and those who swerved to the next lanes instead of speeding where 6.5% and 31.1% respectively. In the survey, 20.5% male and 19.6% female drivers reported remaining calm and wait for improper passing minibus taxis and there were no participants who reported to drive to the next lane and pass or to speed and refuse to extend cooperation with aggressive cutting minibus taxi drivers.

5.3 Recommendations

Based on the findings of this case study, the following recommendations are offered as possible ways to improve this study.

1. More sites should be selected and more video recording hours should be allowed to collect large and detailed samples of the minibus taxi drivers' aggressive driving behaviours. In this study, aggressive driving behaviours which require long stretches of roads to be observed were not examined. The large sample will help in establishing a general profile of the minibus taxi drivers' on-road aggressive behaviours and hence, give a better understanding of how much aggressive driving is taking place on roads.

2. The results obtained on the effect of driver age and gender on the minibus taxi drivers' on-road aggressive behaviours as well as on the response behaviours reported by drivers of normal passenger cars should be treated as preliminary and further investigation using a larger sample should be conducted to confirm some of the findings. The chi-square test of relationship used is more sensitive to sample size. It seemed the sample selected for the purpose of this study was possibly not sufficient enough to reveal statistically significant relationships between driver age and gender, levels of anger aroused, and the response behaviours reported.

3. The participant observational method of data collection in which the researcher takes part in the social situation under observation should be conducted to assess how frequent minibus taxis drivers engage in the on-road aggressive behaviours such as horn-honking, yelling at another driver, making rude signs to other drivers, and flashing head lights. In the survey, these types of aggressive on-road behaviours were reported at a rate of 60.0%, 27.5%, and 33.5% respectively by drivers of normal passenger cars and were not examined in the video footage.

4. A comparative study should be conducted to test the hypothesis if the response behaviours of drivers of other vehicles to the minibus taxi drivers' on-road aggressive behaviours are similar to those of victims of bullying.

5. Heart Rate Monitors (HRM) supplemented with video clips of minibus taxis' aggressive driving manoeuvres should be used as an alternative method to assess the levels of anger aroused by drivers exposed to minibus taxis' frustrating situations. In the present study the researcher was uncertain to know whether the levels of anger reported corresponded to what the subjects really feel. If possible, the state or mood of the subjects under investigation should be checked before the use of Heart Rate Monitors since this may alter results.

6. The road-side observational method should be conducted to simultaneously assess individual differences and the response behaviours demonstrated to the minibus taxi drivers' on-road aggressive behaviours. In the survey part of this study, the involvement of female drivers as well as that of old drivers was higher in the mild or less severe forms of aggressive responses to the minibus taxis' aggressive behaviours than that of males and younger drivers. However, nothing was concluded in the video observation part on individual differences and aggressive response behaviours showed.

7. A study should be conducted to assess the relationship between levels of anger aroused by drivers frustrated by minibus taxis' frustrating situations and their likely response behaviours.

This study did not establish a relationship between individual characteristics, levels of anger aroused, and the likely response behaviour showed.

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Appendices

Appendix 1: Preliminary survey questionnaire

Preliminary survey questionnaire	
Question:	Please write down minibus taxi drivers' on-road behaviours that frustrate or irritate you most when you are driving ?
1	…… ……
2	…… ……
3	…… ……
4	…… ……
5	…… ……
6	…… ……
7	…… ……
8	…… ……
9	…… ……
10	…… ……
Thank you for your time!	

Appendix 2: Estimated average Travel Time (Tav) and average Travel Speed (S)

Car No	Entry Time	Exit Time	Travel Time	Car No	Entry Time	Exit Time	Travel Time	Car No	Entry Time	Exit Time	Travel Time	Car No	Entry Time	Exit Time	Travel Time
1	03:59:57	04:00:02	00:00:05	31	04:05:28	04:05:35	00:00:07	61	04:13:03	04:13:13	00:00:10	91	04:30:15	04:30:21	00:00:06
2	04:00:07	04:00:12	00:00:05	32	04:05:43	04:05:49	00:00:06	62	04:13:20	04:13:24	00:00:04	92	04:30:32	04:30:37	00:00:05
3	04:00:13	04:00:17	00:00:04	33	04:05:49	04:05:54	00:00:05	63	04:13:27	04:13:31	00:00:04	93	04:30:39	04:30:43	00:00:04
4	04:00:19	04:00:25	00:00:06	34	04:06:16	04:06:23	00:00:07	64	04:14:50	04:14:55	00:00:05	94	04:30:45	04:30:50	00:00:05
5	04:00:27	04:00:33	00:00:06	35	04:06:27	04:06:31	00:00:04	65	04:14:58	04:15:07	00:00:09	95	04:30:54	04:30:58	00:00:04
6	04:00:39	04:00:47	00:00:08	36	04:06:40	04:06:45	00:00:05	66	04:15:12	04:15:17	00:00:05	96	04:31:11	04:31:15	00:00:04
7	04:00:50	04:00:55	00:00:05	37	04:06:46	04:06:51	00:00:05	67	04:15:26	04:15:33	00:00:07				
8	04:01:05	04:01:09	00:00:04	38	04:06:55	04:07:01	00:00:06	68	04:15:37	04:15:43	00:00:06				
9	04:01:11	04:01:15	00:00:04	39	04:07:02	04:07:08	00:00:06	69	04:15:46	04:15:52	00:00:06				
10	04:01:17	04:01:24	00:00:07	40	04:07:17	04:07:24	00:00:07	70	04:15:55	04:15:59	00:00:04				
11	04:01:25	04:01:31	00:00:06	41	04:07:29	04:07:33	00:00:04	71	04:16:02	04:16:07	00:00:05				
12	04:01:38	04:01:49	00:00:11	42	04:07:35	04:07:40	00:00:05	72	04:16:13	04:16:18	00:00:05				
13	04:01:51	04:01:55	00:00:04	43	04:07:42	04:07:46	00:00:04	73	04:16:25	04:16:33	00:00:08				
14	04:01:57	04:02:03	00:00:06	44	04:07:51	04:07:59	00:00:08	74	04:16:33	04:16:41	00:00:08				
15	04:02:06	04:02:11	00:00:05	45	04:08:14	04:08:19	00:00:05	75	04:16:52	04:16:56	00:00:04				
16	04:02:20	04:02:24	00:00:04	46	04:08:29	04:08:35	00:00:06	76	04:17:02	04:17:09	00:00:07				
17	04:02:31	04:02:36	00:00:05	47	04:08:37	04:08:41	00:00:04	77	04:17:12	04:17:22	00:00:10				
18	04:02:41	04:02:48	00:00:07	48	04:08:46	04:08:50	00:00:04	78	04:17:24	04:17:29	00:00:05				
19	04:02:57	04:03:02	00:00:05	49	04:11:08	04:11:15	00:00:07	79	04:17:31	04:17:35	00:00:04				
20	04:03:07	04:03:11	00:00:04	50	04:11:18	04:11:23	00:00:05	80	04:17:37	04:17:43	00:00:06				
21	04:03:19	04:03:24	00:00:05	51	04:11:31	04:11:36	00:00:05	81	04:17:45	04:17:51	00:00:06				
22	04:03:28	04:03:34	00:00:06	52	04:11:41	04:11:50	00:00:09	82	04:17:56	04:18:02	00:00:06				
23	04:03:44	04:03:48	00:00:04	53	04:11:55	04:12:01	00:00:06	83	04:18:12	04:18:18	00:00:06				
24	04:03:50	04:03:54	00:00:04	54	04:12:03	04:12:07	00:00:04	84	04:18:37	04:18:42	00:00:05				Total Time
25	04:03:57	04:04:03	00:00:06	55	04:12:09	04:12:13	00:00:04	85	04:18:46	04:18:50	00:00:04				[seconds]
26	04:04:05	04:04:09	00:00:04	56	04:12:15	04:12:20	00:00:05	86	04:18:55	04:19:02	00:00:07				**0:08:55**
27	04:04:14	04:04:19	00:00:05	57	04:12:23	04:12:29	00:00:06	87	04:29:36	04:29:43	00:00:07				
28	04:04:31	04:04:37	00:00:06	58	04:12:32	04:12:36	00:00:04	88	04:29:46	04:29:53	00:00:07				Mean Time
29	04:05:02	04:05:09	00:00:07	59	04:12:40	04:12:46	00:00:06	89	04:29:56	04:30:02	00:00:06				T [seconds]
30	04:05:14	04:05:18	00:00:04	60	04:12:50	04:12:55	00:00:05	90	04:30:04	04:30:09	00:00:05				**0:00:06**
Estimated average Travel Speed **S** = 10.8 km/h															

Appendix 3: Traffic count (Main Road and Station Road in Observatory), March 2014

			15 minutes count [vehicles/15 min]					
			Cape Town to Rondebosch [Leg 1 in Figure 2]					Total
		Time	Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles	
Trials	1	8:50 - 9:05	7	142	31	9	7	196
	2	9:30 - 9:45	3	161	27	4	10	205
	3	12:25 - 12:40	3	175	21	5	10	214
	4	12:40 - 12:55	4	149	30	4	9	196
	5	1:15 - 1:30	1	209	21	7	18	256

			Hourly volume [vehicles/hour]					
		Time	Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles	Total
Trials	1	8:50 - 9:05	28	568	124	36	28	784
	2	9:30 - 9:45	12	644	108	16	40	820
	3	12:25 - 12:40	12	700	84	20	40	856
	4	12:40 - 12:55	16	596	120	16	36	784
	5	1:15 - 1:30	4	836	84	28	72	1024

			15 minutes count [vehicles/hour]					
			Rondebosch to Cape Town [Leg 2 in Figure 2]					Total
	1	Time	Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles	
Trials	2	10:35 -10:50	1	169	30	8	11	219
	3	1:15 - 1:30	5	149	31	8	7	200
	4	9:15 - 9:30	2	152	52	9	6	221
	5	9:55 - 10:10	1	159	43	8	11	222
		4:20 - 4:35	2	136	26	27	5	196

			Hourly volume [vehicles/hour]					
		Time	Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles	Total
Trials	1	10:35 -10:50	4	676	120	32	44	876
	2	1:15 - 1:30	20	596	124	32	28	800
	3	9:15 - 9:30	8	608	208	36	24	884
	4	9:55 - 10:10	4	636	172	32	44	888
	5	4:20 - 4:35	8	544	104	108	20	784

Appendix 4: Traffic count on the stretch of the N2 (Hospital Bend in Cape Town), June 2014

		15 minutes count [vehicles/15 min/lane]						Total	Hourly volume [vehicles/hour/lane]					
			Stretch of the N2 (Hospital Bend in Cape Town)						Stretch of the N2 (Hospital Bend in Cape Town)					Total
		Time	Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles		Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles	
Trials	1	16:00 - 16:15	3	298	60	1	8	370	12	1192	240	4	32	1480
	2	16:15 - 16:30	2	209	41	0	4	256	8	836	164	0	16	1024
	3	16:30 - 16:45	6	321	68	0	5	400	24	1284	272	0	20	1600

Appendix 5: Traffic count (Belrail Road and M10 in Bellville), March 2014

15 minutes count [vehicles/15 min]									Hourly volume [vehicles/hour]					
			Intersection approach [1] in Figure 3					Total	Intersection approach [1] in Figure 3					Total
		Time	Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles		Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles	
Trials	1	7:30 - 7:45	1	54	141	3	1	200	4	216	564	12	4	800
	2	8:00 - 8:15	0	43	121	1	3	168	0	172	484	4	12	672
	3	8:30 - 8:45	2	60	137	4	5	208	8	240	548	16	20	832
			Intersection approach [2] in Figure 3					Total	Intersection approach [2] in Figure 3					Total
		Time	Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles		Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles	
Trials	1	7:30 - 7:45	1	267	131	13	19	431	4	1068	524	52	76	1724
	2	8:00 - 8:15	1	201	142	7	11	362	4	804	568	28	44	1448
	3	8:30 - 8:45	2	249	153	14	8	426	8	996	612	56	32	1704
			Intersection approach [3] in Figure 3					Total	Intersection approach [3] in Figure 3					Total
		Time	Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles		Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles	
Trials	1	7:30 - 7:45	0	195	76	2	2	275	0	780	304	8	8	1100
	2	8:00 - 8:15	0	263	130	5	5	403	0	1052	520	20	20	1612
	3	8:30 - 8:45	3		87	9	1	100	12	0	348	36	4	400
			Intersection approach [4] in Figure 3					Total	Intersection approach [4] in Figure 3					Total
		Time	Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles		Motocycles	Cars	Minibus taxis	Buses	Commercial vehicles	
Trials	1	7:30 - 7:45	4	247	20	0	10	281	16	988	80	0	40	1124
	2	8:00 - 8:15	1	298	34	4	12	349	4	1192	136	16	48	1396
	3	8:30 - 8:45	2	198	51	2	7	260	8	792	204	8	28	1040

Appendix 6: Self-reporting questionnaire for minibus taxi drivers

Date : ……/……/2014
Site : ……

A. Driver's personal information

1. Gender	Male		Female		
2. Age	18 – 29		40 – 49		
	30 – 39		50 & above		

B. On-road driving behaviours

3. Under which circomstances do you perform the following driving behaviours ?

3.1 Hooting at other drivers.

How often do you do this?

1	2	3	4
Never	Sometimes	Often	Very often

3.2 Driving fast or speeding

How often do you do this?

1	2	3	4
Never	Sometimes	Often	Very often

3.3 Not stopping at the red light (Robots)

How often do you do this?

1	2	3	4
Never	Sometimes	Often	Very often

3.4 Changing lanes without indicating.

How often do you do this?

1	2	3	4
Never	Sometimes	Often	Very often

3.5 Cutting in too close in front of other vehicles.

How often do you do this?

1	2	3	4
Never	Sometimes	Often	Very often

3.6 Driving on road shoulder to pass vehicles in front

How often do you do this?

1	2	3	4
Never	Sometimes	Often	Very often

3.7 Obstructing other vehicles from passing.

How often do you do this?

1	2	3	4
Never	Sometimes	Often	Very often

B. Exposure time, accident history, and road safety awareness

4. How many hours do you drive per day?

1	Less than 3 hours	
2	Between 3 – 8 hours	
3	More than 8 hours	

5. Have you been involved in road traffic accident in the last 12 months? Yes ☐ No ☐

If "Yes": How many times?

1	1 – 2 times	
2	3 – 5 times	
3	More than 5 times	

6. As a driver, what sort of attention do you usually pay while driving?

1. Drive on the right way	☐	4. Correct LT/RT and U-turn	☐
2. Correct lane maneuvres	☐	5. Follow speed limit	☐
3. Follow traffic signs / signals	☐	6. Driving with good health conditions	☐

Thank you for your time!

Appendix 7: Self-reporting questionnaire for drivers of other vehicles

Date	: ……/……/2014				
Site	: ……				
a. Driver's personal information					
1. Gender		Male		Female	
2. Age		18 – 29		40 – 49	
		30 – 39		50 and +	
b. Minibus taxi drivers' aggressive behaviours suffered by normal drivers					
3. Have you been subject to the minibus taxi drivers' on-road aggressive behaviours in the last 12 months?					
		Yes		No	
4. If "Yes" which of the following types of minibus taxi drivers' on-road aggressive behaviours have you been subject to ?					
	4.1 I have been closely followed by a minibus taxi driver.				
	4.2 I have been obstructed or blocked by a minibus taxi driver from moving.				
	4.3 I have been overtaken by a minibus taxi driver who drove on road shoulder.				
	4.4 I have been subject to a minibus taxi driver weaving in and out of the traffic.				
	4.5 I have been subject to minibus taxi divers speeding.				
	4.6 I have been subject to a minibus taxi driver changing lane without indicating.				
	4.7 A minibus taxi driver forced his way into the traffic from a minor street.				
	4.8 I have been subject to minibus taxis cutting in too close in front of me.				

4.9 I have been subject to a minibus taxi driver running a red light in front of me.

4.10 A minibus taxi failed to yield the right of way for me at stop street.

4.11 I have been hooted at by a minibus driver because of my driving.

4.12 A minibus taxi driver flashed aggressively his/her head lights at night at me.

4.13 A minibus taxi driver said rude things to me when I complained about his/her driving.

4.14 A minibus taxi made a rude gesture to me when I complained about his/her driving

4.15 I have been subject to other types of minibus taxi aggressive driving behaviours.

c. Levels of anger produced by each situation and the corresponding response behaviours

5. Please read each statement and indicate how angry each of the situations would make you. Indicate your most likely reaction to each of the situations [_Use of photographs and video clips describing these driving situations if possible]

5.1 You are obstructed from passing by a minibus taxi pulling out or loading passengers inside the road.

How do you feel?			How do you react?
	1	Not at all angry	
	2	A little angry	
	3	Very angry	
	4	Extremely angry	

5.2 You are driving and a minibus taxis cuts in too close in front of you.

How do you feel?			How do you react?
	1	Not at all angry	
	2	A little angry	
	3	Very angry	
	4	Extremely angry	

5.3 You are overtaken by a minibus taxi driver driving on road shoulder.

How do you feel?				How do you react?	
	1	Not at all angry			
	2	A little angry			
	3	Very angry			
	4	Extremely angry			

5.4 You are approaching a robot and a minibus taxi in front of you accelerates to run the red light.

How do you feel?				How do you react?	
	1	Not at all angry			
	2	A little angry			
	3	Very angry			
	4	Extremely angry			

5.5 You are driving and a minibus taxi drivers drives at a very high speed past you.

How do you feel?				How do you react?	
	1	Not at all angry			
	2	A little angry			
	3	Very angry			
	4	Extremely angry			

5.6 You are driving and a minibus taxi driver hoots at you, aggressively flashes headlights or makes rude gestures at you.

How do you feel?				How do you react?	
	1	Not at all angry			
	2	A little angry			
	3	Very angry			
	4	Extremely angry			

6. Is there any area in the Western Cape/Cape Town where you find minibus taxi drivers more aggressive?

Yes ☐ No ☐

If "Yes" Where?

Thank you for your time!

Appendix 8: Chi-square test results / Driver gender and levels of anger aroused

	Male	Female
Cutting in too close in front of cars	χ^2(df = 3, N = 101) = 5.300, p = 0.15	χ^2(df = 3, N = 81) = 4.702, p = 0.19
Preventing vehicles from passing	χ^2(df = 3, N = 101) = 6.167, p = 0.10	χ^2(df = 3, N = 81) = 0.352, p = 0.95
Overtaking on road shoulder or yellow lanes	χ^2(df = 3, N = 101) = 3.011, p = 0.39	χ^2(df = 3, N = 81) = 6.089, p = 0.11
Exceeding speed limits or speeding	χ^2(df = 3, N = 101) = 2.357, p = 0.50	χ^2(df = 3, N = 81) = 4.876, p = 0.18
Hooting	χ^2(df = 3, N = 101) = 1.431, p = 0.69	χ^2(df = 3, N = 81) = 8.177, p = 0.04
Red light running	χ^2(df = 3, N = 101) = 8.092, p = 0.04	χ^2(df = 3, N = 81) = 6.300, p = 0.09

Appendix 9: Chi-square test results / Driver age and levels anger aroused

	18 – 29 years	30 – 39 years	40 – 49 years	50 – above
Cutting in too close	χ^2(df = 3, N = 79) = 1.762, p = 0.62	χ^2(df = 3, N = 50) = 4.064, p = 0.25	χ^2(df = 3, N = 32) = 3.872, p = 0.27	χ^2(df = 3, N = 21) = 4.667, p = 0.19
Traffic obstruction	χ^2(df = 3, N = 79) = 1.143, p = 0.77	χ^2(df = 3, N = 50) = 1.670, p = 0.64	χ^2(df = 3, N = 32) = 6.446, p = 0.09	χ^2(df = 3, N = 21) = 7.165, p = 0.06
Overtaking on shoulder	χ^2(df = 3, N = 79) = 3.256, p = 0.35	χ^2(df = 3, N = 50) = 8.474, p = 0.03	χ^2(df = 3, N = 32) = 4.590, p = 0.20	χ^2(df = 3, N = 21) = 1.706, p = 0.64
Speeding	χ^2(df = 3, N = 79) = 0.511, p = 0.92	χ^2(df = 3, N = 50) = 0.716, p = 0.87	χ^2(df = 3, N = 32) = 5.000, p = 0.17	χ^2(df = 3, N = 21) = 8.986, p = 0.03
Hooting	χ^2(df = 3, N = 79) = 2.954, p = 0.40	χ^2(df = 3, N = 50) = 5.729, p = 0.13	χ^2(df = 3, N = 32) = 3.275, p = 0.35	χ^2(df = 3, N = 21) = 11.645, p = 0.01
RLR	χ^2(df = 3, N = 79) = 4.521, p = 0.21	χ^2(df = 3, N = 50) = 4.246, p = 0.23	χ^2(df = 3, N = 32) = 1.876, p = 0.60	χ^2(df = 3, N = 21) = 10.576, p = 0.01

Appendix 10: Driver gander and response behaviours to minibus taxis' aggressive behaviours

Driver gender	Response behaviours of the victims	Cutting in too close		Obstructing traffic		Overtaking on road shoulder	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
Male	I stay calm and wait for the taxi. It's becoming normal!	15	20.5	32	58.2	16	27.6
	I hoot at the minibus taxi and continue driving	10	13.7	3	5.5	6	10.3
	I always find my way out and move	0	0.0	8	14.5	0	0.0
	I quickly move aside for my safety and my car	2	2.7	1	1.8	8	13.8
	I slow down / stop and remain in my lane	15	20.5	2	3.6	11	19.0
	I lough at the taxi driver's fun action and share it with my friends later	0	0.0	0	0.0	2	3.4
	I stick on my speed and don't mind with minibus taxi drivers	0	0.0	1	1.8	3	5.2
	I hoot at the taxi in a very loud mode and wait until the road is free	9	12.3	2	3.6	0	0.0
	I quickly follow the taxi and do the same thing. It is not their road!	4	5.5	0	0.0	0	0.0
	I hoot and talk out the window asking why?	6	8.2	2	3.6	0	0.0
	I turn up the volume and listen to music	0	0.0	0	0.0	0	0.0
	I call a traffic police is there is one around	0	0.0	0	0.0	0	0.0
	I swear inside my car	1	1.4	2	3.6	6	10.3
	I confront with the taxi driver sometimes	0	0.0	0	0.0	0	0.0
	I try to close the space so that the taxi driver cannot pass	1	1.4	0	0.0	6	10.3
	I smile to the taxi driver and let him go. I am scared!	0	0.0	0	0.0	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	1	1.4	0	0.0	0	0.0
	I stop, hoot and shout at the taxi driver	8	11.0	2	3.6	0	0.0
	I respect traffic signs and signals	0	0.0	0	0.0	0	0.0
	I hoot back to the taxi driver in a very loud mode	1	1.4	0	0.0	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	0	0.0	0	0.0	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	0	0.0	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0.0	0	0.0
	I pull a face at him	0	0.0	0	0.0	0	0.0
Total		73	100.0	55	100.0	58	100.0

Appendix 11: Driver gander and response behaviours to minibus taxis' aggressive behaviours "(cont.)"

Driver gender	Response behaviours of the victims	Cutting in too close		Obstructing traffic		Overtaking on road shoulder	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
Female	I stay calm and wait for the taxi. It's becoming normal!	11	19.6	34	55.7	20	35.1
	I hoot at the minibus taxi and continue driving	5	8.9	8	13.1	5	8.8
	I always find my way out and move	0	0.0	3	4.9	0	0.0
	I quickly move aside for my safety and my car	1	1.8	0	0.0	13	22.8
	I slow down / stop and remain in my lane	9	16.1	1	1.6	6	10.5
	I lough at the taxi driver's fun action and share it with my friends later	0	0.0	0	0.0	2	3.5
	I stick on my speed and don't mind with minibus taxi drivers	0	0.0	1	1.6	2	3.5
	I hoot at the taxi in a very loud mode and wait until the road is free	10	17.9	5	8.2	1	1.8
	I quickly follow the taxi and do the same thing. It is not their road!	1	1.8	0	0.0	0	0.0
	I hoot and talk out the window asking why?	3	5.4	3	4.9	0	0.0
	I turn up the volume and listen to music	0	0.0	0	0.0	0	0.0
	I call a traffic police is there is one around	0	0.0	0	0.0	0	0.0
	I swear inside my car	5	8.9	2	3.3	4	7.0
	I confront with the taxi driver sometimes	0	0.0	0	0.0	0	0.0
	I try to close the space so that the taxi driver cannot pass	0	0.0	0	0.0	1	1.8
	I smile to the taxi driver and let him go. I am scared!	0	0.0	2	3.3	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0.0	0	0.0	1	1.8
	I stop, hoot and shout at the taxi driver	8	14.3	1	1.6	1	1.8
	I respect traffic signs and signals	0	0.0	0	0.0	1	1.8
	I hoot back to the taxi driver in a very loud mode	1	1.8	0	0.0	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	2	3.6	0	0.0	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	1	1.6	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0.0	0	0.0
	I pull a face at him	0	0.0	0	0.0	0	0.0
Total		56	100.0	61	100.0	57	100.0

Appendix 12: Driver gander and response behaviours to minibus taxis' aggressive behaviours "(cont.)"

Driver gender	Response behaviours of the victims	Speeding		Hooting		Red Light Running	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
Male	I stay calm and wait for the taxi. It's becoming normal!	27	49.1	13	24.1	14	41.2
	I hoot at the minibus taxi and continue driving	1	1.8	1	1.9	4	11.8
	I always find my way out and move	0	0.0	0	0.0	0	0.0
	I quickly move aside for my safety and my car	4	7.3	4	7.4	0	0.0
	I slow down / stop and remain in my lane	4	7.3	0	0.0	3	8.8
	I lough at the taxi driver's fun action and share it with my friends later	1	1.8	1	1.9	0	0.0
	I stick on my speed and don't mind with minibus taxi drivers	12	21.8	14	25.9	1	2.9
	I hoot at the taxi in a very loud mode and wait until the road is free	0	0.0	0	0.0	0	0.0
	I quickly follow the taxi and do the same thing. It is not their road!	1	1.8	0	0.0	0	0.0
	I hoot and talk out the window asking why?	0	0.0	0	0.0	1	2.9
	I turn up the volume and listen to music	0	0.0	1	1.9	0	0.0
	I call a traffic police is there is one around	0	0.0	0	0.0	0	0.0
	I swear inside my car	5	9.1	2	3.7	3	8.8
	I confront with the taxi driver sometimes	0	0.0	0	0.0	0	0.0
	I try to close the space so that the taxi driver cannot pass	0	0.0	0	0.0	0	0.0
	I smile to the taxi driver and let him go. I am scared!	0	0.0	1	1.9	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0.0	1	1.9	0	0.0
	I stop, hoot and shout at the taxi driver	0	0.0	2	3.7	0	0.0
	I respect traffic signs and signals	0	0.0	2	3.7	7	20.6
	I hoot back to the taxi driver in a very loud mode	0	0.0	6	11.1	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	0	0.0	5	9.3	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	0	0.0	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0.0	1	2.9
	I pull a face at him	0	0.0	1	1.9	0	0.0
Total		55	100.0	54	100.0	34	100.0

Appendix 13: Driver gander and response behaviours to minibus taxis' aggressive behaviours "(cont.)"

Driver gender	Response behaviours of the victims	Speeding		Hooting		Red Light Running	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
Female	I stay calm and wait for the taxi. It's becoming normal!	15	28.3	6	11.5	8	18.6
	I hoot at the minibus taxi and continue driving	3	5.7	1	1.9	3	7.0
	I always find my way out and move	0	0.0	0	0.0	0	0.0
	I quickly move aside for my safety and my car	4	7.5	6	11.5	0	0.0
	I slow down / stop and remain in my lane	9	17.0	2	3.8	8	18.6
	I lough at the taxi driver's fun action and share it with my friends later	1	1.9	0	0.0	0	0.0
	I stick on my speed and don't mind with minibus taxi drivers	15	28.3	11	21.2	3	7.0
	I hoot at the taxi in a very loud mode and wait until the road is free	1	1.9	0	0.0	0	0.0
	I quickly follow the taxi and do the same thing. It is not their road!	0	0.0	0	0.0	0	0.0
	I hoot and talk out the window asking why?	0	0.0	0	0.0	0	0.0
	I turn up the volume and listen to music	0	0.0	1	1.9	0	0.0
	I call a traffic police is there is one around	1	1.9	0	0.0	1	2.3
	I swear inside my car	3	5.7	3	5.8	2	4.7
	I confront with the taxi driver sometimes	0	0.0	0	0.0	0	0.0
	I try to close the space so that the taxi driver cannot pass	1	1.9	0	0.0	0	0.0
	I smile to the taxi driver and let him go. I am scared!	0	0.0	10	19.2	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0.0	4	7.7	0	0.0
	I stop, hoot and shout at the taxi driver	0	0.0	3	5.8	0	0.0
	I respect traffic signs and signals	0	0.0	0	0.0	18	41.9
	I hoot back to the taxi driver in a very loud mode	0	0.0	1	1.9	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	0	0.0	1	1.9	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	2	3.8	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0.0	0	0.0
	I pull a face at him	0	0.0	1	1.9	0	0.0
Total		53	100.0	52	100.0	43	100.0

Appendix 14: Chi-square test results / Driver gender and responses to minibus taxis 'aggressive behaviours

	Male	Female
Cutting in too close in front of cars	χ^2(df = 12, N = 101) = 12.766, p = 0.38	χ^2(df = 11, N = 81) = 22.325, p = 0.02
Preventing vehicles from passing	χ^2(df = 11, N = 101) = 9.691, p = 0.56	χ^2(df = 10, N = 81) = 16.588, p = 0.08
Overtaking on road shoulder or yellow lanes	χ^2(df = 10, N = 101) = 10.881, p = 0.37	χ^2(df = 12, N = 81) = 16.217, p = 0.18
Exceeding speed limits or speeding	χ^2(df = 10, N = 101) = 10.869, p = 0.37	χ^2(df = 10, N = 81) = 7.014, p = 0.72
Hooting	χ^2(df = 16, N = 101) = 22.103, p = 0.140	χ^2(df = 15, N = 81) = 23.736, p = 0.07
Red light running	χ^2(df = 9, N = 101) = 14.038, p = 0.12	χ^2(df = 10, N = 81) = 18.497, p = 0.04

Appendix 15: Driver age and responses to minibus taxis' aggressive behaviours

Driver age	Response behaviours of the victims	Cutting in too close		Obstructing traffic		Overtaking on road shoulder	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
18 - 29	I stay calm and wait for the taxi. It's becoming normal!	9	17.6	16	37.2	9	18.8
	I hoot at the minibus taxi and continue driving	6	11.8	5	11.6	2	4.2
	I always find my way out and move	0	0.0	5	11.6	0	0.0
	I quickly move aside for my safety and my car	0	0.0	0	0.0	7	14.6
	I slow down / stop and remain in my lane	6	11.8	3	7.0	11	22.9
	I lough at the taxi driver's fun action and share it with my friends later	0	0.0	0	0.0	2	4.2
	I stick on my speed and don't mind with minibus taxi drivers	0	0.0	1	2.3	3	6.3
	I hoot at the taxi in a very loud mode and wait until the road is free	8	15.7	3	7.0	0	0.0
	I quickly follow the taxi and do the same thing. It is not their road!	4	7.8	0	0.0	0	0.0
	I hoot and talk out the window asking why?	5	9.8	2	4.7	0	0.0
	I turn up the volume and listen to music	0	0.0	0	0.0	0	0.0
	I call a traffic police is there is one around	0	0.0	0	0.0	0	0.0
	I swear inside my car	4	7.8	3	7.0	8	16.7
	I confront with the taxi driver sometimes	0	0.0	0	0.0	0	0.0
	I try to close the space so that the taxi driver cannot pass	0	0.0	0	0.0	4	8.3
	I smile to the taxi driver and let him go. I am scared!	0	0.0	2	4.7	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	1	2.0	0	0.0	0	0.0
	I stop, hoot and shout at the taxi driver	7	13.7	2	4.7	1	2.1
	I respect traffic signs and signals	0	0.0	0	0.0	1	2.1
	I hoot back to the taxi driver in a very loud mode	0	0.0	0	0.0	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	1	2.0	1	2.3	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	0	0.0	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0.0	0	0.0
	I pull a face at him	0	0.0	0	0.0	0	0.0
Total		51	100.0	43	100.0	48	100.0

Appendix 16: Driver age and responses to minibus taxis' aggressive behaviours "(cont.)"

Driver age	Response behaviours of the victims	Speeding		Hooting		Red Light Running	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
18 - 29	I stay calm and wait for the taxi. It's becoming normal!	16	32	6	16.2	5	20
	I hoot at the minibus taxi and continue driving	3	6	1	2.7	4	16
	I always find my way out and move	0	0	0	0.0	0	0
	I quickly move aside for my safety and my car	2	4	5	13.5	0	0
	I slow down / stop and remain in my lane	7	14	2	5.4	3	12
	I lough at the taxi driver's fun action and share it with my friends later	1	2	1	2.7	0	0
	I stick on my speed and don't mind with minibus taxi drivers	15	30	8	21.6	2	8
	I hoot at the taxi in a very loud mode and wait until the road is free	0	0	0	0.0	0	0
	I quickly follow the taxi and do the same thing. It is not their road!	0	0	0	0.0	0	0
	I hoot and talk out the window asking why?	0	0	0	0.0	1	4
	I turn up the volume and listen to music	0	0	1	2.7	0	0
	I call a traffic police is there is one around	0	0	0	0.0	0	0
	I swear inside my car	5	10	0	0.0	1	4
	I confront with the taxi driver sometimes	0	0	0	0.0	0	0
	I try to close the space so that the taxi driver cannot pass	1	2	0	0.0	0	0
	I smile to the taxi driver and let him go. I am scared!	0	0	4	10.8	0	0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0	1	2.7	0	0
	I stop, hoot and shout at the taxi driver	0	0	1	2.7	0	0
	I respect traffic signs and signals	0	0	1	2.7	9	36
	I hoot back to the taxi driver in a very loud mode	0	0	1	2.7	0	0
	I flash my lights back to the taxi driver. They need to respect others!	0	0	3	8.1	0	0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0	2	5.4	0	0
	I hold my breath to see if he makes it	0	0	0	0.0	0	0
	I pull a face at him	0	0	0	0.0	0	0
Total		50	100.0	37	100.0	25	100.0

Appendix 17: Driver age and responses to minibus taxis' aggressive behaviours "(cont.)"

Driver age	Response behaviours of the victims	Cutting in too close		Obstructing traffic		Overtaking on road shoulder	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
30 - 39	I stay calm and wait for the taxi. It's becoming normal!	7	18.9	25	69.4	11	33.3
	I hoot at the minibus taxi and continue driving	1	2.7	1	2.8	4	12.1
	I always find my way out and move	0	0.0	4	11.1	0	0.0
	I quickly move aside for my safety and my car	1	2.7	1	2.8	8	24.2
	I slow down / stop and remain in my lane	8	21.6	0	0.0	4	12.1
	I lough at the taxi driver's fun action and share it with my friends later	0	0.0	0	0.0	1	3.0
	I stick on my speed and don't mind with minibus taxi drivers	0	0.0	0	0.0	1	3.0
	I hoot at the taxi in a very loud mode and wait until the road is free	8	21.6	2	5.6	1	3.0
	I quickly follow the taxi and do the same thing. It is not their road!	1	2.7	0	0.0	0	0.0
	I hoot and talk out the window asking why?	1	2.7	2	5.6	0	0.0
	I turn up the volume and listen to music	0	0.0	0	0.0	0	0.0
	I call a traffic police is there is one around	0	0.0	0	0.0	0	0.0
	I swear inside my car	0	0.0	0	0.0	1	3.0
	I confront with the taxi driver sometimes	0	0.0	0	0.0	0	0.0
	I try to close the space so that the taxi driver cannot pass	1	2.7	0	0.0	1	3.0
	I smile to the taxi driver and let him go. I am scared!	0	0.0	0	0.0	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0.0	0	0.0	1	3.0
	I stop, hoot and shout at the taxi driver	7	18.9	1	2.8	0	0.0
	I respect traffic signs and signals	0	0.0	0	0.0	0	0.0
	I hoot back to the taxi driver in a very loud mode	2	5.4	0	0.0	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	0	0.0	0	0.0	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	0	0.0	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0.0	0	0.0
	I pull a face at him	0	0.0	0	0.0	0	0.0
Total		37	100.0	36	100.0	33	100.0

Appendix 18: Driver age and responses to minibus taxis' aggressive behaviours "(cont.)"

Driver age	Response behaviours of the victims	Speeding		Hooting		Red Light Running	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
30 - 39	I stay calm and wait for the taxi. It's becoming normal!	10	34.5	4	11.8	5	20
	I hoot at the minibus taxi and continue driving	1	3.4	0	0.0	1	4
	I always find my way out and move	0	0.0	0	0.0	3	12
	I quickly move aside for my safety and my car	4	13.8	0	0.0	0	0
	I slow down / stop and remain in my lane	4	13.8	0	0.0	0	0
	I lough at the taxi driver's fun action and share it with my friends later	0	0.0	0	0.0	0	0
	I stick on my speed and don't mind with minibus taxi drivers	7	24.1	13	38.2	1	4
	I hoot at the taxi in a very loud mode and wait until the road is free	1	3.4	0	0.0	0	0
	I quickly follow the taxi and do the same thing. It is not their road!	0	0.0	0	0.0	0	0
	I hoot and talk out the window asking why?	0	0.0	0	0.0	0	0
	I turn up the volume and listen to music	0	0.0	1	2.9	0	0
	I call a traffic police is there is one around	1	3.4	0	0.0	0	0
	I swear inside my car	1	3.4	1	2.9	2	8
	I confront with the taxi driver sometimes	0	0.0	0	0.0	0	0
	I try to close the space so that the taxi driver cannot pass	0	0.0	0	0.0	0	0
	I smile to the taxi driver and let him go. I am scared!	0	0.0	4	11.8	0	0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0.0	2	5.9	0	0
	I stop, hoot and shout at the taxi driver	0	0.0	3	8.8	0	0
	I respect traffic signs and signals	0	0.0	0	0.0	12	48
	I hoot back to the taxi driver in a very loud mode	0	0.0	5	14.7	0	0
	I flash my lights back to the taxi driver. They need to respect others!	0	0.0	0	0.0	0	0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	0	0.0	0	0
	I hold my breath to see if he makes it	0	0.0	0	0.0	1	4
	I pull a face at him	0	0.0	1	2.9	0	0
Total		29	100.0	34	100.0	25	100.0

Appendix 19: Driver age and responses to minibus taxis' aggressive behaviours "(cont.)"

Driver age	Response behaviours of the victims	Cutting in too close		Obstructing traffic		Overtaking on road shoulder	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
40 - 49	I stay calm and wait for the taxi. It's becoming normal!	3	13.0	11	55	11	52.4
	I hoot at the minibus taxi and continue driving	2	8.7	2	10	0	0.0
	I always find my way out and move	0	0.0	2	10	0	0.0
	I quickly move aside for my safety and my car	0	0.0	0	0	5	23.8
	I slow down / stop and remain in my lane	8	34.8	0	0	1	4.8
	I lough at the taxi driver's fun action and share it with my friends later	0	0.0	0	0	0	0.0
	I stick on my speed and don't mind with minibus taxi drivers	0	0.0	1	5	1	4.8
	I hoot at the taxi in a very loud mode and wait until the road is free	3	13.0	2	10	0	0.0
	I quickly follow the taxi and do the same thing. It is not their road!	0	0.0	0	0	0	0.0
	I hoot and talk out the window asking why?	2	8.7	1	5	0	0.0
	I turn up the volume and listen to music	0	0.0	0	0	0	0.0
	I call a traffic police is there is one around	0	0.0	0	0	0	0.0
	I swear inside my car	2	8.7	1	5	1	4.8
	I confront with the taxi driver sometimes	0	0.0	0	0	0	0.0
	I try to close the space so that the taxi driver cannot pass	0	0.0	0	0	2	9.5
	I smile to the taxi driver and let him go. I am scared!	0	0.0	0	0	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0.0	0	0	0	0.0
	I stop, hoot and shout at the taxi driver	2	8.7	0	0	0	0.0
	I respect traffic signs and signals	0	0.0	0	0	0	0.0
	I hoot back to the taxi driver in a very loud mode	0	0.0	0	0	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	1	4.3	0	0	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	0	0	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0	0	0.0
	I pull a face at him	0	0.0	0	0	0	0.0
Total		23	100.0	20	100.0	21	100.0

Appendix 20: Driver age and responses to minibus taxis' aggressive behaviours "(cont.)"

Driver age	Response behaviours of the victims	Speeding		Hooting		Red Light Running	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
40 - 49	I stay calm and wait for the taxi. It's becoming normal!	7	43.8	6	24	8	50.0
	I hoot at the minibus taxi and continue driving	0	0.0	1	4	1	6.3
	I always find my way out and move	1	6.3	0	0	0	0.0
	I quickly move aside for my safety and my car	0	0.0	4	16	0	0.0
	I slow down / stop and remain in my lane	0	0.0	0	0	4	25.0
	I lough at the taxi driver's fun action and share it with my friends later	1	6.3	0	0	0	0.0
	I stick on my speed and don't mind with minibus taxi drivers	4	25.0	4	16	0	0.0
	I hoot at the taxi in a very loud mode and wait until the road is free	0	0.0	0	0	0	0.0
	I quickly follow the taxi and do the same thing. It is not their road!	1	6.3	0	0	0	0.0
	I hoot and talk out the window asking why?	0	0.0	0	0	0	0.0
	I turn up the volume and listen to music	0	0.0	0	0	0	0.0
	I call a traffic police is there is one around	0	0.0	0	0	0	0.0
	I swear inside my car	2	12.5	3	12	0	0.0
	I confront with the taxi driver sometimes	0	0.0	0	0	0	0.0
	I try to close the space so that the taxi driver cannot pass	0	0.0	0	0	0	0.0
	I smile to the taxi driver and let him go. I am scared!	0	0.0	1	4	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0.0	1	4	0	0.0
	I stop, hoot and shout at the taxi driver	0	0.0	1	4	0	0.0
	I respect traffic signs and signals	0	0.0	0	0	3	18.8
	I hoot back to the taxi driver in a very loud mode	0	0.0	1	4	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	0	0.0	3	12	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	0	0	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0	0	0.0
	I pull a face at him	0	0.0	0	0	0	0.0
Total		16	100.0	25	100.0	16	100.0

Appendix 21: Driver age and responses to minibus taxis 'aggressive behaviours "(cont.)"

Driver age	Response behaviours of the victims	Cutting in too close		Obstructing traffic		Overtaking on road shoulder	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
50 - above	I stay calm and wait for the taxi. It's becoming normal!	7	38.9	14	82.4	5	38.5
	I hoot at the minibus taxi and continue driving	6	33.3	3	17.6	5	38.5
	I always find my way out and move	0	0.0	0	0.0	0	0.0
	I quickly move aside for my safety and my car	2	11.1	0	0.0	1	7.7
	I slow down / stop and remain in my lane	2	11.1	0	0.0	1	7.7
	I lough at the taxi driver's fun action and share it with my friends later	0	0.0	0	0.0	1	7.7
	I stick on my speed and don't mind with minibus taxi drivers	0	0.0	0	0.0	0	0.0
	I hoot at the taxi in a very loud mode and wait until the road is free	0	0.0	0	0.0	0	0.0
	I quickly follow the taxi and do the same thing. It is not their road!	0	0.0	0	0.0	0	0.0
	I hoot and talk out the window asking why?	1	5.6	0	0.0	0	0.0
	I turn up the volume and listen to music	0	0.0	0	0.0	0	0.0
	I call a traffic police is there is one around	0	0.0	0	0.0	0	0.0
	I swear inside my car	0	0.0	0	0.0	0	0.0
	I confront with the taxi driver sometimes	0	0.0	0	0.0	0	0.0
	I try to close the space so that the taxi driver cannot pass	0	0.0	0	0.0	0	0.0
	I smile to the taxi driver and let him go. I am scared!	0	0.0	0	0.0	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0.0	0	0.0	0	0.0
	I stop, hoot and shout at the taxi driver	0	0.0	0	0.0	0	0.0
	I respect traffic signs and signals	0	0.0	0	0.0	0	0.0
	I hoot back to the taxi driver in a very loud mode	0	0.0	0	0.0	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	0	0.0	0	0.0	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	0	0.0	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0.0	0	0.0
	I pull a face at him	0	0.0	0	0.0	0	0.0
Total		18	100.0	17	100.0	13	100.0

Appendix 22: Driver age and responses to minibus taxis' aggressive behaviours "(cont.)"

Driver age	Response behaviours of the victims	Speeding		Hooting		Red Light Running	
		Frequency	(%)	Frequency	(%)	Frequency	(%)
50 - above	I stay calm and wait for the taxi. It's becoming normal!	9	69.2	3	30	4	36.4
	I hoot at the minibus taxi and continue driving	0	0.0	0	0	1	9.1
	I always find my way out and move	0	0.0	0	0	0	0.0
	I quickly move aside for my safety and my car	2	15.4	1	10	0	0.0
	I slow down / stop and remain in my lane	1	7.7	0	0	1	9.1
	I lough at the taxi driver's fun action and share it with my friends later	0	0.0	0	0	0	0.0
	I stick on my speed and don't mind with minibus taxi drivers	1	7.7	0	0	1	9.1
	I hoot at the taxi in a very loud mode and wait until the road is free	0	0.0	0	0	0	0.0
	I quickly follow the taxi and do the same thing. It is not their road!	0	0.0	0	0	0	0.0
	I hoot and talk out the window asking why?	0	0.0	0	0	0	0.0
	I turn up the volume and listen to music	0	0.0	0	0	0	0.0
	I call a traffic police is there is one around	0	0.0	0	0	1	9.1
	I swear inside my car	0	0.0	1	10	2	18.2
	I confront with the taxi driver sometimes	0	0.0	0	0	0	0.0
	I try to close the space so that the taxi driver cannot pass	0	0.0	0	0	0	0.0
	I smile to the taxi driver and let him go. I am scared!	0	0.0	2	20	0	0.0
	I do a hand sign to the taxi to pass. They are dangerous drivers!	0	0.0	1	10	0	0.0
	I stop, hoot and shout at the taxi driver	0	0.0	0	0	0	0.0
	I respect traffic signs and signals	0	0.0	1	10	1	9.1
	I hoot back to the taxi driver in a very loud mode	0	0.0	0	0	0	0.0
	I flash my lights back to the taxi driver. They need to respect others!	0	0.0	0	0	0	0.0
	I make rude gesture back to the taxi driver. I am not scared of them!	0	0.0	0	0	0	0.0
	I hold my breath to see if he makes it	0	0.0	0	0	0	0.0
	I pull a face at him	0	0.0	1	10	0	0.0
Total		13	100.0	10	100.0	11	100.0

Appendix 23: Chi-square test results / Driver age and responses to minibus taxis' aggressive behaviours

	18 – 29 years	30 – 39 years	40 – 49 years	50 – above
Cutting in too close	χ^2(df = 12, N = 79) = 17.875, p = 0.12	χ^2(df = 9, N = 50) = 8.781, p = 0.46	χ^2(df = 7, N = 32) = 8.214, p = 0.27	χ^2(df = 4, N = 21) = 3.850, p = 0.43
Traffic obstruction	χ^2(df = 12, N = 79) = 9.968, p = 0.62	χ^2(df = 7, N = 50) = 8.942, p = 0.26	χ^2(df = 6, N = 32) = 9.035, p = 0.31	χ^2(df = 2, N = 21) = 4.978, p = 0.08
Overtaking on shoulder	χ^2(df = 12, N = 79) = 26.624, p = 0.09	χ^2(df = 10, N = 50) = 11.311, p = 0.34	χ^2(df = 6, N = 32) = 14.311, p = 0.02	χ^2(df = 5, N = 21) = 7.315, p = 0.19
Speeding	χ^2(df = 9, N = 79) = 10.881, p = 0.28	χ^2(df = 8, N = 50) = 6.122, p = 0.63	χ^2(df = 7, N = 32) = 9.850, p = 0.19	χ^2(df = 3, N = 21) = 3.041, p = 0.38
Hooting	χ^2(df = 15, N = 79) = 23.929, p = 0.06	χ^2(df = 11, N = 50) = 14.727, p = 0.19	χ^2(df = 10, N = 32) = 12.495, p = 0.25	χ^2(df = 9, N = 21) = 9.450, p = 0.39
RLR	χ^2(df = 10, N = 79) = 18.912, p = 0.04	χ^2(df = 8, N = 50) = 10.879, p = 0.21	χ^2(df = 5, N = 32) = 1.876, p = 0.59	χ^2(df = 7, N = 21) = 6.786, p = 0.45

Appendix 24: Example of a calculation sheet of minibus taxis' traffic obstructions evaluation indices

Place	Date	Time [sec]	Taxis [veh/h/ln]	Number	Traffic obstructions by minibus taxis				Comments	Response manoeuvres of the driver behind						Comments
					Indicator [Yes/No]	Taxi stops where?			aggess./non-aggress. briving because….	Start [sec]	End [sec]	Delay [sec]	Reactions			aggress./no-aggress. reaction because….
						In the road	Cross RL	Outside Bus Stop					Stop & wait	Stop & swerve	Hoot / hand signs	
Observatory (M4)	28/3/2014 (Friday)	07:05 - 8:05 AM	225	1	No	x			aggress[block traffic in the road & no signal]	00:06:13	00:06:15	00:00:02	x			non-aggress[stop&wait]
				2	No	x			aggress[block traffic in the road & no signal]	00:06:31	00:06:34	00:00:03		x	x	aggress[swerve&hoot]
				3	No	x			aggress[block traffic in the road & no signal]	00:07:42	00:07:47	00:00:05		x		aggress[swerve]
				4	Yes			x	aggress[block traffic outside bus stop]	00:08:30	00:08:32	00:00:02		x	x	aggress[swerve&hoot]
				5	No			x	aggress[block traffic outside bus stop & no signal]	00:15:43	00:15:47	00:00:04		x		aggress[swerve]
				6	Yes			x	aggress[block traffic outside bus stop]	00:18:06	00:18:08	00:00:02		x		aggress[swerve]
				7	Yes	x			aggress[block traffic in the road]	00:19:36	00:19:38	00:00:02	x		x	aggress[hoot]
				8	No			x	aggress[block traffic outside bus stop & no signal]	00:13:14	00:13:18	00:00:04		x	x	aggress[swerve&hoot]
		09:15 - 10:15:00 AM	132	1	Yes	x			aggress[block traffic in the road]	00:11:16	00:11:19	00:00:03		x		aggress[swerve]
				2	Yes	x			aggress[block traffic in the road]	00:04:25	00:04:59	00:00:34		x	x	aggress[swerve&hoot]
	28/3/2014 (Friday)	03:00 - 4:00 PM	244	1	Yes	x			aggress[block traffic in the road]	00:06:47	00:06:54	00:00:07		x	x	aggress[swerve&hoot]
				2	No	x			aggress[block traffic in the road & no signal]	00:08:22	00:08:27	00:00:05		x		aggress[swerve]
				3	No			x	aggress[block traffic outside bus stop & no signal]	00:15:00	00:15:03	00:00:03		x	x	aggress[swerve&hoot]
				4	Yes			x	aggress[block traffic outside bus stop]	00:06:25	00:06:29	00:00:04	x		x	aggress[hoot]
				5	No	x			aggress[block traffic in the road & no signal]	00:02:20	00:02:25	00:00:05		x	x	aggress[swerve&hoot]
				6	No	x			aggress[block traffic in the road & no signal]	00:02:31	00:02:35	00:00:04		x	x	aggress[swerve&hoot]
				7	No	x			aggress[block traffic in the road & no signal]	00:07:52	00:08:04	00:00:12	x		x	aggress[hoot]
				8	Yes	x			aggress[block traffic in the road]	00:08:20	00:08:27	00:00:07		x	x	aggress[swerve&hoot]
				9	No			x	aggress[block traffic outside bus stop & no signal]	00:10:50	00:11:04	00:00:14		x	x	aggress[swerve&hoot]
				10	No	x			aggress[block traffic in the road & no signal]	00:14:27	00:14:33	00:00:06		x	x	aggress[swerve&hoot]
				11	No	x			aggress[block traffic in the road & no signal]	00:17:11	00:17:14	00:00:03		x	x	aggress[swerve&hoot]
				12	No	x			aggress[block traffic in the road & no signal]	00:01:43	00:01:51	00:00:08	x		x	aggress[hoot]
				13	No			x	aggress[block traffic outside bus stop & no signal]	00:03:36	00:03:45	00:00:09	x		x	aggress[hoot]
				14	Yes			x	aggress[block traffic outside bus stop]	00:07:28	00:07:33	00:00:05		x	x	aggress[swerve&hoot]
				15	Yes	x			aggress[block traffic in the road]	00:08:36	00:08:38	00:00:02		x		aggress[swerve]
				20	No			x	aggress[block traffic outside bus stop & no signal]	00:09:09	00:09:20	00:00:11	x		x	aggress[hoot]
				21	No	x			aggress[block traffic in the road & no signal]	00:12:30	00:12:33	00:00:03		x	x	aggress[swerve&hoot]
				22	No			x	aggress[block traffic outside bus stop & no signal]	00:14:03	00:14:17	00:00:14		x	x	aggress[swerve&hoot]
				23	No			x	aggress[block traffic outside bus stop & no signal]	00:03:57	00:04:03	00:00:06		x	x	aggress[swerve&hoot]
				24	No			x	aggress[block traffic outside bus stop & no signal]	00:10:46	00:10:49	00:00:03		x	x	aggress[swerve&hoot]

Appendix 25: Example of a calculation sheet of minibus taxis' red light running and stop line violations evaluation indices

Place	Date	Time [sec]	Taxis [veh/h/ln]	Number	Disregard of traffic signs and signals by minibus taxi drivers											Comments	Response manoeuvre of the driver behind			Comments
					Time at Yellow Light [sec]	Distance from Stop Line [m]	Time to Stop Line [hms]	TTI [hms]	TTI [sec]	approach speed [km/h]	Speed change		stopping option			aggress./non-aggress. driving because…..	Deceler. & stop at Stop Line	Acceler. and run Red Light	Beep horn or hand sign	aggress./non-aggress. reaction because….
											Acceler.	Deceler.	Before SL	Cross SL	RLR					
Observatory (M4)	28/3/2014 (Friday)	07:05 - 8:05 AM	225	1	00:01:38	70	00:01:43	00:00:05	5	50		x	x			non-aggress[deceler., stop before SL]	x			non-aggress[deceler., stop at SL]
				2	00:04:03	75	00:04:09	00:00:06	6	45		x		x		aggress[TTI > 2]	x			non-aggress[deceler., stop at SL]
				3	00:05:38	35	00:05:40	00:00:02	2	63	x				x	aggress[acceler., Speed > 60]		x		aggress [acceler. & RLR]
				4	00:08:05	70	00:08:09	00:00:04	4	63	x			x		aggress[TTI > 2, acceler., Speed ≥ 60]	x			non-aggress[deceler., stop at SL]
				5	00:10:02	38	00:10:04	00:00:02	2	68	x				x	aggress[acceler., Speed > 60]		x		aggress [acceler. & RLR]
				6	00:12:03	77	00:12:10	00:00:07	7	40		x		x		aggress[TTI > 2]	x			non-aggress[deceler., stop at SL]
				7	00:13:54	17	00:13:55	00:00:01	1	61	x				x	aggress[acceler., Speed> 60]		x		aggress [acceler. & RLR]
				8	00:13:54	46	00:13:57	00:00:03	3	55		x			x	aggress[TTI > 2]	x			non-aggress[deceler., stop at SL]
				9	00:15:30	58	00:15:34	00:00:04	4	52		x		x		aggress[TTI > 2]	x			non-aggress[deceler., stop at SL]
				10	00:20:08	36	00:20:10	00:00:02	2	65	x				x	aggress[acceler., Speed > 60]	x			non-aggress[deceler., stop at SL]
				11	00:03:22	20	00:03:23	00:00:01	1	72	x				x	aggress[acceler., Speed > 60]		x		aggress [acceler. & RLR]
				12	00:07:33	73	00:07:39	00:00:06	6	44		x	x			non-aggress[deceler., stop before SL]	x			non-aggress[deceler., stop at SL]
				13	00:09:57	55	00:10:03	00:00:06	6	33		x	x			non-aggress[deceler., stop before SL]	x			non-aggress[deceler., stop at SL]
				14	00:13:50	77	00:13:58	00:00:08	8	35		x		x		aggress[TTI > 2]	none	none	none	Minibus taxi was not followed
				15	00:17:58	38	00:18:00	00:00:02	2	68	x				x	aggress[acceler., Speed > 60]		x		aggress [acceler. & RLR]
				16	00:01:29	39	00:01:31	00:00:02	2	70	x				x	aggress[acceler., Speed > 60]	x			non-aggress[deceler., stop at SL]
				17	00:07:39	61	00:07:43	00:00:04	4	55		x	x			non-aggress[deceler., stop before SL]	x			non-aggress[deceler., stop at SL]
		09:15 - 10:15:00 AM	132	1	00:08:33	65	00:08:36	00:00:03	3	78	x				x	aggress[TTI >2, acceler., Speed > 60]		x		aggress [acceler. & RLR]
				2	00:11:01	78	00:11:05	00:00:04	4	70	x				x	aggress[TTI >2, acceler., Speed > 60]	x			non-aggress[deceler., stop at SL]
				3	00:14:40	44	00:14:42	00:00:02	2	79	x				x	aggress[acceler., Speed > 60]		x		aggress [acceler. & RLR]
				4	00:02:53	72	00:02:57	00:00:04	4	65	x				x	aggress[TTI >2, acceler., Speed > 60]	x			non-aggress[deceler., stop at SL]
				5	00:15:29	68	00:15:36	00:00:07	7	35		x	x			non-aggress[deceler., stop before SL]	x			non-aggress[deceler., stop at SL]
				6	00:14:50	63	00:14:55	00:00:05	5	45		x	x			non-aggress[deceler., stop before SL]	x			non-aggress[deceler., stop at SL]
				7	00:05:12	77	00:05:19	00:00:07	7	40		x		x		aggress[TTI > 2]	x			non-aggress[deceler., stop at SL]
				8	00:01:05	60	00:01:10	00:00:05	5	43		x		x		aggress[TTI > 2]	x			non-aggress[deceler., stop at SL]
	28/3/2014 (Friday)	03:00 - 4:00 PM	244	1	00:09:24	50	00:09:30	00:00:06	6	30		x		x		aggress[TTI > 2]	x			non-aggress[deceler., stop at SL]
				2	00:12:44	55	00:12:50	00:00:06	6	33		x		x		aggress[TTI > 2]	x			non-aggress[deceler., stop at SL]
				3	00:00:40	61	00:00:44	00:00:04	4	55		x	x			non-aggress[deceler., stop before SL]	x			non-aggress[deceler., stop at SL]
				4	00:03:10	72	00:03:14	00:00:04	4	65	x				x	aggress[TTI >2, acceler., Speed > 60]	x			non-aggress[deceler., stop at SL]
				5	00:15:20	72	00:15:24	00:00:04	4	65		x		x		aggress[TTI >2, Speed > 60]	x			non-aggress[deceler., stop at SL]
				6	00:05:08	56	00:05:11	00:00:03	3	67	x			x		aggress[TTI >2 acceler., Speed > 60]	x			non-aggress[deceler., stop at SL]
				7	00:12:47	33	00:12:50	00:00:03	3	40		x		x		aggress[TTI >2, Speed > 60]	x			non-aggress[deceler., stop at SL]
				8	00:17:02	40	00:17:04	00:00:02	2	72	x				x	aggress[acceler., Speed > 60]		x		aggress [acceler. & RLR]
				9	00:08:16	70	00:08:20	00:00:04	4	63	x				x	aggress[TTI >2, acceler., Speed > 60]	x			non-aggress[deceler., stop at SL]
				10	00:08:12	68	00:08:19	00:00:07	7	35		x		x		aggress[TTI > 2]	x			non-aggress[deceler., stop at SL]
				11	00:12:03	76	00:12:07	00:00:04	4	68	x		x			non-aggress[deceler., stop before SL]	x			non-aggress[deceler., stop at SL]

Appendix 26: Example of a calculation sheet of minibus taxis' improper passing manoeuvres evaluation indices

Place	Date	Time [sec]	Taxis [veh/h/ln]	Number	Improper passing behaviours by minibus taxi drivers									Comments	Response manoeuvre of the overtaken driver					Comments
					Passing manoeuvre					Indicator [Yes/No]	Estimated spacing [Sd1, Sd2] and cross path angle				Speed change		Swerve / lane change	Brake & stop	Hoot / hand sign	
					Cutting in too close	Pass on road shoulder/ YL	Use of turning lane to pass	Use of through lane to turn	Cross continuous line to pass		Sd2 [m]	Sd1 [m]	θ [Degree]	aggress./non-aggress. driving because...	Deceler.	Acceler.				aggress./non-aggress. reaction because...
Observatory (M4)	28/3/2014 (Friday)	07:05 - 8:05 AM	225	1	x					no	3	10		aggress[Sd1<12.5m, Sd2<4m, no signal]	x					non-aggress[deceler.]
				2	x					no	3.5	11		aggress[Sd1<12.5m, Sd2<4m, no signal]			x			aggress[swerve]
				3			x			no				aggress[use of turn lane as through lane, no signal]	x				x	aggress[hoot]
				4			x			no				aggress[use of turn lane as through lane, no signal]	x				x	aggress[hoot]
				5			x			no				aggress[use of turn lane as through lane, no signal]	x				x	aggress[hoot]
				6			x			no				aggress[use of turn lane as through lane, no signal]	x				x	aggress[hoot]
				7			x			no				aggress[use of turn lane as through lane, no signal]	x				x	aggress[hoot]
				8			x			no				aggress[use of turn lane as through lane, no signal]	x					non-aggress[deceler.]
				9			x			no				aggress[use of turn lane as through lane, no signal]	x					non-aggress[deceler.]
				10			x			no				aggress[use of turn lane as through lane, no signal]	x				x	aggress[hoot]
				11		x				Yes				aggress[drove on Yellow Lane to pass]				x		non-aggress[brake & stop]
				12		x				Yes				aggress[drove on Yellow Lane to pass]	x				x	aggress[hoot]
		09:15 - 10:15:00 AM	132	1		x				No				aggress[drove on Yellow Lane to pass, no signal]				x	x	aggress[hoot]
				2	x					No	3	9		aggress[Sd1<12.5m, Sd2<4m, no signal]	x				x	aggress[hoot]
				3			x			Yes				aggress[use of turn lane as through lane]	x				x	aggress[hoot]
				4			x			Yes				aggress[use of turn lane as through lane]	x				x	aggress[hoot]
				5			x			Yes				aggress[use of turn lane as through lane]		x			x	aggress[acceler.]
				6		x				Yes				aggress[drove on Yellow Lane to pass]		x				aggress[acceler.]
	28/3/2014 (Friday)	03:00 - 4:00 PM	244	1	x					No	2	7.5		aggress[Sd1<12.5m, Sd2<4m, no signal]				x	x	aggress[hoot]
				2			x			Yes				aggress[use of turn lane as through lane]	x				x	aggress[hoot]
				3			x			Yes				aggress[use of turn lane as through lane]	x					non-aggress[deceler.]
				4			x			Yes				aggress[use of turn lane as through lane]	x				x	aggress[hoot]
				5			x			Yes				aggress[use of turn lane as through lane]	x				x	aggress[hoot]
				6	x					Yes	1.5	7.5		aggress[Sd1<12.5m, Sd2<4m]				x	x	aggress[hoot]
				7	x					No	1.5	7.5		aggress[Sd1<12.5m, Sd2<4m, no signal]				x	x	aggress[hoot]
				8			x			no				aggress[use of turn lane as through lane, no signal]	x					non-aggress[deceler.]
				9			x			no				aggress[use of turn lane as through lane, no signal]	x				x	aggress[hoot]
				10			x			no				aggress[use of turn lane as through lane, no signal]	x				x	aggress[hoot]
				11			x			no				aggress[use of turn lane as through lane, no signal]				x		non-aggress[brake & stop]
				12			x			no				aggress[use of turn lane as through lane, no signal]				x		non-aggress[brake & stop]
				13			x			no				aggress[use of turn lane as through lane, no signal]	x				x	aggress[hoot]
				14		x				Yes				aggress[drove on Yellow Lane to pass]			x			aggress[swerve]
				15		x				Yes				aggress[drove on Yellow Lane to pass]			x			aggress[swerve]

Appendix 27 Taxi driver age and aggressive on-road behaviours

	Chi-square test results
Hooting at other drivers	χ^2(df = 1, N = 91) = 1.805, p = 0.179
Exceeding speed limits	χ^2(df = 1, N = 91) = 15.935, p = 0.000
Changing lane without signalling	χ^2(df = 1, N = 91) = 3.484, p = 0.062
Cutting in too close in front of cars	χ^2(df = 1, N = 91) = 4.958, p = 0.026
Passing by driving on road shoulder	χ^2(df = 1, N = 91) = 0.224, p = 0.636
Obstructing traffic	χ^2(df = 1, N = 91) = 0.385, p = 0.535

Appendix 28 Taxi driver's exposure time and aggressive on-road behaviours

	Chi-square test results
Hooting at other drivers	χ^2(df = 1, N = 91) = 6.067, p = 0.014
Exceeding speed limits	χ^2(df = 1, N = 91) = 1.071, p = 0.301
Red light running	χ^2(df = 1, N = 91) = 0.190, p = 0.663
Changing lane without indicating	χ^2(df = 1, N = 91) = 1.877, p = 0.171
Cutting in too close in front of cars	χ^2(df = 1, N = 91) = 0.304, p = 0.582
Driving on road shoulders or on yellow lanes to pass vehicles	χ^2(df = 1, N = 91) = 9.588, p = 0.002
Traffic obstructions	χ^2(df = 1, N = 91) = 1.517, p = 0.218

Appendix 29 Taxi driver's safe driving practices and frequency of road accidents

	Chi-square test results
Driving on the right way	χ^2(df = 1, N = 91) = 1.805, p = 0.179
Correct lane change	χ^2(df = 1, N = 91) = 15.935, p = 0.000
Follow traffic signs and signals	χ^2(df = 1, N = 91) = 3.484, p = 0.062
Correct Left/Right and U-turns	χ^2(df = 1, N = 91) = 4.958, p = 0.026
Exceeding speed limits	χ^2(df = 1, N = 91) = 0.224, p = 0.636
Driving with good health	χ^2(df = 1, N = 91) = 0.385, p = 0.535

Appendix 30 Utilisation of a through lane as a passing lane / M10 and Belrail Road in Bellville

Appendix 31 Red light running and stop line violation / M4 in Observatory

Appendix 32 Cutting in too close in front of cars / N2 Cape Town

Appendix 33 Traffic obstructions / M4 in Observatory